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Dissertação orientada por:

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To Virgílio…

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Resumo

O objectivo principal desta investigação é o de contribuir para o preenchimento da lacuna actualmente existente no conhecimento da forma como as crianças em fase de aquisição do Português Europeu (PE) adquirem o sistema consonântico da sua língua. Apesar de este ter constituído um tópico de análise frequente em diversas línguas (Bernardt & Stemberger, 1998; Lamprecht et al. 2004) e de ter implicações quer ao nível da fonologia teórica quer em áreas aplicadas como a fonologia clínica e o ensino da língua (Dinnsen, 1990; Gierut, 1992; Mota, 1996; Lazzarotto-Volcão, 2009), a aquisição consonântica não foi alvo, até à presente data, de uma investigação exaustiva no PE.

A aquisição do sistema consonântico envolve a aprendizagem de vários aspectos relacionados com a estrutura sonora da língua alvo, nomeadamente a aquisição dos traços distintivos que compõem cada segmento (Jakobson, Fant & Halle, 1952; Chomsky & Halle, 1968; Rice & Avery, 1995; Mota, 1996; Bernardt & Stemberger, 1998; Lamprecht et al. 2004; Clements, 2009). Nesta investigação, o foco de análise é colocado no desenvolvimento dos traços de Ponto de Articulação (PA) e de Modo de Articulação (MA). Esta opção metodológica baseia-se no facto de estas classes de PA de MA abrangerem a maioria dos traços distintivos que caracterizam as consoantes em PE, permitindo assim obter uma perspectiva geral sobre a aquisição dos traços nesta variedade do Português.

Para além de adquirir o sistema segmental, a criança tem também de construir um léxico, no qual são armazenadas as representações fonológicas; estas representações mentais desempenham um papel importante quer na percepção quer na produção (Fikkert, 2005, 2007). Há, no entanto, muitas questões que permanecem em aberto relativamente à natureza desta representações, nomeadamente (i) como são adquiridas; (ii) qual o seu conteúdo (*adult-like* ou *child-specific*).

Tendo em conta os aspectos referidos acima, a esta dissertação subjazem dois objectivos principais: descrever os padrões de aquisição do sistema consonântico em Português Europeu e contribuir para a discussão acerca da natureza das representações fonológicas das crianças portuguesas. De forma a atingir estes objectivos, são efectuados quatro estudos principais: (i) analisa-se a ordem geral de aquisição do sistema consonântico, no capítulo 3; (ii), estuda-se a relação entre o desenvolvimento segmental e a unidade palavra, nos capítulos 4 e 5; (iii) discute-se as formas alternativas de produção, no capítulo 6. Esta análise é baseada em dados longitudinais espontâneos de cinco crianças, em fase de aquisição do PE como língua maternal, entre os 0;11 e os 4;10, aproximadamente. Ao longo da dissertação, os dados da aquisição são comparados com

dados relativos à distribuição de traços de PA e de MA num *corpus* de fala do adulto (corpus *Português Falado* - Instituto Camões/CLUL; Bacelar, Pereira & Saramago, 2000; base de dados FrePOP – Frota, Vigário, Martins & Cruz, to appear), de forma a estudar a relação entre os padrões de distribuição na fala do adulto e os padrões de aquisição. Dois programas informáticos foram utilizados para a análise dos dados: o *software Phon* (Rose et al, 2006), usado para a inserção, transcrição e análise dos dados da aquisição e o *software FreP* (Frota, Vigário & Martins, 2006), para a extracção automática de dados de frequência das unidades semi-fonológicas no corpus de fala do adulto.

No que diz respeito à análise da ordem geral de aquisição dos traços, verificou-se que, em termos gerais, as crianças portuguesas tendem a adquirir o PA pela ordem anterior >> não anterior: labiais e coronais [+ant] são adquiridas antes de coronal [-ant] e de dorsal. Quanto ao MA, as crianças adquirem as nasais e as oclusivas antes das fricativas, sendo as líquidas as últimas consoantes a emergir. Estes padrões gerais corroboram os resultados obtidos noutras línguas (Jakobson, 1941/68; Matzenauer, 1990; Vihman, 1992; Levelt, 1994; Fikkert, 1994; Lléo et al., 1996; Bernhardt & Stemberger, 1998; Lamprecht et al. 2004). Observou-se ainda que as oclusivas coronais apresentam um comportamento não marcado no sistema fonológico das crianças pois, para além de serem adquiridas cedo, são também usadas para substituir outras consoantes de aquisição mais tardia.

Relativamente à relação entre a aquisição segmental e a unidade palavra, verificou-se que as primeiras palavras produzidas pelas cinco crianças apresentam, na sua vasta maioria, consoantes em Ataque silábico que partilham os traços de PA e de MA (padrões [C=C]). Padrões semelhantes têm sido identificados noutras línguas, nomeadamente no inglês (Stoel-Gammon, 2002); no holandês (Levelt, 1994; Langeslag, 2007; Fikkert & Levelt, 2008), no espanhol (Macken, 1979); no alemão e no francês (Altvater-Mackensen, dos Santos & Fikkert, 2008; Altvater-Mackensen & Fikkert, 2009). Durante o estádio [C=C], a especificação de PA e de MA das consoantes produzidas pelas crianças portuguesas coincide muito frequentemente com a especificação da consoante em ataque da sílaba acentuada na palavra alvo; por exemplo, palavras como /ˈb̲ɔlɐ/ são produzidas como [poˈpɐ], /ʃɐˈp̲ɛw/ como [paˈbɛw] ou /liˈm̲ɐ̃w̃/ como [miˈmɐ̃w̃]. Com base nestes dados, sugere-se, nesta dissertação, que as crianças seleccionam a especificação de PA e de MA da consoante em ataque da sílaba acentuada do alvo, associando essa especificação a toda a unidade palavra, à semelhança do que é proposto por Fikkert & Levelt (2008) e Levelt (1994; to appear) para a aquisição do traços de PA em holandês.

Os dados mostraram ainda que as combinações heterogéneas quanto ao PA e ao MA consonântico ([C≠C]) não estão disponíveis desde o início da produção, sendo adquiridas de forma gradual. No que diz respeito aos padrões [C_{PoA}≠C_{PoA}], mostrou-se que [Lab…Cor] e [Dor…Cor] são as primeiras sequências adquiridas, o que aponta para o estatuto não marcado destas estruturas no sistema das crianças. Quanto ao MA observou-se que, em geral, as primeiras sequências contêm uma oclusiva numa das posições da palavra, enquanto que as combinações adquiridas mais tardiamente envolvem soantes e fricativas. Mostrou-se ainda que os traços tendem a ser adquiridos por posição; por exemplo, Labial emerge primeiro em posição inicial de palavra (C1) e só mais tarde em posição intervocálica (C2), ao passo que as líquidas são adquiridas primeiro em C2 e só depois em C1. Esta aquisição gradual resulta em assimetrias posicionais nas produções das crianças. Verificou-se também que um determinado traço pode estar adquirido numa determinada posição em formas CV ou CVV, mas ser submetido a estratégias de produção alternativa em sequências [C≠C]. Por exemplo, ao mesmo tempo que uma criança omite laterais em C1 em combinações [Lat…Stop] (*lobo* /ˈlobu/->[ˈobu] Luma, 2;6) ela já produz correctamente formas CV como (*lago* /ˈlagu/->[ˈlaː] Luma, 2;4). Estes dados sugerem que o estudo da aquisição dos traços distintivos deve focar não só o desenvolvimento por posição na palavra mas também as interacções que ocorrem entre as duas posições, à semelhança do que é defendido no trabalho de Langeslag (2007).

A análise mostrou ainda que, nas primeiras sessões, existem muitas discrepâncias entre a frequência com que os diferentes traços de PA e de MA aparecem no conjunto de palavras que as crianças tentam produzir (*intake*) e a distribuição destes traços na palavras que constam do *corpus* de fala do adulto. Por exemplo, as crianças seleccionam palavras com o traço Labial mais frequentemente do que Coronal, embora Coronal seja o traço mais frequente na palavras que constam do *corpus* de fala do adulto. Discrepâncias semelhantes foram identificadas entre a ordem geral de aquisição dos traços e a distribuição dos mesmos na fala do adulto. Resultados similares foram reportados no holandês (Levelt & van Oostendorp, 2007) e no francês (Dos Santos, 2007). Contudo, a partir de um determinado estádio de desenvolvimento, em que as crianças portuguesas começam a adquirir combinações heterogéneas quanto ao PA e ao MA (a partir dos 1;8, aproximadamente), a ordem de aquisição do padrões [C≠C] coincide, de um modo geral, com a distribuição destas sequências na fala do adulto: [Lab...Cor] e [Dor...Cor] são as mais frequentes no *corpus* do adulto e são adquiridas cedo; [Nas...Ocl], [Stop..Nas], [Ocl...Fric] e [Ocl...Lat] estão também entre as primeiras sequências adquiridas e são frequentes na fala do adulto. À semelhança do que foi verificado para o holandês em Fikkert & Levelt (2008), os padrões de distribuição do alvo não se reflectem imediatamente nos padrões iniciais de aquisição, mas apenas a partir de um determinado estádio de desenvolvimento.

Palavras-chave: aquisição, consoantes, traços, representações fonológicas

Abstract

This dissertation aims to contribute to filling the gap on the knowledge of how European Portuguese (EP) children acquire the consonantal system of their language. Two general goals underlie this dissertation: to describe the patterns of acquisition of the consonantal system in EP, focusing on place and manner features, and to contribute for the discussion of the nature of Portuguese children's phonological representations.

Aiming to achieve these goals, four main studies were carried out: we analyzed the general order of acquisition of the consonantal inventory; studied the relation between segmental development and the word and focused on the alternative forms children produce when attempting problematic target forms.

The studies conducted in this dissertation were based on spontaneous longitudinal data of five children acquiring EP as their first language, between 0;11 and 4;10 (approximately). Throughout the dissertation, acquisition patterns were compared with distributional data of EP adult language, in order to check if the distribution of features in adult speech could be related to the order of acquisition (Jusczyk *et al.* 1994; Edwards & Beckman, 2007).

One of the crucial findings of this investigation is the fact that the unit of specification of place and manner features is, at the beginning of meaningful speech, higher than the segment. This suprassegmental specification underlies the five children's productions until at least the age of 1;8, resulting in [C=C] output forms. Similar results were reported in Dutch (Langeslag, 2007; Fikkert & Levelt, 2008).

As for the development of [C≠C] productions, it occurs gradually and is influenced by positional and combinatorial restrictions. The different type of alternative output forms that occur in [C=C] and [C≠C] stages allowed for the discussion of children's underlying representations in the two developmental time frames.

The findings discussed in this dissertation are important not only to phonological theory but also to other linguistic-related fields, namely educational and clinical.

Keywords: consonantal acquisition, features, phonological representations

Symbols and abbreviations

C	Consonant
C_1	Consonant in onset, word-initial position
C_2	Consonant in onset, intervocalic position
V	Vowel
G	Glide
PoA	Place of articulation features
MoA	Manner of articulation features
Lab	Labial
Cor	Coronal
Dor	Dorsal
Nas	Nasal
Fric	Fricative
Liq	Liquid
Lat	Lateral
Rhot	Rhotic
[C=C]	Form where the consonants in onset share place or manner feature specification
[C≠C]	Form where the consonants in onset differ in place or manner feature specification
$[C_iV_i\ C_iV_i]$	Form where consonants and vowels share place or manner feature specification
$[C_iV_jC_iV_j]$	Form where consonants differ from vowels in place or manner specification
$[C_{PoA}=C_{PoA}]$	Form where the consonants in onset share place feature specification
$[C_{PoA}\neq C_{PoA}]$	Form where the consonants in onset differ in place feature specification
$[C_{MoA}=C_{MoA}]$	Form where the consonants in onset share manner feature specification
$[C_{MoA}\neq C_{MoA}]$	Form where the consonants in onset differ in manner feature specification
EP	European Portuguese
BP	Brazilian Portuguese

IPA symbols

- **Consonants**

Stops [p] pata; [b] bata; [t] fato; [d] fado; [k] cola; [g] gola

Nasals [f] faca; [v] vaca; [s] caça; [z] casa; [ʃ] chá; [ʒ] já

Fricatives [m] mota; [n] nota; [ɲ] manha

Liquids [l] mala; [ɾ] caro; [ʎ] malha; [ɫ] caldo; [ʀ] carro

- **Vowels**

Oral [a] pá, [ɛ] pé, [ɔ] pó, [ɐ] cama, [e] cena, [o] bolo, [i] fita, [ɨ] pente, [u] fumo

Nasal [ɐ̃] canto, [ẽ] lente, [õ] ponte, [ĩ] tinta, [ũ] mundo

- **Glides**

Oral [j] pai, [w] pau

Nasal [j̃] mãe, [w̃] pão

- **Primary word stress -** [ˈ] patu [ˈpatu]

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CHAPTER 1 – INTRODUCTION

> The most exciting phrase to hear in science, the one that heralds most discoveries, is not *"Eureka!"* (I found it!) but *"That's funny..."* Isaac Asimov

Two general goals underlie the current dissertation: to describe the patterns of acquisition of the consonantal system in European Portuguese (EP) and to contribute to the discussion of the nature of Portuguese children's phonological representations.

Acquiring the consonantal system implies learning several aspects related to the sound structure of the target language, namely which sounds are contrastive and how these sounds are distributed within words and syllables. Furthermore, the development of the segmental system results also from the gradual acquisition of the sounds' minimal units: the distinctive features (Jakobson, Fant & Halle, 1952; Chomsky & Halle, 1968; Rice & Avery, 1995; Mota, 1996; Bernardt & Stemberger, 1998; Lamprecht et al. 2004; Clements, 2009, among many others). In the current investigation, we will study the acquisition of the consonantal system, focusing on place and manner features.

In addition to acquiring the segmental system, children need to build a lexicon, in which phonological representations are stored (Fikkert, 2007). These mental representations are assumed to play an important role both in the recognition and in the production of words. However, there are still many unanswered questions regarding the nature of these representations, namely (i) how they are acquired; (ii) what they look like (adult-like or child-specific). According to some theoretical approaches, children's lexical representations are identical to the adult's, and differences in constraint rankings are responsible for the discrepancy between children and adult's speech (for a review of constraint-based approaches (Optimality Theory) concerning phonological acquisition, see Boersma & Levelt, 2004). Other approaches suggest that children's early representations are holistic, containing only enough detail to distinguish between the few words that constitute the early lexicon (Ferguson & Garnica, 1975; Fischer et al. 2004; Fikkert & Levelt, 2008). Tracking the developmental changes in the process of acquisition can provide us with valuable information about the nature and the content of children's phonological representations (Fikkert, 2005a). Thus, based on the analysis of EP children's developmental patterns we intend to discuss both the nature of their underlying representations and the constraints on their phonological outputs.

When discussing the research questions that underlie Generative Grammar, Chomsky (1986), states that, besides investigating what constitutes the knowledge of Language, two basic questions are crucial: (i) how knowledge of language is acquired; (ii) how knowledge of language is put to use (Chomsky, 1986:3).

Ultimately, assuming that there is continuity between child and adult phonology (for a review on this issue, see Goodluck, 1991), the insight into the development of children's phonological representations is of crucial importance to understanding phonological knowledge in general.

In the majority of cases, children are able to acquire the segmental system of their language and to build a lexicon without any formal instruction (thus giving rise to the *logical problem* – see Chomsky, 1981, 1986; Goodluck, 1991; Macken, 1995). However, some children do not acquire such a complex system successfully only on their own. They present phonological deviations that can only be remediated with therapeutic intervention.

According to Lamprecht (1999:66), in order to identify a deviant phonological acquisition, it is necessary to have a reference of what is considered to be a normal or typical development. In some languages, the findings of phonological acquisition studies and the work developed within Clinical Phonology and Speech Therapy has been brought together in order to create efficient tools for the diagnosis and remediation of phonological disorders (Blodgett & Miller 1989; Matzenauer, 1995; Mota, 1996; Soares, 2001, Lamprecht et al, 2004; Lazzarotto-Volcão, 2009). Up until this moment, this combined work has not been possible in EP, since extensive information was not available on typical segmental acquisition in this language.

One of the specific aims of the current investigation is to provide a description of consonantal acquisition patterns, based on longitudinal data of five typically developing children. This project will, thus, contribute to filling the gap on the knowledge of how EP children acquire the consonantal system of their language and provide some reference data on what can be considered a typical developmental path. This is the first time that the consonantal system in EP child language is studied in detail. Furthermore, within this comprehensive overview, segments are studied not only as individual objects but also in the context of their position in the word.

This dissertation provides a relatively theory-independent description of acquisition patterns. This methodological choice was based on the fact that this study is partly directed to an audience that is not necessarily specialized in phonological theory, namely speech therapists and teachers. However, it is also of crucial importance to compare EP children's acquisition data to the patterns reported in other languages, in order to identify general cross-linguistic trends, as well as language-specific developmental patterns. Based on this assumption, we will compare the five children's acquisition patterns to the general developmental trends observed in other languages, namely English, Brazilian Portuguese (BP), French, Dutch, German and Spanish.

The research on segmental acquisition across languages has reported on an initial developmental stage in which children's output forms are overwhelmingly characterized by a [C=C] format (for instance, /dʌk/->[gʌk], Amahl, Smith, 1973) where consonants are identical for place and/or manner features (Macken, 1979; Bernhardt & Stemberger, 1998; Stoel-Gammon, 2002; Fikkert & Levelt, 2008, Altvater-Mackensen, Dos Santos & Fikkert (2008), among others). Several studies have approached early [C=C] output patterns as a result of Consonant Harmony (Smith, 1973; Vihman, 1978; Stoel-Gammon & Stemberger, 1994; Pater, 1997). Other studies, however, suggest that the preference for [C=C] output forms is an epiphenomenon of an initial holistic stage, in which features are associated to the word, and not to individual segments (Menn, 1978; Iverson & Wheeler, 1987; Levelt, 1994; to appear; Langeslag, 2007, Fikkert & Levelt, 2008).

This suprassegmental approach to early [C=C] outputs will be explored in the current dissertation, particularly in chapters 4 and 6.

Another issue investigated in this project is the relation between developmental patterns and the distributional properties of adult speech. There is a relatively large body of research that shows that input frequency may influence phonological developmental, both in perception and production (Jusczyk *et al.* (1994) Storkel, 2001; Vodopivec, 2004; Edwards, Beckman, & Munson, 2004; Zamuner, Gerken, & Hammond, 2004; Monnin, Lœvenbruck & Beckman, 2007). Since no extensive data of Child Directed Speech (CDS) is available in EP, we will focus on a sample of adult speech taken from the corpus *Português Falado* (Instituto Camões/CLUL and FrePOP database, see chapter 2). However, since there is no relation between the adults that constitute the speech sample and the children studied in this dissertation, the results of this comparison can only be used to formulate hypotheses, which will have to be tested against a larger set of adult speech data as well as on CDS (see chapter 7).

The consonantal system in European Portuguese - adult language

In the current subsection, we present an overview of the target consonantal system in EP, focusing on its characterization in terms of place and manner features and on its distribution within the word. This description will only contemplate the consonants that occur in non-branching onset, since this syllabic position will constitute the focus on the current investigation.

In standard EP, a set of 19 contrastive consonants can be found in onset position (Mateus & d' Andrade, 2000). That set is given in (1).

(1) Contrastive consonants in EP – onset position

[p b t d k g f v s z ʃ ʒ m n ɲ l ʎ ɾ ʀ]

In the set depicted above, all consonants are contrastive in word-medial onsets and all but the sonorants [ɲ ʎ ɾ] are contrastive in word-initial position.[1]

The place and manner feature characterization of the set of consonants given above are provided in (2), largely based on Mateus & d' Andrade (2000).

(2) Feature characterization of consonants in EP

(2.a) Manner

	Sounds	Manner features
Stops	[p t k b d g]	[-sonorant]; [-continuant]
Nasals	[m n ɲ]	[+sonorant];[nas]
Fricatives	[f v s z ʃ ʒ]	[-sonorant]; [+continuant]
Liquids (Laterals)	[l ʎ]	[+sonorant];[lateral]
(Rhotics)	[ɾ ʀ]	[+sonorant]

(2.b) Place

	Sounds	Place features
Labials	[p b f v m]	Labial
Coronals	[t d n s z l ɾ]	Coronal; [+anterior]
	[ʃ ʒ ʎ ɲ]	Coronal; [-anterior]
Dorsals	[k g ʀ]	Dorsal

It is worth noticing that, for ease of exposition, we will often refer to the major sound classes (stops, fricatives, labials, for instance) instead of referring to the place or manner features that characterize each class, when describing acquisition patterns.

As already mentioned, there are 19 contrastive consonants in EP's inventory. As far as non-branching onset is concerned, all those consonants are contrastive in intervocalic position (see 4), but only 16 are contrastive word-initially (see 3).

(3) EP consonants contrastive word-initially (Mateus & d' Andrade, 2000)

[p]	[ˈpalɐ]	pala	visor	[b]	[ˈbalɐ]	bala	bullet
[t]	[ˈtõ]	tom	tone	[d]	[ˈdõ]	dom	gift
[k]	[ˈkalu]	calo	corn	[g]	[ˈgalu]	galo	cock
[f]	[ˈfalɐ]	fala	speech	[v]	[ˈvalɐ]	vala	trench
[s]	[ˈselu]	selo	seal	[z]	[ˈzelu]	zelo	care
[ʃ]	[ˈʃa]	chá	tea	[ʒ]	[ˈʒa]	já	already
[m]	[ˈmatɐ]	mata	wood	[n]	[ˈnatɐ]	nata	cream
[l]	[ˈlatu]	lato	large	[ʀ]	[ˈʀatu]	rato	mouse

[1] Note that there are some occurrences of [ɲ ʎ] in word initial position in EP, but they are limited to a small number of lexical morphemes.

(4)   Word-medial consonants, intervocalic (onset position)

[p]	[ˈʀip̲ɐ]	ripa	chip	[b]	[ˈʀib̲ɐ]	riba	cliff
[t]	[ˈlat̲u]	lato	wide	[d]	[ˈlad̲u]	lado	side
[k]	[ˈvak̲ɐ]	vaca	cow	[g]	[ˈvag̲ɐ]	vaga	wave
[f]	[ˈʃtaf̲ɐ]	estafa	fatigue	[v]	[ˈʃtav̲ɐ]	estava	s/he was
[s]	[ˈkas̲ɐ]	caça	hunt	[z]	[ˈkaz̲ɐ]	casa	house
[ʃ]	[ˈaʃ̲ɐ]	acha	s/he finds	[ʒ]	[ˈaʒ̲ɐ]	haja	there may be
[l]	[ˈmal̲ɐ]	mala	bag	[ʎ]	[ˈmaʎ̲ɐ]	malha	mesh
[m]	[ˈgɐm̲ɐ]	gama	range	[n]	[ˈgɐn̲ɐ]	gana	energy
[ɲ]	[ˈsɐɲ̲ɐ]	sanha	fury	[n]	[ˈsɐn̲ɐ]	sana	s/he heals
[ɾ]	[ˈkaɾ̲u]	caro	expensive	[ʀ]	[ˈkaʀ̲u]	carro	car

Further information on the target consonantal system will be provided in each of the following chapters.

Organization of this dissertation

This dissertation is organized in seven different chapters. The present chapter provided a general introduction to the project; chapter 2 describes the general methodological issues that underlie the current study. The data analyses that constitute the core of this dissertation are discussed in the chapters 3 through 6. Each of these chapters aims to discuss particular research questions and to attain specific goals, which will be summarized below. Finally, chapter 7 provides a summary of the main findings and conclusions, adding some final remarks and topics for future research.

Chapter 3 – Two research questions are contained in this chapter: (1) which developmental patterns with respect to place and manner features characterize the acquisition of the consonantal inventory in EP and (2) what insights do those developmental patterns provide into children's developing phonological systems. Aiming to gather empirical evidence that allows for the discussion of the two questions referred to above, the following specific goals have been formulated in chapter 3: (i) describe the order of acquisition of consonants and of place and manner features; (ii) explore the feature substitutions, in the light of phonological context; (iii) compare intake and acquisition patterns to the distribution of features in EP adult speech.

Chapter 4 – This chapter aims to check if, similarly to Dutch learners (Levelt, 1994, Langeslag, 2007; Fikkert & Levelt, 2008), EP children go through an initial [C=C] stage for place and/or manner features. The specific goals devised for this particular study are the following: (i) describe the distribution of harmonic ([C=C]) and non-harmonic ([C≠C]) patterns, in intake and output forms, both for place and for manner features; (ii) identify the most frequent place and manner feature patterns in early word productions and compare them to the distribution of feature word-patterns in EP adult speech.

Chapter 5 – Following the same line of investigation presented in chapter 4, chapter 5 aims to analyze and discuss the acquisition of [C≠C] word-patterns in EP. Amongst the specific aims formulated there are the following: (i) identify the order of acquisition of [C_{PoA}≠C_{PoA}] and [C_{MoA}≠C_{MoA}] patterns; (ii) describe the relation between the development of [C≠C] patterns, word position and C1-C2 combinatorial restrictions; (iii) discuss the influence of distributional properties of adult speech on the acquisition of [C≠C] patterns.

Chapter 6 – This chapter focuses on the nature and development of the forms produced by the five children that deviate from the target adult forms, relating it to the two major stages observed in the previous chapters: the [C=C] and the [C≠C] stages. The most important aim of this chapter is to gather empirical evidence that allows for the discussion of the nature of children's lexical and output representations in both developmental stages.

Chapter 2 - Methodology

This chapter presents a general characterization of the empirical data that underlies the current dissertation, as well as providing a description of the software used to analyze the data.[2]

The chapter is organized in the following way. Section 2.1 focuses on the acquisition data, providing information on (i) the subjects and the data collection (subsection 2.1.1); (ii) the software program *Phon* and the transcription criteria (subsection 2.1.2). Section 2.2 focuses on the sample of EP adult speech studied in this dissertation and provides information on *FreP*, an electronic tool used to extract frequency rates of semi-phonological units.

2.1 The acquisition data

This dissertation is based on the analysis of spontaneous speech data of five children acquiring European Portuguese (EP) as their first language. Detailed information about this corpus is presented in the following subsections.

2.1.1 Subjects and data collection

The five children studied, four girls (Clara, Inês, Joana, Luma)[3] and one boy (João L) did not show any type of deviation in cognitive or motor development nor in hearing acuity. All the children live in Lisbon and acquired EP as their first language.

All subjects were video-recorded in their homes, while they interacted, spontaneously, with the investigator and with one of the parents.[4] The recording sessions varied from 30 to 60 minutes.

The setting for the recordings was naturalistic, consisting mostly of usual activities, such as looking at picture books and playing with their toys and pets. Since it is not pre-structured, the main advantage of a naturalist setting in acquisition studies is the fact that it is not biased to elicit information on any specific linguistic structure. However, there are limitations inherent to this recording method: (i) depending on the child's mood or lexical preferences at a given recording, we may not have access to structures already available in his/her system. Some patterns may thus be underrepresented at some points in time; (ii) the surrounding noise (toys, adult's voices) frequently masks the children's speech, compromising the reliability of the

[2] Specific methodological choices were taken in each chapter, according to the topics studied; those particular methodological issues will be described in the method section, in each chapter.
[3] Luma is a pseudonym.
[4] In the cases of João L and Clara, their brothers also participated in some of the sessions.

transcriptions (see the following section, about the criteria established to overcome these problems).

It is worth emphasizing that all children were recorded from the beginning of meaningful speech, but their development was not recorded for the same number of months nor with the same interval of time between each session. The data from Inês and Joana were gathered between 1993 and 2000;[5] the collection started when both children were 11 months old and took place over a period of more than three years (until 4;2 for Inês and 4;10 for Joana). During the first 10 to 15 sessions, the recordings were made on a monthly basis; after that, the interval range was from one to two months (see appendix A). The other three children were recorded between 2004 and 2007;[6] their ages at the first session varied from 0;7 to 1;0. Clara was recorded monthly, until the age of 1;10; João L and Luma were recorded every other week, until they were 2;0 and 2;6 respectively.

The table given in (5) presents (i) the age of each child at the beginning and at the end of collection; (ii) the number of sessions and of records per child; (iii) the time gap between recordings and the session's duration (see appendix A for a description of the age and number of records per session in each child's data). Note that each record includes a single word, a phrase or a sentence, phonetically transcribed; records containing unintelligible speech were not taken into consideration.

(5) General information of the recording sessions studied in this dissertation

	Age -1st session	**Age - last session**	**Number of sessions studied**	**Time gap between sessions (aprox.)**	**Total number of records**	**Avg. duration of sessions**	**Total duration of sessions**
Clara	0;11.1[7]	1;10.15	12	1 month	1335	46,7 min.	9h54m
Inês	0;11.14	4;2.18	30		10796	42 min.	21h
Joana	0;11.24	4;10.7	33		7345	29,4 min.	16h17m
João	1;0.1	2;0.20	22	2 weeks	3709	48,6 min.	18h22m
Luma	0;11.23[8]	2;6.27	37		4735	45,1 min.	30h27m

The corpus is, thus, heterogeneous, regarding the frequency of sampling and the children's ages in the last session. Two main sets of data can be delimited: on the one hand, there are the data of Inês and Joana, collected over a longer period of time, but with larger intervals between gatherings; on the other hand, there is the data of João,

[5] The data of Inês and Joana were collected by M. J. Freitas, within the PCSH/C/LIN/524/93 project, funded by JNICT, developed at the Laboratory of Psycholinguistics (University of Lisbon). Part of Inês' data (first eleven sessions) integrated the corpus analyzed in Freitas' PhD dissertation on the Acquisition of Syllabic Structure in EP (Freitas, 1997).
[6] Luma and João L were recorded by the researcher S. Correia and the recordings of Clara were made by both T. Costa and S. Correia.
[7] Clara's recordings started at the age of 0;9, but it was only from 0;11 onwards that meaningful speech could be perceived.
[8] Luma's recordings started at the age of 0;7, but meaningful speech was perceived only from 0;11 onwards.

Clara and Luma, collected over a shorter period, but with a higher sampling frequency. The age-period covered by each child's data is depicted in (6).

(6) Time frame covered by the recordings, per child.

Clara	**0;11**	**1;10**
Inês	**0;11**	**4;2**
Joana	**0;11**	**4;10**
João	**1;0**	**2;0**
Luma	**0;11**	**2;6**

In fact, the two sets of data complement each other, allowing for the analysis of different aspects of the acquisition process. Inês' and Joana's recordings will allow for the study of the major stages of development, from early words (0;11) until a point where the phonological system is considered to be very close to stability (4;2-4;10). The data of the other three children will provide a fairly detailed characterization of the first developmental stages, disclosing information on the initial consonantal patterns that characterize each child's productions and allowing for the discussion of crucial issues about the early stages (see chapter 4).

The data of Inês and Joana were collected with a Sony Handycam video 8, AF Hi-Fi stereo (Freitas, 1997); the other three children were recorded with a Cannon MV210 digital video camcorder and videotaped in Hi8 cassetes. The videos of all subjects were compressed in a digital format (320x240, mov format), using the iMovie© software.

2.1.2 Transcription criteria and the software *Phon*

Two trained researchers (Portuguese native speakers) performed the phonetic transcription of the data, using the International Phonetic Alphabet (IPA). This transcription was carried out within the *Phon* software program (Rose at al, 2006).[9] Each transcriber revised around 50% of the transcriptions performed by the other researcher. All records where both researchers couldn't reach a consensus were submitted to the analysis of a third trained transcriber (in a blind transcription task). All cases where the doubts persisted where marked as unintelligible (*) and excluded from the analysis. Apart from the unintelligible productions, every speech production was fully transcribed.

Each target word attempted by the children was phonetically transcribed (in the IPA Target field, see below); the transcriptions took into account the following processes:

[9] Further information on this software is provided in http://phon.ling.mun.ca.

(a) Voicing assimilation of coda fricatives in sandhi context (*asas pretas, asas brancas*), transcribed as [ˈazɐʃ] [ˈpɾetɐʃ] and [ˈazɐʒ] [ˈbɾɐ̃kɐʃ].

(b) Re-syllabification of the word-final lateral coda as onset of the following word, when followed by a vowel in word-initial position (*sol amarelo* – [ˈsɔɫ] [ɐmɐˈɾɛlu]) transcribed as [ˈsɔl] [ɐmɐˈɾɛlu].

(c) Re-syllabification of the word-final coda fricative as onset of the following word, when followed by a vowel in word-initial position (casas amarelas – [ˈkazɐʃ] [ɐmɐˈɾɛlɐʃ]), transcribed as [ˈkazɐz] [ɐmɐˈɾɛlɐʃ].

Regarding the target words with sC clusters (e.g. *escola*), in the target field these forms were not transcribed with an initial vowel ([ˈʃkɔlɐ]), since, according to Andrade & Rodrigues, (1999) sC clusters are sequences of Coda of an empty headed syllable followed by an obstruent (_C.CV).

Rising diphthongs were transcribed, in the target words, as sequences of two vowels and assigned to two different syllables (pi.a.no), according to the syllabification proposed for EP by Mateus & d' Andrade (2000).

The primary word stress was placed before the stressed syllable, both in the target words and in children's utterances.

The phonetic transcription of children's produced forms focused particularly on place and manner consonantal features, stress and number of syllables in a word. Pauses are signaled with cardinal symbols (#) in the phonetic transcription fields.

Still regarding the notation criteria used in this dissertation, we will use slashes (//) to refer to the target form and square brackets ([ ]) to represent children's output forms.

The software Phon

As previously mentioned, two trained researchers[10] entered manually the phonetic transcriptions in *Phon*. The picture given in (7) presents the session editor window of this software.[11] The first step of the process was to associate the videos with *Phon*, through a built-in media window (see (a), in (7)) and segment the audio file, according to the children's utterances (b). Then, the target words attempted in those utterances were transcribed orthographically, in the Orthography field (c) and phonetically, in the IPA Target field (d). The transcription of the children's renditions of

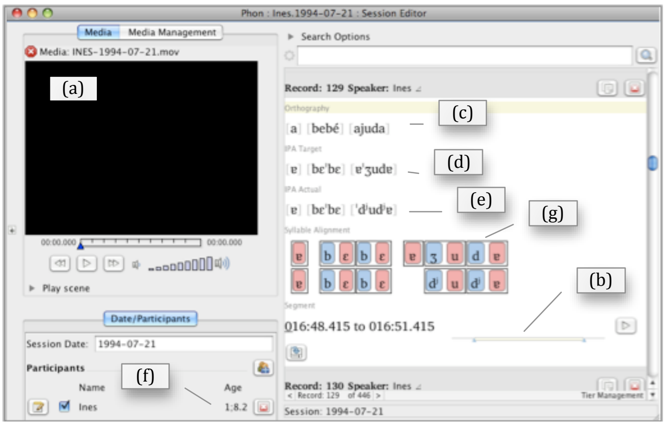
[10] Susana Correia and Teresa Costa.

[11] This picture refers to the version used in this investigation (version 1.3r500).

those target forms was inserted in the IPA Actual field (e).

(7) Session editor window – Phon

(a) Media player
(b) Audio segmentation
(c) Orthography field
(d) IPA Target field
(e) IPA Actual Field
(f) Child's age
(g) Syllable alignment



Some information was computed automatically by *Phon*, namely the child's age (see (f), in (7)), the syllabification of the Target and the Actual field and the syllable alignment between both fields (see g). The automatic alignments were manually checked.

The built-in search module of *Phon* allowed for a number of different queries, not only for segments but also for features, combined with other phonological information, namely syllable, word and stress position. Thus, we were able to look for specific consonants and specific place or manner features in particular word or syllable positions. Furthermore, we were able to look for *combinations* of consonantal features within the word, focusing on syllable onset position ([Labial...Coronal] or [Stop...Nasal], for instance).

The queries outlined above can be performed either within each field separately (in IPA Target or in IPA Actual) or across fields, comparing the attempted form with the corresponding child's production. *Phon* is also programmed to search for potential cases of consonantal harmony and metathesis, providing the user with the possibility of going through each search output and exclude the wrongly selected cases.

2.2 The EP adult speech sample and the software *FreP*

In the chapters 3 to 6, comparisons will be made between patterns observed in the five children's data, regarding the acquisition of the consonantal system, and the distribution of place and manner features in a sample of EP adult speech.

The data from EP adult speech analyzed in this dissertation is part of the corpus *Spoken Portuguese (Português Falado*; TA90PE; CLUL/Instituto Camões)[12] and from the

[12] Further information is provided in www.clul.ul.pt/sectores/linguistica_de_corpus/projecto_portuguesfalado.

FrePOP database (Frota, Vigário, Martins & Cruz, to appear). This corpus comprises orthographic transcriptions of informal conversations recorded in the 1990's, in different geographic areas of Portugal (Bacelar, Pereira & Saramago, 2000). The sample analyzed in this project consists of 22842 orthographic words (15702 lexical words and 7140 clitics).

The electronic tool *FreP*

The electronic tool *FreP* was developed at the Phonetics Laboratory, University of Lisbon; it is a product of the project *Frequency Patterns of Phonological Objects in Portuguese* - Research and Applications[13] (Frota, Vigário & Martins, 2006; Frota & Vigário 2007). This program extracts frequency information of semi-phonological units; it identifies and quantifies lexical words, clitics, syllables, segmental classes, among others, based on written texts. It also provides information on the location of features within words, taking stress into account.[14] Further information on the output of this program will be provided in chapters 3 to 6, when we present the distribution of place and manner features in the adult speech sample described above.

[13] Project under contract number PTDC/LIN/70367/2006. Two versions of *FreP* were used in this dissertation: (i) Version 1 - Martins, F., M. Vigário & S. Frota (2004-2007). FreP - Frequências no Português (IGAC nº 3179/2007); (ii) Version 2.0 - Martins, F., M. Vigário, S. Frota. (2009). FreP - Frequências no Português (IGAC nº 5969/2009).

[14] Further information on this tool can be found at http://www.fl.ul.pt/LaboratorioFonetica/FreP.

Chapter 3 – The development of the consonantal inventory

Introduction

One of the crucial tasks children have to perform throughout phonological development is the acquisition of the segmental system. Among other aspects, young learners have to acquire the system of contrastive sounds in their native language, as well as its distribution within words and syllables (see chapter 1).

Segmental acquisition has constituted the focus of numerous studies, in several different languages, since the mid-twentieth century; the main goals of this research have been to describe the way children acquire sound systems and to discuss what insights the several developmental stages provide into the organization of children's phonology (Jakobson, 1941/68; Chomsky & Halle, 1968; Stampe, 1969; Smith, 1973; Ingram, 1974; Menn, 1978; Matzenauer, 1990; 1994; Kenstowicz, 1994; Lléo, 1996; Fikkert, 1994; Levelt, 1994; Goldsmith, 1995; Lamprecht et. al. 2004; Dos Santos, 2007, among many others).

As already referred to in chapter 1, the knowledge of how typically developing children acquire the segmental system of their native language is also important for linguistic-related contexts, namely educational and clinical. In spite of the importance of this issue, no extensive research has yet been performed on the acquisition of the consonantal system in EP. This chapter (and this dissertation, in general) aims to contribute to filling this gap, by providing information on the acquisition of the consonantal inventory, based on longitudinal data of five children acquiring EP as their first language.

The analysis presented in this chapter will focus on consonants in non-branching onset position (word-initial onset (C1) and intervocalic onset (C2)), paying particular attention to the development of place and manner features. The main goal here is to provide a general picture of consonantal acquisition in EP; for this reason, we will analyze developmental patterns independently of word-extension (both monosyllables and polysyllabic forms are explored) and word-stress (the position of consonants and features regarding the stressed syllable is not considered).

This chapter is organized as follows. In section 3.1, we provide an overview of the literature on acquisition of consonant inventories, across languages. Section 3.2 presents a description of the consonantal system in adult EP. Section 3.3 provides a summary of theoretical issues and an outline of the aims and research questions underlying the current chapter. The methodological issues are discussed in section 3.4.

The results are described in section 3.5, followed by a discussion in 3.6. Some concluding remarks are provided in section 3.7.

3.1 Research on the acquisition of consonantal inventories

As already mentioned in the previous section, numerous studies have focused on segmental acquisition, across different languages, for more than half a century. The theoretical framework underlying the different studies has changed over the years: from linear phonology, where segments were viewed as unordered feature bundles (Chomsky & Halle, 1968), to autosegmental phonology, where features were described as both autonomous and interdependent constituents, hierarchically organized in feature geometries (Clements, 1985; Sagey, 1986, Clements & Hume, 1995) and to constraint-based models, where the focus shifted from representations to constraints on output structure, and segmental development was thought to result from the reranking of featural constraints vis-à-vis faithfulness constraints (Optimality Theory (OT); McCarthy & Prince, 1993; Prince & Smolensky, 1993, 2004; McCarthy, 2004).

Within feature geometry frameworks, segmental acquisition has been described as a process of unfolding (or building) feature hierarchies, through gradual addition of complexity: in general, higher ranked features (for instance, [sonorant]) are acquired before lower ranked features (for instance, [±anterior] contrasts) (Bernhardt, 1992; Stoel-Gammon, 1993, 1994; Bernhardt & Stoel-Gammon, 1994; Rice & Avery, 1995; Beers, 1996; Mota, 1996). Within OT frameworks, segmental development is described as the result of re-rankings of faithfulness and markedness constraints, on individual features or on feature combinations (Bernhardt & Stemberger, 1998; Matzenauer & Bonilha, 2003; Bonillha, 2005; Dos Santos, 2007).

Central to all theoretic approaches on segmental development is the notion of markedness; structures that occur in many languages of the world are usually among the first to be acquired by young children. According to Jakobson (1941/68), the presence of a marked segment in the system presupposes an earlier acquisition of the unmarked one. For instance, Jakobson claims that the acquisition of (marked) fricatives implies an earlier acquisition of (unmarked) stops and that the acquisition of (marked) back sounds presupposes an earlier mastery of (unmarked) front segments. Research in the field has shown trends in this direction, although there is much variation. Different children may show different unmarked (default) segments or features (Bernhardt & Stemberger, 1998; Morrisette, Dinnsen & Gierut, 2003).

Independently of the theoretical framework used, different studies have found some typical patterns in segmental development, to which we turn to in the next subsections. We will start with the description of major trends in the acquisition of manner features, in subsection 3.1.1 and then present an overview of common patterns in place feature development, in 3.1.2. Subsection 3.1.3 provides an outline of the most frequent substitution patterns observed for place and manner features. Lastly, subsection 3.1.4 explores the relation between acquisition patterns, intake properties and distribution of consonants in the input.

3.1.1 Trends in the development of manner features

Stops seem to be universally present in early development in typically developing systems; they constitute a highly frequent sound class in babbling and early words, being produced both target-like and as substitutes for non-acquired consonants (Jakobson, 1941/68; Vihman, 1992; Stoel-Gammon, 1993; Robb & Bleile, 1994).

Nasals are also frequently present in early inventories, but their early acquisition has not been attested in some studies (Fikkert, 1994; Bernhardt & Stemberger, 1998).

As for fricatives, they tend to be infrequent in early words (according to Bernhardt & Stemberger, 1998, the acquisition of fricatives may not be complete until the age of 8 or 9), but some studies have observed that a high frequency of fricatives in the target language may prompt an early acquisition of this consonantal class (Boysson-Bardies et al. 1992; Lléo, 1996; Langeslag, 2007).

Similarly to fricatives, the development of liquids may occur over an extended period of time. Typically, children acquire the lateral [l] before rhotic consonants, but the reverse order has also been observed (Bernhardt, 1990; Dinnsen, 1992; Beers, 1995).

The most common patterns observed in the acquisition of manner features are summarized in (8).

(8) Trends in the acquisition of manner features

a) Acquired earlier: stops and nasals

b) Acquired later: fricatives and liquids

This general order has been observed in many languages, including Brazilian Portuguese (BP), as summarized in (9), based on Matzenauer, (1990) and Lamprecht et.al, (2004).

(9) Order of acquisition of manner features in Brazilian Portuguese

Stops and Nasals (1;6-1;8) >> Fricatives (1;8-2;10) >> Liquids (2;8-4;2)

This order of acquisition of manner features has also been observed by Freitas (1997), when analyzing the development of syllable structure in EP.

It is worth emphasizing that the patterns described above are common but not invariant; in fact, variation has been frequently observed, both across children and across languages (Bernhardt & Stemberger, 1998).

3.1.2 Trends in the development of place features

Segmental research has shown that the order of acquisition of place features tends to vary from one manner to the other: within stops and nasals, either Labial or Coronal [+anterior] can appear first, followed by dorsals (Ingram, 1992), while within fricatives the coronal anterior [s] is frequently the first consonant acquired, before labials (Jakobson, 1941/68; Beers, 1996). There is much variability, though, as to the order of acquisition of [f v s z]: in some studies, labials are acquired before coronals and in others the reverse pattern is attested (Bernhardt & Stemberger, 1998). Coronal [-anterior] consonants tend to be acquired later (Lamprecht et al. 2004).

In sum, the most common patterns in the acquisition of place features could be summarized in the following sequence: anterior>>non-anterior. This generalization is given in (10).

(10) *Trends in the acquisition of place features*

a) Anterior features (Labial and Coronal [+ant]) tend to be acquired earlier.

b) Non-anterior features (Coronal [-ant] and Dorsal) tend to be acquired later.

It is not necessarily the case, however, that all anterior consonants are acquired before [-anterior] ones. Some studies have shown that place features may be acquired within subcategories determined by voicing. For instance, studies in BP and in French (Dos Santos, 2007; Oliveira, 2004) show that stops are acquired in the sequence [p t k]>>[b d g].

Taking manner and voicing subgroups into consideration, the order anterior>>non-anterior can accommodate many of the reports on segmental development, across languages, including BP. The order of acquisition of place features in BP is given in (11), based on Rangel (1998), Matzenauer (1990), Lamprecht (1990) and Lamprecht et. al. (2004).

(11) Order of acquisition of consonants in Brazilian Portuguese

a) Stops: Labial and Coronal >> Dorsal (1;6-1;8)

b) Nasals: Labial and Coronal [+ant](1;6-1;8)>>Coronal [ant] (1;9 onwards)

c) Fricatives: Labial (1;8-1;9)>> Coronal [+ant](2;0-2;6)>> Coronal [-ant][(2;6-2;10)

d) Laterals: Coronal [+ant] (2;8-3;0)>> Coronal [-ant] (4;0)

e) Rhotics: Dorsal(3;4)>> Coronal [+ant](4;2)

As shown above, in BP, labial and coronal stops are acquired before dorsals; within nasals, labial and coronal [+ant] are acquired in the same time frame, followed by [-ant] [ɲ]. Within fricatives, labial and coronal [+ant] tend to be acquired before coronal [-ant]. As for liquids, the order anterior>>non-anterior is only supported by the acquisition of laterals, where alveolar [l] is acquired before palatal [ʎ]. As for rhotics, the reverse order of acquisition is observed: dorsal [ʀ] is acquired before the flap.

According to Miranda (1996; 2007), the earlier acquisition of the trill relatively to the flap in BP may be related to different degrees in sonority of the two segments, with the trill being closer to fricatives than to liquids. Miranda argues that the acquisition patterns of rhotics in Brazilian Portuguese are best accounted for if adopting a sonority scale as the one proposed by Bonet & Mascaró (1996; 1997), given in (12).

(12) Sonority scale (Bonet & Mascaró, 1996; Apud Miranda, 2007)

0	1	2	3	4	5
Stops	Fricatives +[ʀ]	Nasals	Laterals	Glides +[ɾ]	Vowels

Two main arguments are put forward by Miranda (2007): (i) Brazilian children acquire the two rhotics in onset according to the order trill>>flap, with an extended time lag in-between (the trill is acquired between 2;8 and 3;1 and the flap between 3;8 and 3;9); (ii) Brazilian children tend to replace targets [ɾ] by other sonorants, namely by glides or the lateral [l]; as for the trill, it can be replaced by sonorants and by (dorsal) stops. Assuming that children replace segments by others that are close to them in terms of sonority, the substitution of the trill by stops could not be accounted for within a traditional scale where all liquids are equal in sonority: Obstruents (Stops <Fricatives)<Nasals<Liquids (Selkirk, 1984). On the contrary, the substitution of trills by stops can be accounted for if the trill is adjacent to stops in the sonority scale, as proposed by Bonet & Mascaró (1996). This issue will be further discussed in section 3.6, based on the data of EP children.

3.1.3 Substitution patterns

Substitution patterns are not arbitrary in children's speech; they result from the learner's developing grammar (Mezzomo, 2007). The analysis of deviant production patterns provides insights into the developing system; for instance, the type of substitutions that occur at a given developmental stage may provide evidence of the default or non-default status of particular features, since defaults in the system tend to replace non-defaults more often than the reverse (Bernhardt & Stemberger, 1998).

Children can replace place, manner or voicing features (individually or in combination). In the current overview of the literature, we will focus on the substitution trends that involve place and/or manner features.

A. Substitutions affecting manner features

Stops and nasals are less prone to be submitted to substitution patterns (Yavas, 1988; Bernhardt & Stemberger, 1998; Lamprecht et. al., 2004). However, some substitutions have been reported in the literature, most often nasals being replaced by stops (see example in (13), from BP).

Stops may replace all other sounds, although they are most likely to replace other obstruents, namely fricatives (see examples in (13), from English and French).

Nasals serve relatively infrequently as substitutes; however, they may replace other sonorants, namely the lateral [l] (see (14)).

(13) Substitution of nasals and fricatives by stops – examples -BP, English and French

Nasal->Stop	*coin*	moeda	[beˈɛda]	BP	Freitas (2004)
Fricative->Stop		fish	[ˈtɪs]	English	Edwards (1996)
Fricative->Stop	*to pass*	passer	[pete]	French	Dos Santos (2007)

As for liquids, they are preferably replaced by another sonorant, namely a glide, another liquid or a nasal. There are also cases of substitution by stops, though less frequent. These substitutions are illustrated below, based on the acquisition of BP (Mezzomo & Ribas, 2004).

(14) Common patterns in the substitution of liquids – BP (Mezzomo & Ribas, 2004)

(a)	Lateral->Glide	*hair*	cabelo	[kaˈbeju]
(b)	Rhotic->Glide	*I run*	corro	[ˈkoju]
(c)	Lateral->Nasal	*pencil*	lápis	[ˈnapis]
(d)	Flap->Lateral	*cockroach*	barata	[baˈlata]
(e)	Lateral->Flap	*callus*	calo	[ˈkaɾu]
(f)	Trill->Stop	*king*	rei	[ˈgej]

The fact that liquids are more commonly replaced by sonorants than by obstruents has been explained in the literature on the basis of the sonority distinction: children tend to select substitutes that are close in sonority to the replaced consonant (Miranda, 2007).

Like nasals, liquids serve relatively infrequently as substitutes. If they do, they more typically replace other liquids, in lateral/flap interchanges as the ones exemplified above (see examples (d) and (e)). Within this type of substitutions, children tend to preserve the largest number of features of the replaced consonant, showing a relatively high degree of faithfulness to the target sound.

B. Substitutions affecting place features

Labials are not often submitted to substitution patterns, although some studies have reported on labial->coronal replacements, mostly affecting labial fricatives. This pattern is exemplified in (15) based on acquisition data from German and BP.

(15) Substitution patterns affecting labials – examples from BP and German

Labial->Coronal	bean	feijão	[siˈzə̃w]	(BP, Oliveira, 2004)
Labial->Coronal	many	viele	[ˈti:lə]	(German, Kehoe & Lléo, 2002)

As for coronals, studies report on interchanges between [+ant] and [-ant], though the pattern [-ant]->[+ant] seems to be more frequent (Ingram et al. 1980; Stoel-Gammon & Dunn, 1985; Bernhardt, 1990). These patterns are illustrated in (16), on the basis of acquisition data of French and BP.

(16) Substitution patterns affecting coronals – examples from French and BP

[-ant]->[+ant]	yellow	[ʒ]aune	[zon]	French	Dos Santos, 2007
[-ant]->[+ant]	heat	[ʃ]o	[so]	French	Dos Santos, 2007
[+ant]->[-ant]	house	ca[z]inha	[kaˈʒiɲa]	BP	Oliveira, 2004
[-ant]->[+ant]	eye	o[ʎ]o	[ˈolu]	BP	Mezzomo & Ribas, 2004
[+ant]->[-ant]	shoe	[s]apato	[ʃaˈpatu]	BP	Oliveira, 2004

According to Matzenauer (1993), substitutions of the type illustrated above show that children have already acquired the major place feature Coronal, but are still working on the acquisition of its subcategory [±anterior]; in feature geometry models, for instance, this subcategorization is formalized by placing [±anterior] in a lower hierarchical level (see Clements and Hume, 1995).

Regarding the substitution patterns that affect dorsals, a frequently observed phenomenon is the replacement of velars by coronals, commonly termed as *velar fronting* (Stoel-Gammon, 1996; Stoel-Gammon & Stemberger, 1994; Inkelas & Rose, 2003). This pattern is exemplified below, based on English acquisition data.

(17) Velar fronting – examples from English

[dor] -> [cor]	go	[ˈdo:]	English	Inkelas & Rose (2003)
[dor] -> [cor]	bug	[bʌd]	English	Stoel-Gammon (1996)

As for acting as substitutes, the general trends are that dorsals infrequently replace either labial or coronals, except in assimilation patterns. Dorsals and labials seldom substitute for each other; according to Bernhardt & Stemberger (1998), this results from the fact that nondefaults tend not to replace other nondefaults.

In section 3.6, the acquisition patterns observed in the data of the five EP children will be discussed and compared to the substitution trends described above.

3.1.4 Input, intake and acquisition patterns

Three different concepts will be referred to in the current section: (i) intake patterns, (ii) acquisition patterns and (iii) distribution of consonants in the input. By intake we refer to the set of adult words children attempt (in line with Fikkert & Levelt, 2008); by acquisition patterns we refer to the order of development of target-like productions; as for the distribution in the input, it refers to the frequency of occurrence of consonants (or features) in adult speech.

The claim that the distribution in the input system may influence phonological developmental (both in perception and production) has been put forward in recent works (Jusczyk et al., 1994; Storkel, 2001; Vodopivec, 2004; Edwards, Beckman, & Munson, 2004; Zamuner, Gerken, & Hammond, 2004; Monnin, Lœvenbruck & Beckman, 2007). Most of the studies in this line of research argue that (i) ease of articulation or perception may cause some sounds to be acquired earlier, across languages; (ii) some frequently occurring sound or sound sequences may be acquired first in one language and only later in the other languages, where its frequency is low.

Other studies, however, have found no direct relation between *early* segmental acquisition and the distribution of segments in adult speech (Dos Santos, 2007) or in Child Directed Speech (Levelt & van Oostendorp, 2007; Fikkert & Levelt, 2008).

Levelt & van Oostendorp (2007) compared the order of acquisition of consonants in the Dutch child language database CLPF with the frequency of occurrence of these consonants in Dutch Child Directed Speech (CDS) (Van de Weijer, 1999) and found no direct link between both *corpora*; for instance, [p t] display the lowest frequency in CDS (1.4 and 1.3, respectively) but were acquired early.

Fikkert & Levelt (2008), also based on Dutch acquisition data, found some discrepancies between earlier and later developmental stages, as far as the relation with the input is concerned. The authors compared the distribution of place word patterns (for instance [Lab…Lab] or [Lab…Cor]) in children's production forms to a sample of Dutch CDS. They found out that the distribution in the input is not reflected in the earliest stages of place development (before 1;7, in Robin's data): [Dor…Dor] and [Lab…Lab] are not frequent in CDS but are produced very early. However, the distribution in the input correlates with place development at a later stage, when consonants can receive different place feature specifications (after 1;7, in Robin's data).

As for the relation between intake (the target words attempted by the child) and input, Dos Santos (2007), in a case-study of French, shows that, between 1;10 and 2;2, the frequency of each consonant in the child's intake does not resemble the distribution of consonants in adult speech. According to the author, the child's lexicon at this age is relatively small and the child avoids words with 'problematic' consonants; it is only at a later stage, between 2;3 and 2;11, that distribution in the intake starts reflecting distributional patterns in French adult speech. This change coincides with an expansion of the child's active vocabulary.

One of the aims of the current dissertation is to contribute to the discussion of the potential role of distributional properties in the input both in the intake and in the acquisition patterns observed in the data of the five Portuguese children. Since there is no extensive *corpus* on CDS in EP, this discussion will be based on the frequency rates extracted from a *corpus* of EP adult speech. More details on this topic are provided in 3.4.

3.2 Consonants in European Portuguese: the target system

This section provides a characterization of the consonantal system in EP. We will start with the description of the consonantal inventory, focusing only on the contrastive sounds that occur in non-branching onset position (word-initial (C1) and intervocalic (C2)). The place and manner feature characterization of consonants presented in this section is based on Mateus & d' Andrade (2000).

In standard EP, a set of 19 contrastive consonants can be found in onset position.[15] That set is given in (18).

(18) Contrastive consonants in EP – onset position

[p b t d k g f v s z ʃ ʒ m n ɲ l ʎ ɾ ʀ]

[15] At the phonetic level, there are some other realizations for consonants in onset, namely the uvular fricatives [ʁ] and [χ] for the rhotic [ʀ] (Lisbon region) and the realization of voiced stops [b d g] as the correspondent non-strident fricatives [β ð ɣ], respectively (northern and central dialects; Mateus & d' Andrade, 2000:11); these variants are, however, non-contrastive.

In the set depicted above, all consonants are contrastive in word-medial onsets (see (20)) and all but the sonorants [ɲ ʎ ɾ] are contrastive in word-initial position (see (19)).[16]

(19) Contrastive consonants in word-initial onset (Mateus & d' Andrade, 2000)

[p]	[ˈpalɐ]	pala	visor	[b]	[ˈbalɐ]	bala	bullet
[t]	[ˈtõ]	tom	tone	[d]	[ˈdõ]	dom	gift
[k]	[ˈkalu]	calo	corn	[g]	[ˈgalu]	galo	cock
[f]	[ˈfalɐ]	fala	speech	[v]	[ˈvalɐ]	vala	trench
[s]	[ˈselu]	selo	seal	[z]	[ˈzelu]	zelo	care
[ʃ]	[ˈʃa]	chá	tea	[ʒ]	[ˈʒa]	já	already
[m]	[ˈmatɐ]	mata	wood	[n]	[ˈnatɐ]	nata	cream
[l]	[ˈlatu]	lato	large	[ʀ]	[ˈʀatu]	rato	mouse

(20) Contrastive consonants in intervocalic onset (Mateus & d' Andrade, 2000)

[p]	[ˈʀipɐ]	ripa	chip	[b]	[ˈʀibɐ]	riba	cliff
[t]	[ˈlatu]	lato	wide	[d]	[ˈladu]	lado	side
[k]	[ˈvakɐ]	vaca	cow	[g]	[ˈvagɐ]	vaga	wave
[f]	[ˈʃtafɐ]	estafa	fatigue	[v]	[ˈʃtavɐ]	estava	s/he was
[s]	[ˈkasɐ]	caça	hunt	[z]	[ˈkazɐ]	casa	house
[ʃ]	[ˈaʃɐ]	acha	s/he finds	[ʒ]	[ˈaʒɐ]	haja	there may be
[l]	[ˈmalɐ]	mala	bag	[ʎ]	[ˈmaʎɐ]	malha	mesh
[m]	[ˈgɐmɐ]	gama	range	[n]	[ˈgɐnɐ]	gana	energy
[ɲ]	[ˈsɐɲɐ]	sanha	fury	[n]	[ˈsɐnɐ]	sana	s/he heals
[ɾ]	[ˈkaɾu]	caro	expensive	[ʀ]	[ˈkaʀu]	carro	car

Different place and manner features characterize the consonants given above. That characterization is provided in (21), based on Mateus & d' Andrade (2000).

(21) Feature characterization of consonants in EP

(a) Manner

	Sounds	Manner features
Stops	[p t k b d g]	[-sonorant]; [-continuant]
Nasals	[m n ɲ]	[+sonorant];[nas]
Fricatives	[f v s z ʃ ʒ]	[-sonorant]; [+continuant]
Liquids (Laterals)	[l ʎ]	[+sonorant];[lateral]
(Rhotics)	[ɾ ʀ]	[+sonorant]

[16] Note that there are some occurrences of [ɲ ʎ] in word initial position in EP, but they are limited to a small number of lexical morphemes.

(b) Place

	Sounds	Place features
Labials	[p b f v m]	Labial
Coronals	[t d n s z l ɾ]	Coronal; [+anterior]
	[ʃ ʒ ʎ ɲ]	Coronal; [-anterior]
Dorsals	[k g ʀ]	Dorsal

According to Mateus & d' Andrade (2000) the consonantal classes given in the first column of each table presented in (14) can be distinguished based on the manner features provided in the third column, at the right. Those differences are outlined below.

- stops and fricatives are both [-sonorant] but differ in the [±continuant] specification;
- nasals differ from the other [+sonorants] in the [nas] specification;
- laterals differ from the other liquids (rhotics) in the [lat] specification;
- As for place, the three major classes are specified with a class node feature [Labial, Coronal, Dorsal);
- Anterior and non-anterior coronals differ in the [±anterior] specification.

Note that, based on the geometry model of Clements & Hume (1995), Mateus and d' Andrade distinguish between class nodes, which are unary (Labial, Coronal, Dorsal), and terminal features, which are binary ([±anterior], for instance). For expository reasons, the same type of notation will be used in this dissertation. It is worth noticing, though, that the discussion of the unary/binary nature of distinctive features is beyond the scope of the current investigation.

For ease of exposition when describing acquisition patterns, we will often refer to the major sound classes (stops, fricatives, labials, for instance) instead of referring to the place or manner features that characterize each class (see section 3.4).

In line with Kiparsky (1982) and Archangeli (1982), Mateus & d' Andrade (2000) assume radical underspecification in the phonological representation of segments; they propose that coronal [+anterior] is the unmarked place feature in the system (similarly to what has been established for many other languages (Paradis & Prunet, 1991). For this reason, they suggest that coronal [+ant] consonants [t d s z n ɾ l] are underspecified, at the lexical level, for place features. In section 3.6, this proposal will be discussed, in the light of acquisition data of the five EP children studied in this project.

3.3 Summary and research questions

Research in segmental development has reported on typical developmental trends in the acquisition of place and manner features, although variability is frequently observed. As far as manner features are concerned, stops and nasals tend to be acquired early, while fricatives and liquids are acquired later (Bernhardt & Stemberger, 1998). As for place, Labial and Coronal [+anterior] tend to be acquired before palatals and dorsals (Lamprecht et al. 2004), with the exception of rhotics, where the dorsal trill tends to be acquired before the flap (Miranda, 2007).

Several substitution patterns have also been reported in the literature: nasals and fricatives are more frequently replaced by stops (Edwards, 1996; Freitas, 2004), liquids are more often substituted by another sonorant (Mezzomo & Ribas, 2004), although the trill can be replaced by stops (Miranda, 2007).

Regarding place, Labial is not often submitted to substitution patterns, although some studies have reported on labial->coronal replacements, mostly affecting labial fricatives (Kehoe & Lléo, 2002; Oliveira, 2004). As for coronals, studies report on interchanges between [+ant] and [-ant] features (Oliveira, 2004; Dos Santos, 2007), indicating that the major feature Coronal is acquired, but the subcategorization [±anterior] takes a longer period of time to become stable in children's systems (Matzenauer, 1993). As for dorsals, they tend to be replaced by coronals (known as the velar fronting phenomenon) (Stoel-Gammon, 1996; Inkelas & Rose, 2003).

The analysis of substitution patterns provides insights into the default or non-default status of features and consonants in children's phonological systems; in general, defaults replace non-defaults more often than the reverse (Bernhardt & Stemberger, 1998).

The role of the distribution of sounds in adult speech (or in child directed speech) in the development of intake and acquisition patterns has been explored in several studies (Dos Santos, 2007; Levelt & van Oostendorp, 2007; Fikkert & Levelt, 2008). Those studies found no correlation between input and order of acquisition in early ages, but some of them observed a gradual resemblance between acquisition and input distribution, as soon as children's active vocabulary increases (Dos Santos, 2007; Fikkert & Levelt, 2008).

In spite of the importance of the knowledge on how children acquire their segmental inventory to several linguistic-applied fields, namely educational and clinical, no extensive research has yet been performed on the acquisition of the consonantal system in EP.

Taking the above issues into consideration, two main research questions underlie the analysis presented in the current chapter. They are summarized in (22).

(22) Research questions

(1.) What developmental patterns characterize the acquisition of the consonantal inventory in EP, more specifically, the acquisition of place and manner features?

(1.1) What insights do those developmental patterns provide into children's developing phonological systems?

Aiming to gather empirical evidence that allows for the discussion of the two questions referred to above, the following specific goals have been formulated.

(23) Specific aims of the current chapter

a) Describe the order of acquisition of consonants.

b) Analyze the order of acquisition of place and manner features.

c) Explore the substitution patterns that affect features.

d) Compare intake and acquisition patterns to the distribution of features in EP adult speech.

Based on the empirical information referred to above, we intend to contribute to the discussion of the following issues (see section 3.6)

- Acquisition path: consonant-by-consonant or determined by features?
- Substitution patterns: marked and unmarked status of features in children's systems.
- The role of distributional properties of the input in children's intake and acquisition patterns.
- Differences and similarities between acquisition in EP and in other languages, namely BP.

3.4 Method

The analysis presented in the current chapter is based on spontaneous longitudinal data of five Portuguese children acquiring EP as their first language. The age frame studied per child and the corresponding number of recording sessions are given in (24).

(24) The data: age and number of sessions, per child

Child	Age at the 1st session	Age at the last session	N.º of sessions
Inês	0;11.14	4;2.18	30
Joana	0;11.24	4;10.7	33
Luma	0;11.23	2;6.27	39
Clara	0;11.1	1;10.15	12
João	1;0.1	2;0.20	22

The acquisition data discussed in this chapter is restricted to consonants in non-branching onsets (C1 and C2), independently of their position regarding word stress. In the target words attempted by each child, per session, we looked for all the consonants in non-branching onsets and analyzed the corresponding renditions, quantifying the number of target-like productions, the number of deviant output forms and the type of substitution pattern used (see appendixes C and D).

As a criteria for determining if a given consonant is acquired, we will adopt 80% of target-like productions in at least two consecutive months (corresponding to more than one attempt), with not more than two decreases below 50% in the following months. Although there is no consensus in the literature on the most adequate criteria (Bernhardt & Stemberger, 1998), the 80% criterion is frequently used in studies on segmental acquisition (Bernhardt, 1992; Mota, 1996, 2007; Dos Santos, 2007). By choosing similar criteria we will then be able to compare our results with the ones previously reported in the literature. Note, however, that a full quantitative account of target-like productions is provided in appendix C, allowing for the comparison with studies using other types of criteria.

In the data description, we will focus not only on production but also on intake patterns; by intake we mean the set of attempted adult targets (in line with studies such as Fikkert & Levelt, 2008), per session, in each child's *corpus* (appendix E).

In the current chapter, we will also investigate the distribution of consonants and of place and manner features in a sample of EP adult speech, comparing it to acquisition and intake patterns. That sample is constituted by 15702 lexical words and 7140 clitics and is taken from the *corpus Spoken Portuguese* (*Português Falado*; TA90PE; CLUL/Instituto Camões; FrePOP database) (see appendix B). The frequencies were extracted using *FreP*,[17] an electronic tool developed at the Phonetics Laboratory, University of Lisbon (Frota, Vigário & Martins, 2006).

For the sake of clarity in the data description, we will often refer to natural classes (stops, fricatives, or rhotics, for instance) instead of mentioning the distinctive features that characterize each class (see section 3.2).

3.5 Acquisition of the consonantal system in EP: results

In the current section, we describe the acquisition of the consonantal system in EP, based on longitudinal data of five Portuguese children. This section is organized as follows. Subsection 3.5.1 presents a general analysis, focusing on the order of acquisition

[17] More information on this tool can be found at http://www.fl.ul.pt/LaboratorioFonetica/FreP.

of individual consonants and of features (place and manner), comparing developmental patterns with the distribution of consonants and features in a sample of EP adult speech. Then, in 3.5.2, we describe the substitution patterns that affect place and manner features, within each child's *corpus*. In the sections that follow, we present a detailed description of intake and acquisition patterns, within each manner feature: stops in subsection 3.5.3, nasals in 3.5.4, fricatives in 3.5.5 and liquids in 3.5.6. Within each subsection, the relation between intake, acquisition and distributional properties in the input will be explored.

3.5.1 General order of development

Order of acquisition of consonants

In this subsection, we present the general order of acquisition of consonants (in onset position) in each child's *corpus*; as stated in section 3.4, the criteria of acquisition adopted in the current chapter is of 80% of target-like productions in at least two consecutive months, with a maximum of two decreases below 50%, in the following sessions. A full description of the number of targets selected and the number and percentage of corresponding accurate productions, per child and per session, is provided in appendix C.

It is worth emphasizing that the fact that a given consonant is not acquired does not mean that it is not produced accurately at all. As will be shown from section 3.5.3 to 3.5.6, most of the consonants that are not acquired (not produced systematically above 80%) are already being produced accurately above 50%, thus they are already in the process of being acquired.

In the *corpora* of the two children studied for a longer period of time (Inês, until 4;2 and Joana, until 4;10), we identified the order of acquisition of 17 and 16 consonants, respectively. The other three children (Luma, Clara and João) acquired a smaller set of consonants, since they were recorded for a shorter period of time. The order of acquisition of consonants in each child's *corpus* is provided in the diagrams depicted from (25) to (29).

(25) General order of acquisition of consonants in onset – Inês (appendix C)

0;11	⇨	**1;1**	⇨	**1;4**	⇨	**1;10**	⇨	**2;0**	⇨	**2;5**	⇨	**2;7**	⇨	**2;8**	⇨	**2;11**	⇨	**3;4**	⇨	**3;11**
/m/		/n/		/p/		/t k/		/b d/		/l/		/f/		/g/		/v s z ʃ ʒ/		/ɲ/		/ʀ/

Overall, Inês acquires 17 consonants, between the age of 0;11 and 4;2. The first two consonants acquired are [m] and [n], between 0;11 and 1;1 and the last is [ʀ], three years later, at 3;11. Two consonants are still not produced target-like above 80% in the last session studied (at 4;2): the liquids [ʎ] and [ɾ].

(26) General order of acquisition of consonants in onset – Joana (appendix C)

1;9 /p/ ⇨ **2;2** /t/ ⇨ **2;4** /m ɲ/ ⇨ **2;6** /k/ ⇨ **2;10** /b d f/ ⇨ **3;0** /g v/ ⇨ **3;2** /n/ ⇨ **4;0** /s/ ⇨ **4;2** /z ʃ ʒ/ ⇨ **4;7** /ʀ/

Following the criteria of 80% of target-like productions, 16 consonants can be considered acquired in Joana's *corpus*, until the age of 4;10. The two first consonants acquired are [p] and [t] at the age of 1;9 and 2;2, respectively. Similarly to Inês, the last consonant acquired by Joana until the last session studied is the rhotic [ʀ] (at 4;7). Three consonants are not produced target-like above 80%, until the age of 4;10: laterals [l] and [ʎ] and rhotic [ɾ].

(27) General order of acquisition of consonants in onset – Luma (appendix C)

1;2 /d/ ⇨ **1;8** /t/ ⇨ **2;0** /m n/ ⇨ **2;1** /p/ ⇨ **2;3** /k/ ⇨ **2;4** /v/

Luma was studied from the age of 0;11 to 2;6. Within this period, 7 consonantal sounds are acquired. The first consonants acquired are [d] and [t], at 1;2 and 1;8, respectively. The last consonant acquired is [v], at 2;4.

Until the last session studied (at 2;6), 12 consonants are still not acquired, in Luma's data: stops [b g], nasal [ɲ], all fricatives except for [v] and all liquids .

(28) General order of acquisition of consonants – Clara (appendix C)

1;1 /p/ ⇨ **1;4** /n/ ⇨ **1;5** /m t/ ⇨ **1;7** /k/

Clara was studied from 0;11 to 1;10. Within this period, she acquires 5 consonants, as shown above. The first consonant acquired is [p] (at 1;1). At 1;4, nasal [n] is also acquired. The last consonant to surpass the level of 80% of accurate productions is [k] (at 1;7). Until 1;10, Clara has not yet acquired 14 consonants: all voiced stops, nasal [ɲ], all fricatives and all liquids.

(29) General order of acquisition of consonants – João (appendix C)

1;2	⇨	1;5	⇨	1;7	⇨	1;8	⇨	1;10
/b/		/m/ /p/		/d/		/n/		/t/

João was studied from 0;11 to 2;0. Within this period, 6 consonants are acquired, as shown in (29). The first consonantal sound acquired is [b], at 1;2, followed by [m] and [p], at 1;5. The last consonant acquired is [t], at 1;10. Until the age of 2;0, no dorsal, fricative or liquid is produced accurately above 80%, in João's speech.

Overall, there are some common trends across the five children studied: the consonants [m n p b t d] tend to be amongst the first set of sounds acquired, while [f v s z ʃ ʒ] and, particularly [l ʎ ɾ ʁ] tend to be acquired later. In other words, the first consonants acquired tend to be stops and nasals, labial and coronal [+ant]; the consonants acquired at later ages tend to be fricatives and liquids. It does seems that the path of consonantal acquisition is determined by both manner and place features, and not by individual consonants. This issue will be further explored below, in the comparison between the order of acquisition and distributional properties of the input language.

In the next subsection, we will investigate if the general order of acquisition of individual consonants observed above can be related to the distribution of consonantal sounds in EP Adult speech. The main question that will be addressed is if the early or late acquisition of a given sound can be related to its frequency of occurrence in adult speech.

Order of acquisition and distribution of consonants in the adult language

We will now compare the order of acquisition of consonants in the data of the five Portuguese children with the distribution of consonantal sounds in a sample of EP adult speech (constituted by 22.842 words; see section 3.4). The overall frequency of each consonant (in initial and intervocalic onset position) in the sample of adult speech is given in (30).

(30) Distribution of consonants in a sample of EP adult speech – onset position (appendix B)

Sound	**% of occurrence**	**Sound**	**% of occurrence**
[t]	13%	[v]	4%
[d]	11%	[f]	3%
[k]	11%	[b]	3%
[s]	9%	[g]	2%
[ɾ]	9%	[ɲ]	2%
[p]	8%	[z]	2%
[m]	8%	[ʃ]	1%
[n]	6%	[ʒ]	1%
[l]	5%	[ʎ]	1%
		[ʀ]	1%

As shown in the table above, the most frequently produced consonant in the sample of adult speech is [t] (in 13% of the cases), followed by [d] and [k] (11%). Other frequently occurring consonants are [s], [ɾ] (9%), [p], [m] (8%), [n] (6%) and [l] (5%). All other consonants occur in a percentage below 5% (column at the right).

If we compare the data given in (30) with the general order of acquisition of consonants in each child's *corpus*, we can see that some of the most frequently occurring consonants in the sample of adult speech are amongst the first consonants acquired by Portuguese children: [t d p m]. However, overall the order of acquisition does not match the distribution in adult speech; for instance, [t] and [d] are more frequent in adult speech (13% and 11%, respectively) than [p] (8%) but [p] is acquired before [t d] by the majority of children (all except Luma). Additionally, [m] and [n] are acquired before [k] by most children (all except Joana), but the dorsal stop occurs more often in adult speech (11%) than [m] (8%) or [n] (6%). We can also see that two frequently produced consonants in adult speech ([s] and [ɾ], 9%) tend to be acquired quite late (the fricative is acquired after 2;10, by Inês and Joana; the flap is not acquired by any of the children, in the time frame studied).

As shown above, there is not a straightforward relation between the order of acquisition of consonants and their distribution in the sample of adult speech: even though some frequent sounds in the adult speech sample are acquired early ([p t d k], for instance), other frequent consonants are acquired quite late ([s] and [ɾ]).

One of the questions that could be raised now is if those differences between each consonant in the adult speech sample are big enough to be noticeable; for instance, is the difference between the 13% of [t] and the 8% of [p] noticeable for children? It could very well be the case that those differences are not salient enough and can therefore cause variability in the order of acquisition: some children will pick [t] (Luma) to start with and others will choose [p] (Inês, Joana, Clara and João). If this interpretation were to be correct, though, we would expect much more variability in the order of acquisition of consonants, across children. The variation observed, however, is quite limited, since most children obey to the general trend: first stops and nasals (labials and coronal [+ant]), then fricatives and liquids (see diagrams from (25) to (29), above).

Another hypothesis that could be put forward is that children are more sensitive to the distribution of features than to the distribution of individual consonants in adult speech. This hypothesis will be explored in the next subsection, where we focus on the development of place and manner features.

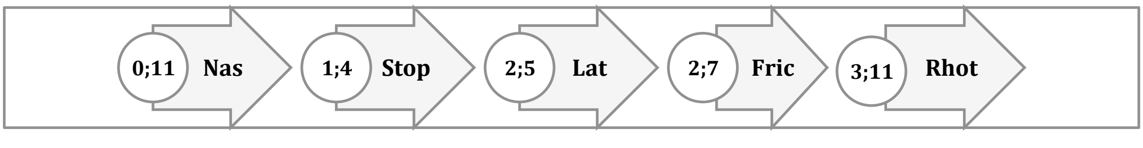
Order of acquisition of place and manner features

This section describes the order of acquisition of place and manner features. As for the criteria of acquisition, we consider that a given feature is available at the moment at least one consonant containing it is acquired; for instance, at the age the first fricative surpasses the level of 80% of target-like productions, we consider fricatives to be available in the child's system, even though some of the members of this natural class might still not be produced accurately (due for instance, to the non-acquisition of place or voicing feature specifications).

Order of acquisition of manner features

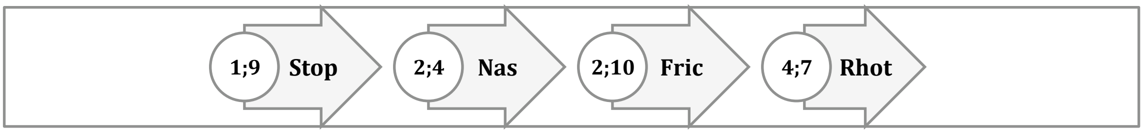
The diagrams provided from (31) to (35) present the order of acquisition of manner features, in each child's *corpus* (see appendix C).

(31) Order of acquisition of manner features – Inês (appendix C)



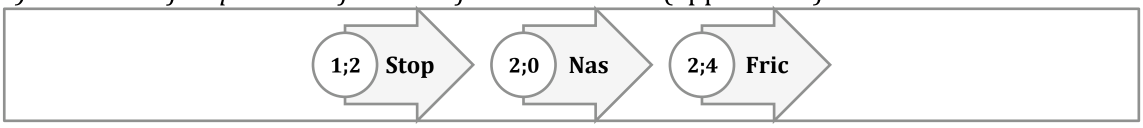
As depicted above, Inês acquires nasals and stops in the first recording sessions: nasal at 0;11 and stop at 1;4. As for fricatives and liquids, they are acquired after the age of 2;0: lateral at 2;5, fricative at 2;7 and rhotic at 3;11 (see order of acquisition of consonants in (25)).

(32) *Order of acquisition of manner features – Joana* (appendix C)



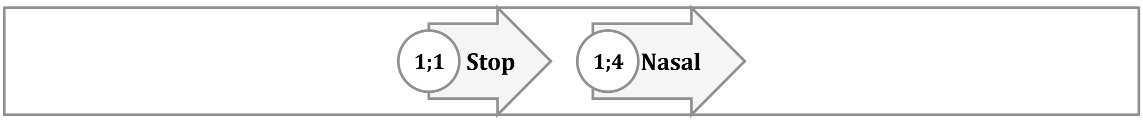
Similarly to Inês, Joana acquires stops and nasals before any other sounds: stop at 1;9 and nasal at 2;4. At the age of 2;10, fricatives are acquired. As for liquids, rhotic is acquired only at 4;7, while lateral is not acquired until the last session studied, at 4;10 (see (26)).

(33) *Order of acquisition of manner features – Luma* (appendix C)



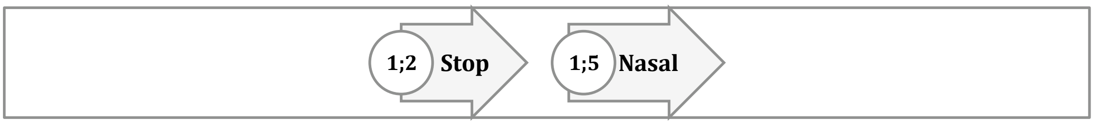
Luma starts by acquiring stop (at 1;2) followed by nasal (at 2;0). Fricatives appear at 2;4. Liquids are not acquired until the last session studied, at 2;6 (see (27).

(34) *Order of acquisition of manner features – Clara* (appendix C)



Clara acquires stops, at 1;1 and nasals, at 1;4. Fricatives and liquids are not acquired until the last session studied, at 1;10 (see (28)).

(35) *Order of acquisition of manner features – João* (appendix C)



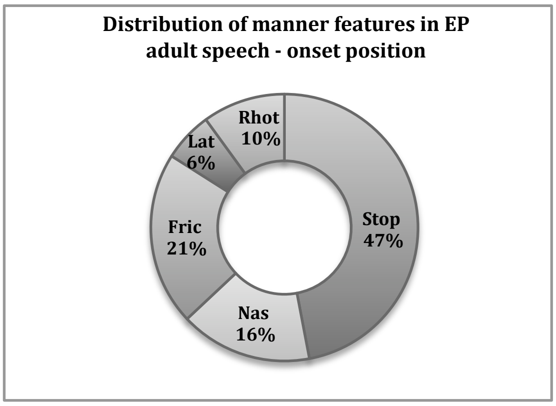
Similarly to Clara, João acquires only: stops, at 1;2 and nasals, at 1;5. Fricatives and liquids are not acquired until 2;0 (see (29)).

In summary, Stop and Nasal are the first two natural classes acquired, in the data of the five children. One of the subjects acquires these two classes in the order Nasal>>Stop (Inês), while the other four show the reverse order: Stop>>Nasal. As for fricatives and liquids, they are not acquired in the data of Clara and João, who where studied only until the age of 1;10 and 2;0, respectively. Luma and Joana acquire fricatives after stops and nasals, in the order: Stop>>Nas>>Fric; as for Inês, she acquires Fricative after Lateral: Nas>>Stop>>Lat>>Fric>>Rhot. These orders of acquisition and its implications to the default and nondefault status of features in children's systems will be discussed in section 3.6.

We will now compare the orders of acquisition of manner features described above with the frequency of occurrence of those features in the sample of adult speech.

The distribution of each manner (in word-initial and intervocalic onset position) in the Spoken Portuguese sample is provided in (36).

(36) Distribution of manner features in a sample of EP adult speech in onset position (appendix B)



As shown above, stops are the most frequently occurring sounds in the adult speech sample (47%), followed by fricatives (21%) and nasals (16%). Laterals and rhotics are the least frequent (6% and 10%, respectively).

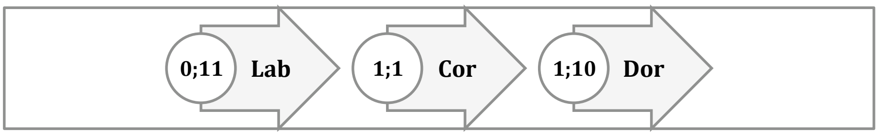
The distribution of manner features in adult speech coincides with the acquisition data in two respects: (i) stops are frequently produced in adult speech and are acquired early; (ii) liquids are infrequent in adult speech and are acquired later. Discrepancies are found, however, in the other two natural classes: Nasal and Fricative. Being the second most frequent sound class in adult speech, we might expect fricatives to be acquired earlier than nasals, but this order of acquisition is not found in any of the children. In fact, nasals are the first consonants acquired by one of the subjects (Inês), even before stops.

It thus seems that frequency of manner features in adult speech cannot fully account for the order of acquisition either: it could be able to explain why stops are acquired early and liquids late, but is not able to explain why nasals are acquired before fricatives. This issue will be further discussed in section 3.6.

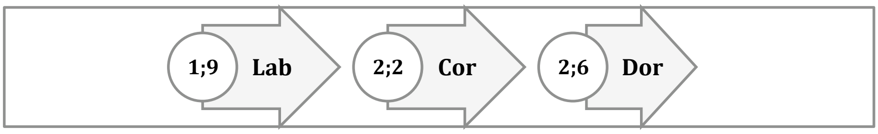
Order of acquisition of place features

The order of acquisition of the three major place features (Labial, Coronal, Dorsal) in each child's *corpus* is given from (37) to (41).

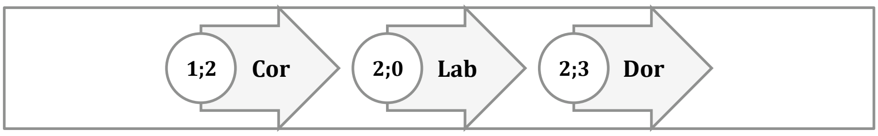
(37) Order of acquisition of place features – Inês (appendix C)



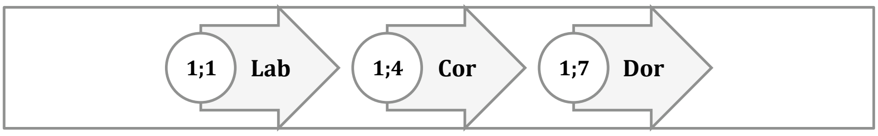
(38) Order of acquisition of place features – Joana (appendix C)



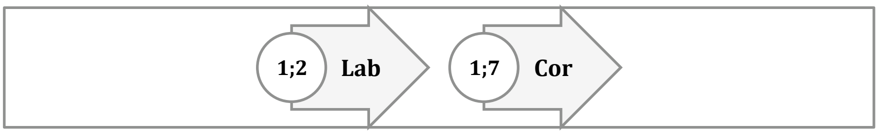
(39) Order of acquisition of place features – Luma (appendix C)



(40) Order of acquisition of place features – Clara (appendix C)



(41) Order of acquisition of place features – João (appendix C)

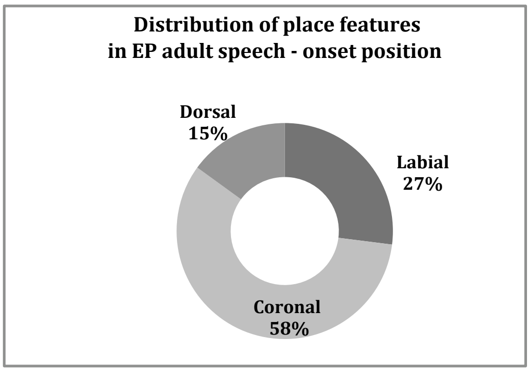


As shown in the diagrams given above, four children (Inês, Joana, Clara, João) acquire Labial first, followed by Coronal; Luma presents the reverse order: she starts by acquiring Coronal, followed by Labial. Dorsal is the last feature to be acquired by all children; in the case of João, this feature is not acquired until the last session studied, at 2;0.

Except for Luma, children show a clear path in the order of acquisition of place features: from the most front place feature (Labial) to the most back place feature (Dorsal). Luma also acquires the most front place features (Labial and Coronal) before the most back (Dorsal), even though she differs from the other children in the order of acquisition of Labial and Coronal. This issue will be discussed in section 3.6.

We will now compare the order of acquisition of place features to the distribution of those features in the sample of adult speech. The distribution of place features in onset position (word-initial and intervocalic) in the sample of adult speech is provided in (42).

(42) Distribution of place features in a sample of EP adult speech (onset position) (appendix B)



As shown above, the most frequently occurring feature in the sample of adult speech is Coronal (58%), followed by Labial (27%). The least frequent feature is Dorsal (15%). If we compare this distributional pattern in adult speech with the order of acquisition of place features in the *corpora* of the five children, we find that (i) Labial and Coronal are the two most frequent features in adult speech and they are the two first acquired features; (ii) Dorsal is the least frequent in adult speech and is the last to be acquired by all children.

There are some discrepancies, however: given the predominance of coronals in adult speech, we might expect them to be the first consonants acquired, but this occurs only in Luma's data. The other children acquire a labial consonant first. It thus seems that, although there are some similarities between the distribution of features in adult speech and the general order of acquisition, the former cannot fully account for the latter. This issue will be further discussed in section 3.6.

3.5.2 Substitution patterns for place and manner features

Before being acquired, features are often submitted to different types of substitution patterns. Among other aspects, the analysis of these substitutions can provide information on the default or non-default status of features in each child's system, as well as on the influence of the phonological context in developmental patterns. Aiming to gain access to this type of information, we will explore substitutions in the next subsections, focusing first on manner and then on place features.

Substitutions affecting manner features

This section focuses on the substitution patterns that involve manner feature changing, since the main goal here is to discuss the default or non-default status of manner features. Two main consonantal classes are often submitted to this type of substitutions: fricatives and liquids.

Substitutions affecting fricatives

In section 3.5.1, it was shown that fricatives are acquired in production at the following ages: at 2;4 for Luma, at 2;7 for Inês; at 2;10 for Joana. As for Clara and João, fricatives are still not acquired at the last session studied, at 1;10 and at 2;0, respectively. In the period preceding acquisition, fricatives are submitted to several substitution processes that involve manner feature changing. The total number of those substitutions is provided in (43), per child, as well as the number and percentage of occurrence of each type of manner substitution pattern (see appendix D, for a detailed report of these patterns, per session and per word-position).

(43) Manner substitutions affecting fricatives (appendix C)

	Inês	**Joana**	**Luma**	**Clara**	**João**
Age	Until 2;7	Until 2;10	Until 2;4	Until 1;10	Until 2;0
Total Nº	548	35	53	57	271
Type	Fric -> Stop	Fric -> Stop	Fric -> Stop	Fric -> Stop	Fric -> Stop
Occur. (%)	545 (99%)	35 (100%)	41 (77%)	49 (86%)	177 (65%)
Type			Fric->Nas	Fric->Glide	Fric -> Nas
Occur. (%)			12 (23%)	8 (14%)	94 (35%)

As shown above, the predominant manner substitution type affecting fricatives is Fric->Stop, where a target fricative is replaced by a stop in children's productions; in this case, the changed feature is [+continuant], which is rendered as [-continuant]. This pattern corresponds to 100% of the substitutions that involve manner change for target fricatives in Joana's data (35 cases), to 99% in the *corpus* of Inês (545 of the 548 cases) and to above 60% in the other three children's data. Some examples of the Fric->Stop substitution pattern are provided in (44).

(44) Examples of Fric -> Stop substitutions (appendix D)

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Inês	1;8.2	vestiu	dressed	/viʃˈtiw/	[bɨˈtiw]
(b)	Inês	1;10.29	vacas	cows	/ˈvakɐʃ/	[ˈdakaʃ]
(c)	Inês	2;4.18	lixo	garbage	/ˈliʃu/	[ˈlitu]
(d)	Joana	1;10.22	avó	granny	/ɐˈvɔ/	[ɐˈbɔː]
(e)	Joana	2;4.1	sopa	soup	/ˈsopɐ/	[ˈpopɐ]
(f)	Joana	2;6.24	coisa	thing	/ˈkojzɐ/	[ˈkudʲɐ]
(g)	Luma	1;10.18	vovô	grandfather	/voˈvo/	[toˈto]
(h)	Luma	2;2.22	sai	get out	/ˈsaj/	[ˈtaj]
(i)	Luma	2;3.26	guizo	bell (toy)	/ˈgizu/	[gidu]
(j)	Clara	1;7.11	João	prop.noun	/ʒuˈɐ̃w̃/	[duˈɐ̃w̃]
(k)	Clara	1;9.23	Uva	prop.noun	/ˈuvɐ/	[ˈubɐ]
(l)	Clara	1;10.15	avô	grandfather	/ɐˈvo/	[aˈbo]
(m)	João	1;10.11	chão	floor	/ˈʃɐ̃w̃/	[ˈtɐ̃w̃]
(n)	João	1;11.10	ajuda	help	/ɐˈʒudɐ/	[ɐˈdudɐ]
(o)	João	2;0.20	fofo	fluffy	/ˈfofu/	[ˈpopu]

As illustrated above, the Fric->Stop pattern affects fricatives both in C1 (see examples in (a), (b), (e), (g), (h), (j), (m), (o) in (44)) and in C2 (as illustrated in (c), (d), (f), (g), (i), (k), (l), (n), (o) in (44)).

In the data of Luma, Clara and João, there are also some cases where fricatives are replaced by a sonorant (a nasal or a glide). It is worth noticing that these substitutions affect a very small number of target words (one in Clara's data and two in Luma and João's *corpora*; see examples in (45), below). In most cases, the substitution of fricatives by sonorants occurs in C2 (Fric->Nas, in Luma (72% of the cases) and in João (64%)). In Clara's *corpus*, all cases of Fric->Glide occur in C1 (referring to one single target word, illustrated in (e), below).

(45) Examples of Fric -> Sonorant substitutions

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Luma	1;10.18	Susana	prop.noun	/suˈzɐnɐ/	[ˈnɐnɐ]
(b)	Luma	2;3.26	azul	blue	/ɐˈzuɫ/	[ˈnuː]
(c)	João	1;9.25	Susana	prop.noun	/suˈzɐnɐ/	[noˈnɐnɐ
(d)	João	2;0.20	kivi	kiwi	/kiˈvi/	[ˈtini]
(e)	Clara	1;7-1;10	João	prop.noun	/ʒuˈɐ̃w̃/	[juˈɐ̃w̃]

To sum up, except for some few cases where fricatives can be replaced by a nasal or a glide, the vast majority of manner substitutions affecting fricatives in the Portuguese children's data is of the type Fric->Stop. This issue will be further explored in section 3.6.

Substitutions affecting laterals

In section 3.5.1, it was shown that laterals were acquired only by Inês, at the age of 2;5. The other children do not produce any lateral in a target-like fashion above 80% up to the last session studied. The global number of manner substitutions affecting laterals in each child's *corpus* is provided in (46), as well as the frequency of occurrence of each type of substitution.

(46) Manner substitution patterns affecting laterals (appendix D)

	Inês	**Joana**	**Luma**	**Clara**	**João**
Age	Until 2;5	Until 4;10	Until 2;6	Until 1;10	Until 2;0
Total Nº	108	317	77	14	68
Type	Lat -> Glide	Lat -> Glide	Lat -> Nas	Lat -> Stop	Lat -> Glide
Occur. (%)	54 (50%)	214 (68%)	40 (52%)	7 (50%)	45 (66%)
Type	Lat-> Stop	Lat-> Stop	Lat -> Stop	Lat -> Glide	Lat -> Stop
Occur. (%)	36 (33%)	51 (16%)	21 (27%)	3 (21%)	11 (16%)
Type	Lat->Rhot	Lat-> Nas	Lat -> Glide	Lat-> Fric	Lat -> Nas
Occur. (%)	15 (14%)	27 (8%)	16 (21%)	3 (21%)	11 (16%)

Except for Clara, all children show a clear preference (above 60% of the cases) for replacing laterals by another sonorant, most often a glide or a nasal. Thus, children tend to preserve the feature [+sonorant] of the target lateral. The substitution of laterals by stops is less frequent (below 33%, for all children, except for Clara).

Some examples of the substitution of laterals by another sonorant are provided in (47); the most common substitute is a glide, but there are also substitutions of laterals by nasals (particularly in Luma's *corpus*, see appendix D) or by rhotics, in the *corpus* of Inês (mostly from 2;0 onwards, see appendix D).

(47) Examples of Lateral -> Sonorant substitutions

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Inês	1;8.2	olha	look	/ˈɔʎ̱ɐ/	[ˈɔj̱ɐ]
(b)	Inês	1;10.29	olhos	eyes	/ˈɔʎ̱uʃ/	[ɔːj̱uʃ]
(c)	Inês	2;2.1	vermelha	red	/vɨɾˈmɐʎ̱ɐ/	[diˈmæj̱ɐ]
(d)	Inês	2;0.11	colo	lap	/ˈkɔḻu/	[ˈkɔɾ̱u]
(e)	Joana	2;0.9	linda	beautiful	/ˈḻidɐ/	[ˈṉiɲɐ]
(f)	Joana	2;4.1	mala	bag	/ˈmaḻɐ/	[ˈmaw̱ɐ]
(g)	Joana	2;8.5	sala	room	/ˈsaḻɐ/	[ˈsaw̱ɐ]
(h)	Luma	1;3.5	lua	moon	/ˈḻuɐ/	[ṉːɐ]
(i)	Luma	2;5.15	vela	candle	/ˈvɛḻɐ/	[ˈvɛṉɐ]
(j)	Luma	2;6.27	amarelo	yellow	/ɐmɐˈɾɛḻu/	[maˈjɛj̱u]
(k)	João	1;7.20	bola	ball	/ˈbɔḻɐ/	[ˈbɔj̱a]
(l)	João	1;9.25	bolo	cake	/ˈboḻu/	[ˈboːj̱u]

The replacement of laterals by glides is illustrated in the data provided from (a) to (c), (f), (g) and from (j) to (l). The substitution of laterals by nasals is illustrated in (e), (h) and (i). As for the less frequent substitution of laterals by rhotics in the speech of Inês, it is exemplified in (d). Note that most cases of Lat->Sonor occur in C2 position. As will be shown further below, a similar pattern will be observed for the substitutions affecting rhotics.

As for the replacement of laterals by stops, it is the most frequent type of substitution affecting laterals in Clara's data (but note that there are only 7 cases) and it is the second most frequent in the other children's *corpora*. Some examples are provided in (48).

(48) Examples of Lat -> Stop substitutions

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Clara	1;9.23	borboleta	butterfly	/buɾbuˈl̲etɐ/	[bɐjˈd̲eːtɐ]
(b)	Clara	1;10.15	bola	ball	/ˈbɔl̲ɐ/	[ˈbɔb̲ɐ]
(c)	Inês	1;10.29	bolo	cake	/ˈbol̲u/	[ˈbod̲u]
(d)	Inês	2;1.10	luz	light	/ˈl̲uʃ/	[ˈd̲oʃ]
(e)	Inês	2;4.18	castelo	castle	/kɐʃˈtɛl̲u/	[kɐˈted̲u]
(f)	Joana	2;2.19	lavar	to wash	/l̲ɐˈvaɾ/	[g̲ɐˈva]
(g)	Joana	2;10.8	língua	tongue	/ˈl̲ĩgwɐ/	[ˈg̲ẽguɐ]
(h)	João	1;10.11	galo	rooster	/ˈgal̲u/	[ˈdaːd̲u]
(i)	João	1;11.1	Lila	prop.nou	/ˈl̲ilɐ/	[ˈt̲idɐ]
(j)	João	2;0.20	ali	there	/ɐˈl̲i/	[ɐˈt̲i]
(k)	Luma	2;3.26	lobo	wolf	/ˈl̲obu/	[ˈb̲obu]
(l)	Luma	2;3-2;4	ali	there	/ɐˈl̲i/	[ɐ̃ˈd̲i]

Note that, contrary to the replacement of laterals by another sonorant, the substitution of laterals by stops occurs both in word-initial and in intervocalic position. This issue will be explored further below, together with the substitution patterns affecting rhotics.

Substitutions affecting rhotics

As shown in section 3.5.1, rhotics are acquired only by Inês and Joana, at the age of 3;11 and 4;7, respectively. The table given in (49) provides the total of manner feature substitutions affecting rhotics in each child *corpus*, in the period preceding acquisition. The number and percentage of occurrence of each manner substitution type is also provided (see appendix D).

(49) Manner substitutions affecting rhotics (appendix D)

	Inês	**Joana**	**Luma**	**Clara**	**João**
Age	Until 3;11	Until 4;7	Until 2;6	Until 1;10	Until 2;0
Total Nº	315	153	34	15	40
Type	Rhot-> Lat	Rhot-> Stop	Rhot-> Glide	Rhot-> Lat	Rhot-> Glide
Occur. (%)	205 (65%)	60 (39%)	22 (65%)	9 (60%)	23 (57%)
Type	Rhot->Stop	Rhot->Lat	Rhot-> Lat	Rhot-> Nas	Rhot-> Stop
Occur. (%)	101 (32%)	35 (23%)	9 (26%)	4 (27%)	8 (20%)
Type	Rhot ->Fric	Rhot -> Glide	Rhot->Stop	Rhot-> Stop	Rhot-> Lat
Occur. (%)	6 (2%)	30 (20%)	2 (6%)	2 (13%)	6 (15%)

Except for Joana's data, the predominant substitution pattern affecting rhotics is of the type Rhotic->Sonorant: the target rhotic is produced as a lateral (Inês, Clara) or a glide (Luma, João). Again, children tend to preserve the [+sonorant] specification of the target liquid in their output forms. Some examples are provided in (50).

(50) Examples of Rhotic -> Sonorant substitutions

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Inês	1;10.29	agora	now	/ɐˈɡɔɾɐ/	[ˈɡɔlɐ]
(b)	Inês	2;1.10	quero	(I) want	/ˈkɛɾu/	[ˈkɛlu]
(c)	Inês	2;4.18	carro	car	/ˈkaʀu/	[ˈkalu]
(d)	Joana	2;0.9	rei	king	/ˈʀɐj/	[ˈnɐj]
(e)	Joana	2;6.24	pêras	pears	/ˈpeɾɐʃ/	[ˈpejɨs]
(f)	Joana	3;0.2	choro	(I) cry	/ˈʃɔɾu/	[ˈʃɔːju]
(g)	Luma	2;4.25	espera	wait	/ʃˈpɛɾɐ/	[ˈpɛjɐ]
(h)	Luma	2;5.20	escuro	dark	/ʃˈkuɾu/	[ˈkuju]
(i)	Luma	2;6.20	chorou	cried	/ʃuˈɾo/	[ʃuˈlo]
(j)	Clara	1;7.11	Aurora	prop.nou	/awˈɾɔɾɐ/	[lɐˈlɔlɐ]
(k)	Clara	1;10.15	Aurora	prop.nou	/awˈɾɔɾɐ/	[ˈnɔlɐ]
(l)	João	1;10.26	adora	loves	/ɐˈdɔɾɐ/	[ˈdɔjɐ]
(m)	João	1;11.19	carro	car	/ˈkaʀu/	[ˈtaju]
(n)	João	2;0.20	burro	donkey	/ˈbuʀu/	[ˈbuwu]

As for the substitution of rhotics by stops, it is an infrequent pattern in the data of Luma, Clara and João (same or below 20%). However, this type of substitution occurs relatively often in the data of the other two children (Inês - 32%; Joana - 39%). Some examples of Rhot->Stop in those two children's *corpora* are given in (51).

(51) Examples of Rhotic ->Stop substitutions -Joana and Inês

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Inês	1;10.29	agora	now	/ɐˈɡɔɾɐ/	[ɐˈɡɔdɐ]
(b)	Inês	2;4.18	rua	street	/ˈʀuɐ/	[ˈɡuɐ]
(c)	Inês	2;10.20	rádio	radio	/ˈʀadiu/	[ˈɡadju]
(d)	Inês	3;0.15	escorrega	slide	/ʃkuˈʀɛɡɐ/	[tuˈdɛɡɐ]
(e)	Inês	3;4.6	rainha	queen	/ʀɐˈiɲɐ/	[ɡɐˈiɲɐ]

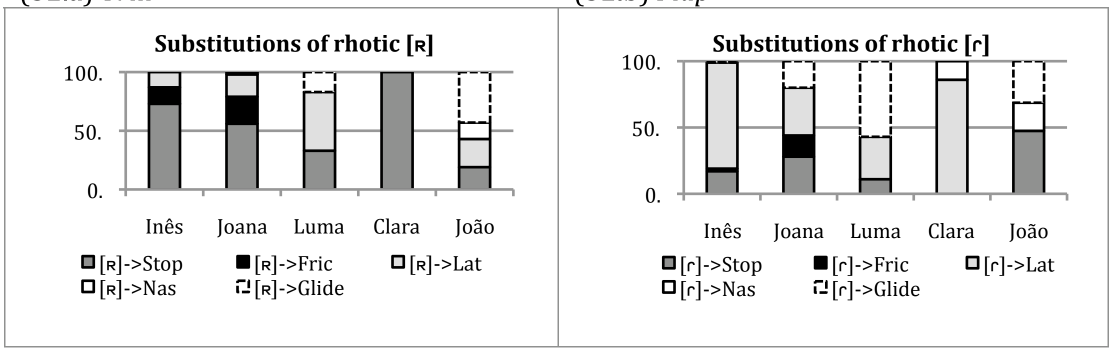
(f)	Inês	3;7.29	ora	well	/ˈɔɾ̱ɐ/	[ˈɔḏɐ]
(g)	Joana	2;6.24	Romeu	prop.noun	/ʀ̱uˈmew/	[ṯʲuˈnɛ]
(h)	Joana	2;10.8	era	it was	/ˈɛɾ̱ɐ/	[ˈɛḏɐ]
(i)	Joana	3;0.26	renas	reindeer	/ˈʀ̱enɐʒ/	[ˈɡ̱enɐz]
(j)	Joana	3;6.20	Paris	Paris	/pɐˈɾ̱iʃ/	[peˈɡ̱isː]
(k)	Joana	4;0.13	barriga	belly	/bɐˈʀ̱iɡɐ/	[bɐˈḏiɡɐ]

Since substitution patterns have been used as an argument for the distinction between the trill and the flap in Brazilian children's systems (in terms of sonority, see section 3.1.2), we will focus on the type of substitutions that affect the two rhotics, individually.

The two graphs provided in (52) present the frequency of occurrence of each substitution pattern affecting the trill (52.a) and the flap (52.b).

(52) Substitutions affecting rhotics (appendix D)

(52.a) *Trill* (52.b) *Flap*



As shown in (52.a), the trill is predominantly replaced by a stop (or a fricative, in the case of Joana) in the data of three children: Inês, Joana and Clara.[18] In the data of Luma and João, the trill can also be replaced by a stop, but is predominantly produced as a lateral or a glide. Luma and João tend to preserve the [+sonorant] specification of the target rhotic in their production, while Inês, Joana and Clara tend to replace the target sonorant by a [-sonorant] (stop or fricative).

As for the flap (see 52.b), it is more often replaced by a sonorant (lateral, glide or nasal), in the data of Inês, Luma and Clara (in above 80% of the cases). As for Joana and João, the number of substitutions by sonorants and by obstruents is more or less even (around 50% of the cases, for each major type of substitution).

Based on the predominant patterns explored above, the following generalizations can be made: (i) substitutions by stops tend to affect the trill more often than the flap; (ii) substitutions by sonorants tend to affect the flap more often than the trill. Children appear to preserve the [+sonorant] specification more often when the target is a flap than when the target is a trill. These observations could corroborate the

[18] Note that, in Clara's *corpus*, the 100% of Trill->Stop corresponds to 2 occurrences only (see appendix D).

analysis presented in BP (see section 3.1.2), where the trill is assumed to have a lower degree of sonority than the flap, being replaced by sounds that are closer to it on the sonority scale (obstruents). However, it might be the case that word-position is also playing a role in these substitution patterns. This issue will be further explored in the next subsection.

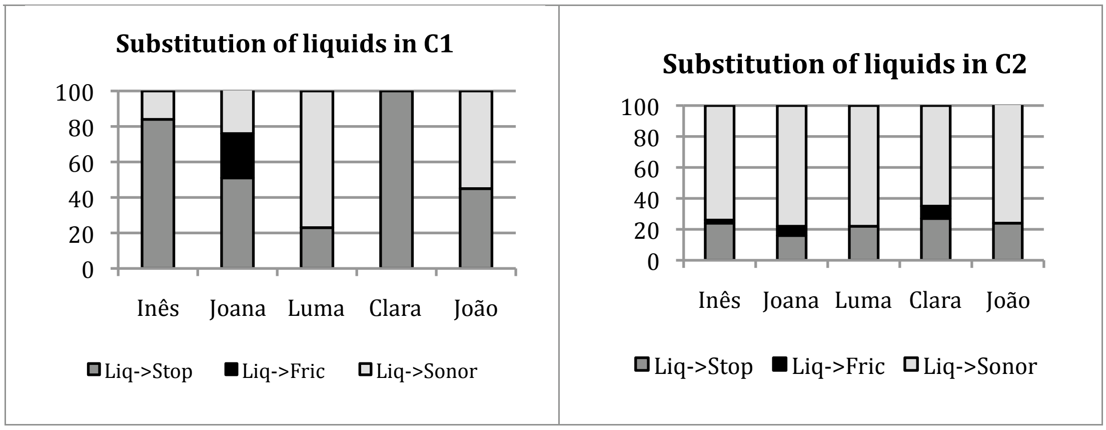
Relation between type of substitution and word position: liquids

As shown above, children tend to replace liquids (both laterals and rhotics) by another sonorant, most often a nasal or a glide. However, substitutions of liquids by non-sonorants (fricatives and, more frequently, stops) are also common, particularly in the data of some of the children studied (see tables in (46) and (49)). The question that will be addressed in this subsection is if word-position can be related to the type of substitution observed, for instance, if there is a privileged position for liquids to be replaced by sonorants.

The two graphs given below provide the frequency of occurrence of the three major types of substitutions affecting liquids: Liq->Stop; Liq->Fric and Liq->Sonor. This analysis is presented per word position: word-initial (C1) in (53.a) and intervocalic (C2) in (53.b).

(53) Substitutions affecting liquids, per word-position (appendix D)

(53.a) C1 position (53.b) C2 position



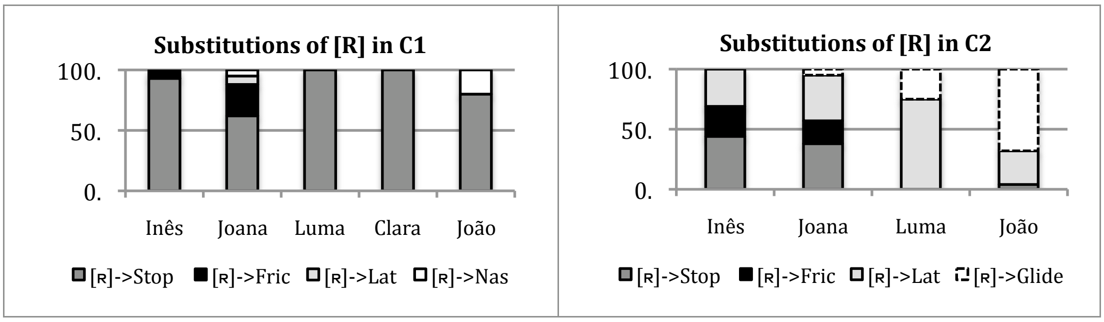
As shown in (53.a), of all manner substitutions affecting liquids in C1, the most frequent type in the data of Inês and Clara is Liq->Stop. In Joana's data, the predominant pattern in C1 is also the replacement of liquids by a non-sonorant consonant, either a stop (around 50%) or a fricative (25%). In João's *corpus*, word-initial liquids can either be replaced by a stop or by a sonorant (a glide). As for Luma's data, liquids in C1 are predominantly replaced by a sonorant (a nasal or a glide).

Focusing on the C2 position (see graph in (53.b), above), there is a clear preference for liquids to be replaced by a sonorant, in all children's data.

In sum, there is a preference for the substitutions of liquids by another sonorant to occur in C2 (attested across all subjects) and the substitutions of liquids by a stop to occur in C1 (observed in the data of three of the children). It thus seems that the type of substitution pattern can be influenced by word-position: C2 seems to promote substitutions of sonorants by other sonorants, while the replacement of sonorants by stops tends to occur more often in word-initial position.

We will now focus on the substitutions that affect the trill. The question we want to pose here is if the preference for the trill to be replaced by a stop can be related to word position. The graphs provided in (54) show the frequency of occurrence of each type of manner substitution affecting the trill in C1 (54.a) and in C2 (54.b). Note that there are no substitutions of the trill in C2 in Clara's *corpus*.

(54) Substitutions of the trill, per word-position (appendix D)



The analysis of the two graphs given above shows that, in word-initial position, the overwhelming majority of the substitutions affecting the trill are of the type trill->obstruent (most often a stop). In the C2 position, the number of substitutions of the type trill->sonorant increases; it becomes the most frequent substitution pattern in the data of Luma and João (between 95% and 100% of the cases) and it surpasses the level of 30% in the *corpus* of Inês and Joana. It thus seems that C2 position promotes the substitution of the trill by another sonorant. However, this is not a 100% predictable pattern, in the sense that all intervocalic trills would be replaced by a sonorant and all word-initial trills will be replaced by a stop. Note that, in the data of Inês and Joana, trills are predominantly replaced by a stop (or a fricative), independently of the word position they occur in.

In summary, the following trends were observed in the substitutions of manner features: (i) fricatives are mostly replaced by stops; (ii) liquids tend to be replaced by sonorants more often than by stops or fricatives; (iii) the substitution of liquids by stops tends to occur more often in C1 than in C2.

Substitutions affecting place features

In this subsection, we will focus on the substitution patterns that affect place features. In section 3.5.1, we observed that the three major place features (Labial, Coronal and Dorsal) are acquired early (in most cases, until 2;0). This early acquisition, added to the fact that, in the first recording sessions, substitutions are not frequent (since target selection, syllable truncation and reduplication are the predominant alternative output forms – see chapter 6), results in a low number of substitution patterns affecting place features. However, in some cases, we identified some general trends in the substitutions that occur across the five children's *corpus*. Those trends are explored below, per place feature.

Substitutions affecting labials

Before being acquired, labials are not often submitted to substitution patterns that change place feature specification. This type of substitution occurs mostly in the data of Luma, as can be seen in appendix D. In all cases, the substitution observed is Lab->Coronal, where the target labial is produced as a coronal [+ant] consonant. These cases are illustrated in (55).

(55) Examples of Labial ->Coronal substitutions - Luma

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Luma	1;3.19	pato	duck	/ˈpatu/	[ˈtat]
(b)	Luma	1;9.29	Pati	prop.noun	/paˈti/	[taˈti]
(c)	Luma	1;10.18	vovô	Granddad	/voˈvo/	[toˈto]
(d)	Luma	1;11.15	Miguel	prop.noun	/miˈgɛɫ/	[niˈɛ]

Substitutions affecting coronals

Substitutions affect mostly coronal [-anterior] target consonants, since coronals [+ant] are acquired relatively early. Coronal [-ant] consonants tend to surface as labials (Joana, Luma and João) or as dorsals (Inês) (see appendix D). In Luma's data, the predominant substitution affecting coronal [-ant] is of the type Cor[-ant]->Cor[+ant], showing that the child has already acquired coronals but there is still some variability in the mastery of the [±anterior] contrast. The number and percentage of the substitutions that affect coronals is provided in (56), per child (no data available on this issue in Clara's *corpus*).

(56) Place substitutions affecting Coronal (appendix D)

	Inês	**Joana**	**Luma**	**João**
Age	Until 2;11	Until 2;4	Until 2;6	Until 1;7
Total Nº	11	4	42	9
Type	Cor[-ant]-> Dor	Cor[-ant]-> Lab	Cor[-ant]-> Cor[+ant]	Cor[+ant]-> Lab
Occur. (%)	9 (82%)	4 (100%)	27 (64%)	9 (100%)
			Cor[-ant]-> Lab	
			11 (26%)	

Some examples of the substitutions listed above are provided in (57).

(57) Examples of place substitutions affecting coronals

	Child	Age	Orthogr	Gloss	Target	Output	Pattern
(a)	Inês	1;9.19	colher	spoon	/kuˈʎ̲ɛɾ/	[keˈɣ̲ɛlɘ]	[-ant]->Dor
(b)	Inês	2;1.10	laranja	orange	/lɐˈɾɐ̃ʒ̲ɐ/	[dɐˈɾɐg̲ɐ]	[-ant]->Dor
(c)	Joana	2;0.9	João	prop.noun	/ʒ̲uˈɐ̃w̃/	[β̲ɐˈβɐ̃ũ]	[-ant]->Lab
(d)	Luma	2;4.11	ajuda	helps	/ɐˈʒ̲udɐ/	[v̲uˈdaː]	[-ant]->Lab
(e)	Luma	2;0.27	chichi	pee	/ʃ̲iˈʃ̲i/	[s̲iˈs̲iː]	[-ant]->[+ant]
(f)	Luma	2;3.26	suja	dirty	/ˈsuʒ̲ɐ/	[suz̲ɐ]	[-ant]->[+ant]
(g)	João	1;7.20	bola	ball	/ˈbɔl̲ɐ/	[ˈbow̲ɐ]	[+ant]-> Lab

Substitutions affecting dorsals

As shown in section 3.5.1, Dorsal is the last place feature acquired by the five children. In the period preceding acquisition, dorsals are predominantly submitted to one type of substitution: Dor->Cor, where the target dorsal is produced as a coronal consonant (most often a coronal [+ant], see appendix D). The number and percentage of these substitutions is given below, per child (no data available in Clara's *corpus*).

(58) Place substitutions affecting Dorsal (appendix D)

	Inês	**Joana**	**Luma**	**João**
Age	Until 1;10	Until 2;6	Until 2;3	Until 2;0
Total Nº	21	10	21	110
Type	Dor-> Cor	Dor-> Cor	Dor-> Cor	Dor-> Cor
Occur. (%)	18 (86%)	6 (60%)	21 (100%)	98 (89%)

Some examples of the Dor->Cor substitutions are provided in (59).

(59) Examples of Dorsal ->Coronal substitutions

	Child	Age	Orthogr.	Gloss	Target	Output
(a)	Inês	1;7.2	aqui	here	/ɐˈk̲i/	[ɐˈd̲i]
(b)	Inês	1;9.19	boneca	doll	/buˈnɛk̲ɐ/	[βɐˈnɛt̲ɐ]
(c)	Joana	2;0.9	rei	king	/ˈʀ̲ɐj/	[ˈɲ̲ɐj]
(d)	Joana	2;2.19	colher	spoon	/k̲uˈʎɛɾ]	[d̲uˈɲɛj]
(e)	Luma	2;2.22	gato	cat	/ˈg̲atu/	[t̲atu]

(f)	Luma	2;3.26	Goldi	prop.noun	/ˈ<u>g</u>o͡ldi/	[ˈ<u>d</u>odi]
(g)	João	1;11.19	pouco	few	/ˈpo<u>k</u>u/	[ˈpo<u>t</u>u]
(h)	João	2;0.20	cuidado	be careful	/<u>k</u>ujˈdadu/	[<u>d</u>iˈdadu]

It is worth noticing that, particularly in Inês' *corpus*, dorsals are also affected by another production strategy, where the target dorsal is produced accurately but not in the expected word-position. These cases occur when a C1 dorsal appears in combination with a C2 labial, for instance in words like *copo* (glass), produced as [ˈkɔpu]->[ˈpɔku] (1;8.2). This metathesis pattern shows that, at this age, the child is dealing with linearity restrictions of place features, which will be explored in detail in chapter 5.

In sum, three main observations can be made, regarding the substitution of place features: (i) Labial is the least affected feature, across children; (ii) Coronal is the second least affected, although there are some cases of substitution of coronals by labials or of cor[-ant] produced as [+ant]; (iii) the most affected feature across children is Dorsal, which is most frequently replaced by coronals.

At this point, we have observed the general order of acquisition of place and manner features and have focused on the most frequent substitutions that cause place or manner change. We will now turn to the analysis of the intake and developmental patterns within each manner feature.

3.5.3 The acquisition of stops

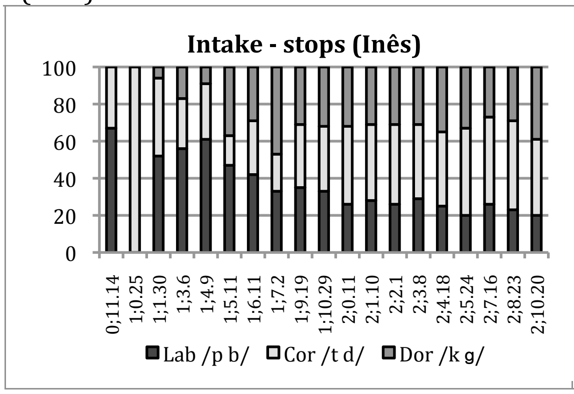
In this section, we analyze the acquisition of stops, in each child's *corpus*, focusing on the place features Labial, Coronal and Dorsal. We will start with the analysis of the distribution of stops in the target words selected (the intake), comparing it to the distribution of stops in the Spoken Portuguese speech sample. Then, we will focus on the development of target-like productions, analyzing the order of acquisition of place features. Finally, we will explore the time lag between the acquisition of the first and the last stop, across children.

Distribution of stops in the intake

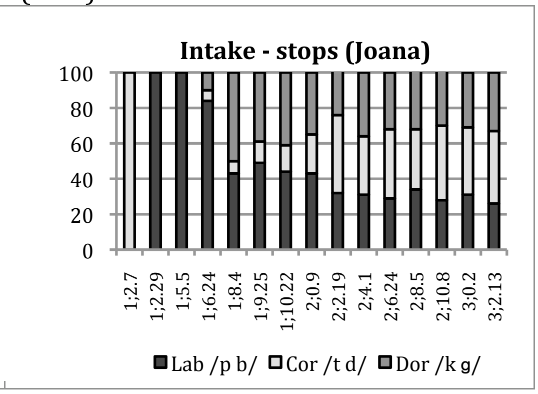
The five graphs given in (60) present the frequency of selection of stops in the target words attempted by each child, focusing on the three place features Labial, Coronal and Dorsal. In the case of Inês and Joana (graphs 60.a and 60.b), the graphs cover the period until the age at which all stops are considered acquired. For Luma, Clara and João (see graphs from 60.c to 60.e), who were studied for a shorter period of time, the graphs cover the whole *corpus*: Luma until 2;6, Clara until 1;10 and João until 2;0.

(60) Distribution of stops in the intake (C1 and C2 onset), per place feature (appendix E)

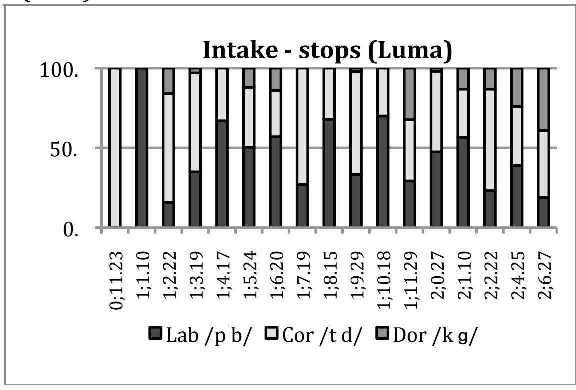
(60.a)



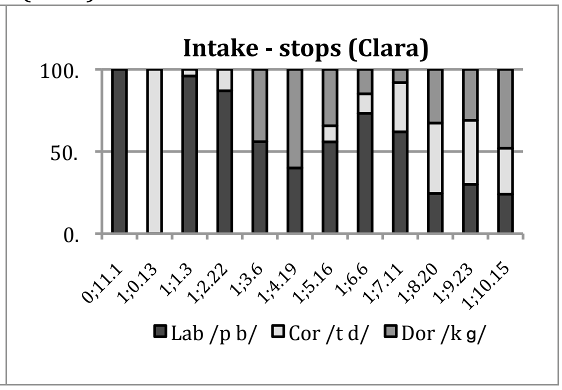
(60.b)



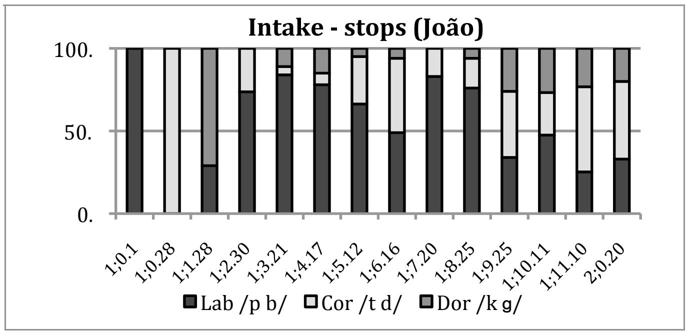
(60.c)



(60.d)



(60.e.) João



The graphs presented above show a common aspect in children's speech: the frequency of selection of stops in the first sessions differs from the intake patterns that appear in later ages. In general, children tend to select labial stops more often in the first period and there is much variability from one session to the other; then, gradually, the frequency of selection of the three place features becomes more evenly distributed. Inês, for instance, starts by selecting labial stops more often until 1;4 (around 60%); then, between 1;5 and 1;7, two features predominate in the target words selected by this child: labial and dorsal. It is only from 1;8 onwards that the distribution between the three features becomes more even (dorsal and coronal in around 40% each and labial 30%) and that the degree of variability from one session to the other decreases. This pattern of initial variability, followed by a gradual tendency to a more even distribution is found in the intake of all children. For ease of exposition, we will refer to that initial period as intake 1 and to the following sessions as intake 2. In (61), we present the time frame covered by both intake-periods, in each child's *corpus*.

(61) Identification of two main periods in the selection of stops

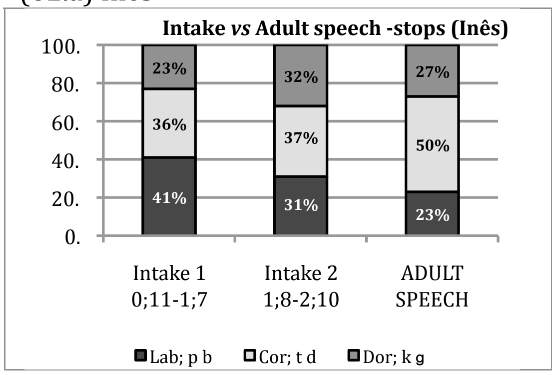
	Intake 1	Intake 2
Inês	0;11-1;7	from 1;8
Joana	1;2-1;6	from 1;8
Luma	0;11-2;1	from 2;2
Clara	0;11-1;7	from 1;8
João	1;0-1;8	from 1;9

A question that arises now is how both intake-periods relate to the adult language, namely if the distribution of stops in these children's intake resemble the frequency of occurrence of stops in adult speech.

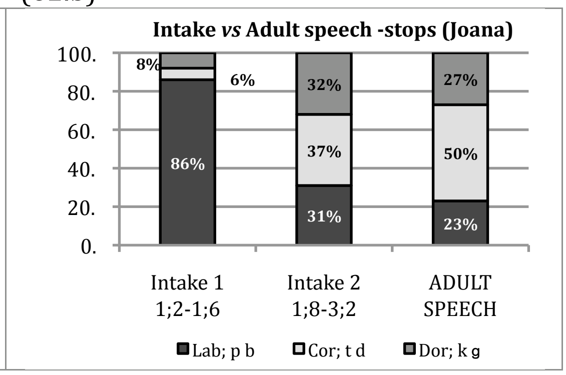
In the graphs given in (62) we provide a comparison between the frequency of selection of stops in each child's *corpus* (intake 1 and intake 2) and the distribution of stops in the sample of adult speech (see section 3.4).

(62) Distribution of stops in adult speech and in children's intake (C1 and C2 onsets) (appendixes B and E)

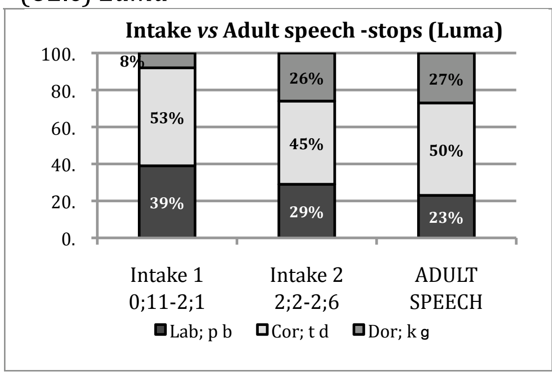
(62.a) Inês



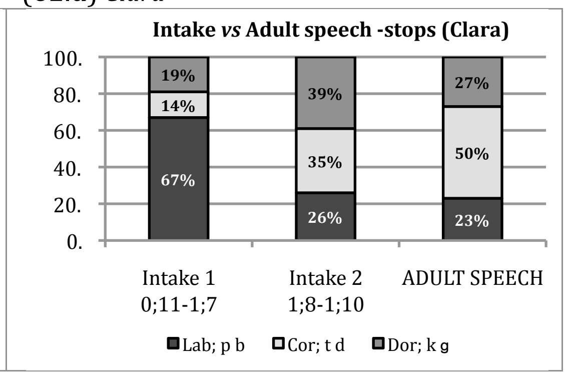
(62.b)



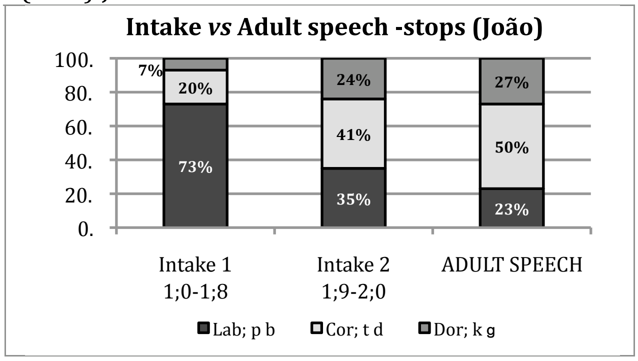
(62.c) *Luma*



(62.d) *Clara*



(62.e) João



In the sample of adult speech (see column at the right, in each graph), 50% of all stops produced are coronal, 27% are dorsal and 23% are labial. Thus, the distributional hierarchy of stops in the adult speech sample is the following: Cor>>Dor>>Lab. In (63), this hierarchy can be compared to the distribution of stops in each child's intake, both in the first sessions (Intake 1) and later ages (Intake 2).

(63) Distributional hierarchy of stops: intake 1, intake 2 and adult speech

	Intake 1	Intake 2	ADULT
Inês	Lab>>Cor>>Dor	Cor>>Dor>>Lab	Cor>>Dor>>Lab
Joana	Lab>>Dor>>Cor	Cor>>Dor>>Lab	
Luma	Cor>>Lab>>Dor	Cor>>Lab>>Dor	
Clara	Lab>>Dor>>Cor	Dor>>Cor>>Lab	
João	Lab>>Cor>>Dor	Cor>>Lab>>Dor	

As shown above, the selection of stops in intake 2 in the data of Inês and Joana coincides with the distribution of stops in the sample of adult speech: coronals are the most frequent, followed by dorsals and finally by labials. Note, however, that this matching between adult speech and intake is not found if we focus only on the first sessions (intake 1). In fact, both Inês and Joana select labial more often than any other feature in the first sessions.

The mismatch between the adult speech sample and initial intake patterns is observed also in the data of the other three children: Clara and João attempt labials more often than any other feature; Luma matches the adult data regarding the predominance of coronals, but differs in the fact that she selects labials more often than dorsals. In intake 2 (after 1;8), Clara and João get closer to the distribution in the adult sample: they start attempting coronals more frequently than labials. However, labial is still more frequent than dorsal. As for Luma, no difference has been found between the first and the second period, in terms of distribution of place features.

It is worth noticing that, within stops, the least frequently produced feature in the adult speech sample (labial) is exactly the most frequently attempted in the first sessions by most children (all, except for Luma). This predominance of labial stops in the first sessions is related to a small set of words that is recurrently attempted in early ages, namely *papa, bebé, pai, pé, papá*. Gradually, the set of words attempted increases, leading (in most children's data) to a decrease in the frequency of labials and to an increase in the frequency of coronals and dorsals. This issue will be further discussed in section 3.6.

Except for the data of Luma, intake 2 coincides with distributional patterns in adult speech more clearly than intake 1. In the case of Inês and Joana, intake 2 matches the adult sample. Luma, Clara and João were studied for a shorter period of time and this is probably the cause for the fact that their intake 2 patterns still do not match the distribution in adult speech.

The development of target-like productions

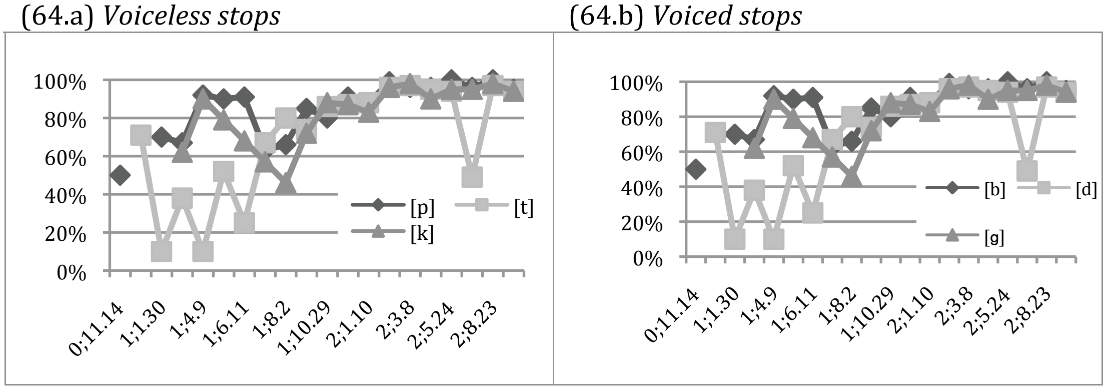
In this section, we present the frequency of occurrence of target-like productions for stops, in each child's *corpus*. Although the focus of this investigation is on place features, we will also refer to voicing subcategories, since some children tend to acquire place within subcategories determined by voicing.

A. INÊS

Inês acquires voiceless stops before voiced ones; this order can be observed in the graphs given in (64), which show the percentage of target-like productions of voiceless (graph 64.a) and voiced stops (graph 64.b).

(64) Target-like productions of stops – Inês (appendix C)

(64.a) *Voiceless stops* (64.b) *Voiced stops*



According to the criteria of acquisition adopted in this chapter (80% of correct productions; see section 3.4), Inês acquires [p] at 1;4 and [t k] at 1;10. Then, she acquires [b d] at 2;0 and, finally, [g] at 2;8. Thus, both within voiceless and voiced subcategories, Inês starts by acquiring labials or coronals; dorsals are either the last or amongst the last to be acquired.

Some examples of target-like productions for stops in Inês' data are provided in (65).

(65) Examples of target-like productions for stops – Inês

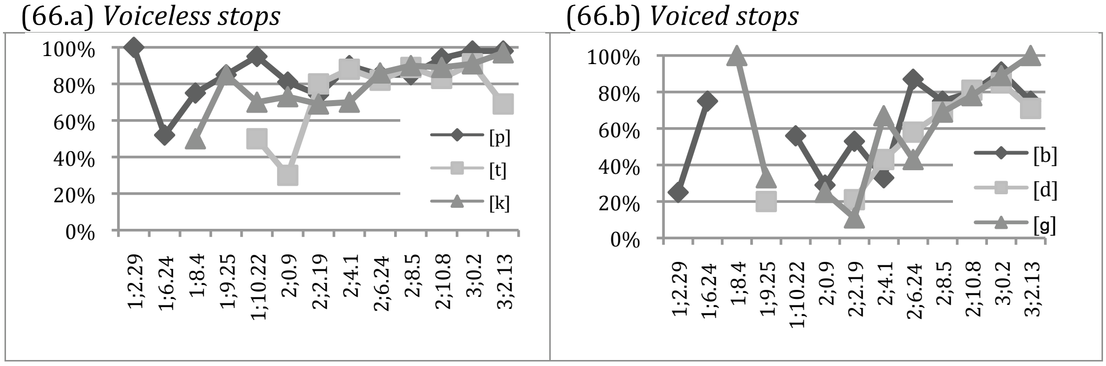
	Child	Age	Orthogr.	Gloss	Target	Output		
(a)	Inês	1;4.9	pêlo	fur	/ˈpelu/	[ˈpe]	/p/ ->	[p]
(b)	Inês	1;10.29	tem	has	/ˈtɐ̃j̃/	[ˈtɐ̃j̃]	/t/ ->	[t]
(c)	Inês	1;10.29	aqui	here	/ɐˈki/	[ˈki]	/k/ ->	[k]
(d)	Inês	2;0.11	boca	mouth	/ˈbokɐ/	[ˈbukɐ]	/b/ ->	[b]
(e)	Inês	2;0.11	dois	two	/ˈdojʃ/	[ˈdoʃː]	/d/ ->	[d]
(f)	Inês	2;8.23	lugar	place	/luˈgaɾ/	[luˈga]	/g/ ->	[g]

B. JOANA

Similarly to Inês, Joana acquires voiceless stops before voiced ones. The graphs given in (66) show the percentage of target-like productions of voiceless (graph 66.a) and voiced stops (graph 66.b), in this child's data.

(66) Target-like productions of stops – Joana (appendix C)

(66.a) *Voiceless stops* (66.b) *Voiced stops*



Joana acquires [p] at 1;9, followed by [t] at 2;2 and [k] at 2;6. Then, voiced stops are acquired: [b] and [d] at 2;10 and [g] at 3;0. Within each group, labial stops are the first (or amongst the first) to be acquired, while dorsals are the last to appear. Some examples of accurate production of stops in Joana's speech are given in (67).

(67) Examples of target-like productions for stops - Joana

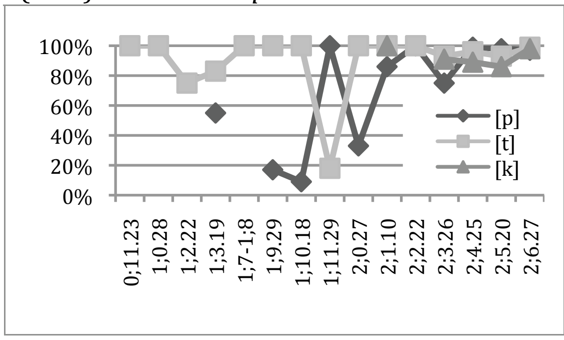
	Child	Age	Orthogr.	Gloss	Target	Output		
(a)	Joana	1;9.25	pai	father	/ˈpaj/	[ˈpaj]	/p/ ->	[p]
(b)	Joana	2;2.19	isto	this	/ˈiʃtu/	[ˈitu]	/t/ ->	[t]
(c)	Joana	2;6.24	querida	dear	/kɨˈɾidɐ/	[ˈkikɐ]	/k/ ->	[k]
(d)	Joana	2;10.8	barco	boat	/ˈbaɾku/	[ˈbaku]	/b/ ->	[b]
(e)	Joana	2;10.8	anda	walks	/ˈɐ̃dɐ/	[ˈɐ̃dɐː]	/d/ ->	[d]
(f)	Joana	3;0.26	gato	cat	/ˈgatu/	[ˈgatu]	/g/ ->	[g]

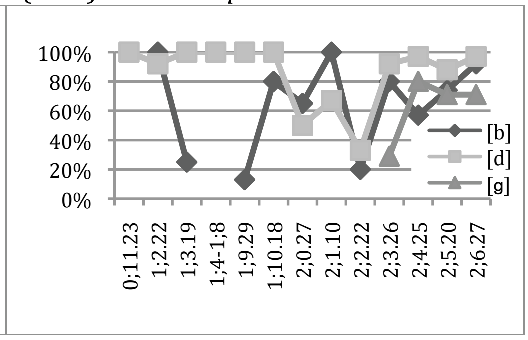
C. LUMA

The graphs given below show the percentage of target-like productions of stops in Luma's data, voiceless in (68.a) and voiced in (68.b).

(68) Target-like productions of stops – Luma (appendix C)

(68.a) *Voiceless stops* (68.b) *Voiced stops*





Contrary to the other children, Luma starts by acquiring a voiced stop: [d], at 1;2;[19] then she acquires the voiceless stops, in the order coronal >> labial >> dorsal: [t] at 1;8, [p] at 2;1 and [k] at 2;3. As for [b] and [g], they are already produced target like at the last session studied (see graph in 68.b), but they do not match the acquisition criteria of at least two consecutive months with 80% of accurate productions.

Some examples of accurate productions of stops in Luma's data are given in (69).

(69) Examples of target-like productions for stops - Luma

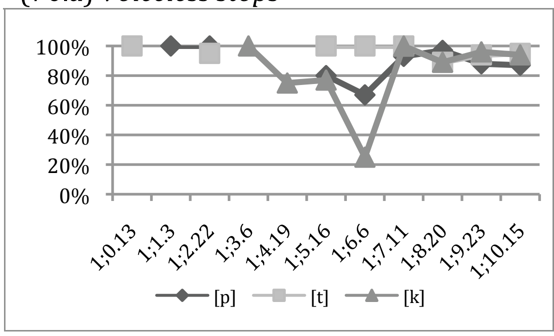
	Child	Age	Orthogr.	Gloss	Target	Output		
(a)	Luma	1;2.22	dá	give (me)	/ˈd̲a/	[ˈd̲a]	/d/ ->	[d]
(b)	Luma	1;8.15	está	is	/ʃˈt̲a/	[ˈt̲a]	/t/ ->	[t]
(c)	Luma	2;1.10	pé	foot	/ˈp̲ɛ/	[pɛˈp̲ɛ]	/p/ ->	[p]
(d)	Luma	2;3.26	cão	dog	/ˈk̲ɐ̃w̃/	[ˈk̲ɐ̃w̃]	/k/ ->	[k]

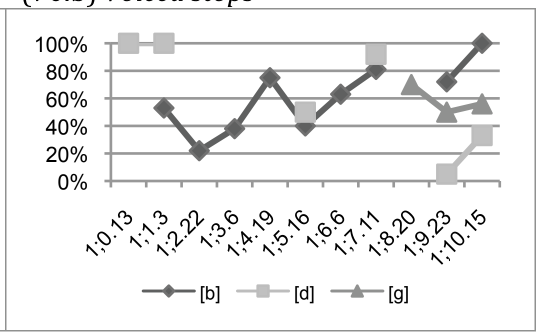
D. CLARA

The graphs provided below show the percentage of occurrence of target-like productions of stops in Clara's data, voiceless in (70.a) and voiced in (70.b).

(70) Target-like productions of stops – Clara (appendix C)

(70.a) *Voiceless stops* (70.b) *Voiced stops*





[19] This consonant is accurately produced from 0;11 but it is considered acquired only from 1;2, since the 100% of target-like production of [d] at 0;11 corresponds to one single occurrence – see appendix C.

As depicted above, Clara acquires only voiceless stops; this acquisition takes place in the order Labial >> Coronal >> Dorsal: [p] at 1;1, [t] at 1;5 and [k] at 1;7. Voiced stops are already produced, particularly [b], but not systematically above 80%, as shown in (70.b).

Some examples of accurate production of voiceless stops in Clara's speech are provided below.

(71) Examples of target-like productions for stops - Clara

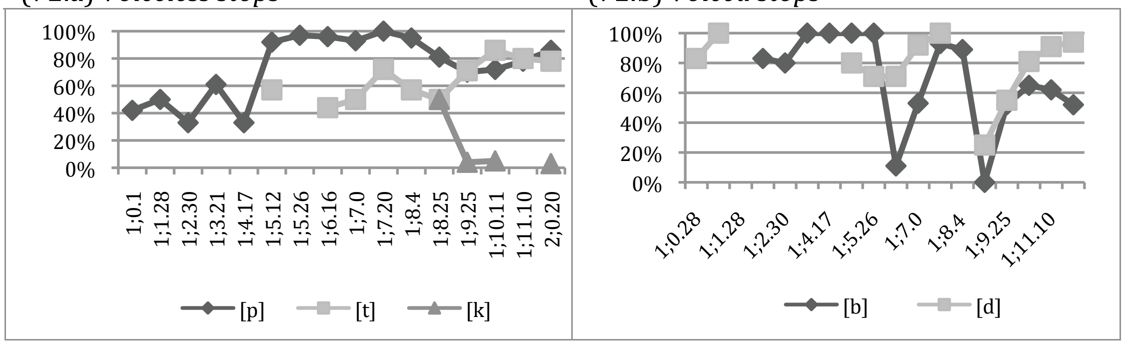
	Child	Age	Orthogr.	Gloss	Target	Output		
(a)	Clara	1;5.16	pé	foot	/ˈp̲ɛ/	[ˈp̲ɛ]	/p/ ->	[p]
(b)	Clara	1;5.16	sapato	shoe	/sɐˈpat̲u/	[pat̲u]	/t/ ->	[t]
(c)	Clara	1;7.11	aqui	here	/ɐˈk̲i/	[ˈk̲i]	/k/ ->	[k]

E. JOÃO

João acquires four stops, until the age of 2;0: two labials and two coronals. Within each homorganic pair, he acquires the voiced cognate first. The frequency of target-like productions of voiceless and voiced stops in João's *corpus* is given in (72.a) and (72.b).

(72) Target-like productions of stops – João (appendix C)

(72.a) *Voiceless stops* (72.b) *Voiced stops*



As shown above, João acquires labials first: [b] at 1;2 and [p] at 1;5. Then he acquires coronals: [d] at 1;7 and [t] at 1;10. Some examples of target-like productions for stops in João's data are provided in (73).

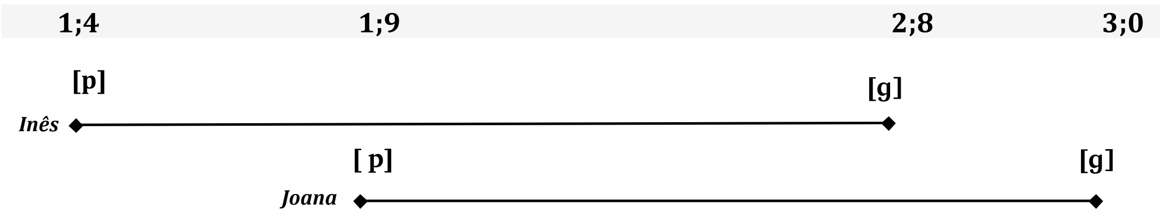
(73) Examples of target-like productions for stops – João

	Child	Age	Orthogr.	Gloss	Target	Output		
(a)	João	1;2.13	bola	ball	/ˈb̲ɔlɐ/	[ˈb̲ɐː]	/b/ ->	[b]
(b)	João	1;5.26	pau	stick	/ˈp̲aw/	[ˈp̲aw]	/p/ ->	[p]
(c)	João	1;7.20	dá	gives	/ˈd̲a/	[d̲ada]	/d/ ->	[d]
(d)	João	1;10.26	tia	aunt	/ˈt̲iɐ/	[ˈt̲iɐ]	/t/ ->	[t]

Lag in the acquisition of stops

The data described above showed that there is usually a long period of time between the age of acquisition of the first stop and the age of acquisition of the last element of this sound class. This lag becomes evident in the data of the two children who were studied for a longer period of time (Inês and Joana), where we were able to identify the beginning and end of acquisition of stops. This lag is depicted in (74).

(74) Lag between the acquisition of the first and the last stop (Inês and Joana) (appendix C)



As shown above, there is a protracted period of time (16 months, approximately) between the age of acquisition of the first stop ([p]) and the age when the last stop is acquired ([g]). It is worth noticing that these two children have already acquired the voiceless dorsal [k] (Inês at 1;10 and Joana at 2;6), as well as other voiced stops ([b d]: Inês at 2;0 and Joana at 2;10). It thus seems that, although these children are able to produce voiced stops on the one hand and dorsal [k] on the other, the co-occurrence of both feature combinations ([voiced, dorsal]) is problematic in their early phonological system. A similar co-occurrence restriction is likely to occur in the other three children's data since, at the last session studied, none of them has yet acquired the voiced dorsal stop.

3.5.4 The acquisition of nasals

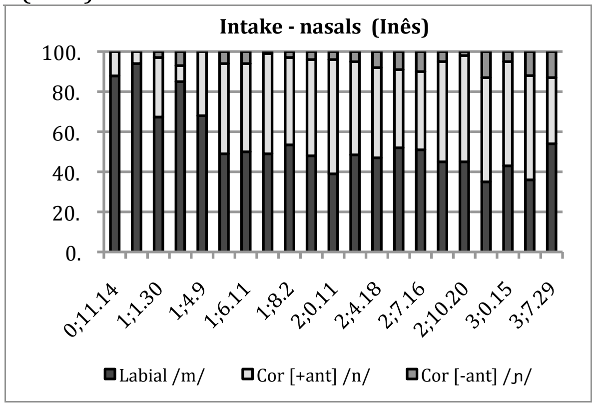
The current section describes the acquisition of nasals, in each child's *corpus*. We will start with an analysis of the frequency of nasals in the intake, comparing it to the distribution of stops in the Spoken Portuguese speech sample. Then we describe the development of target-like productions and explore the time lag between the acquisition of the first and the last nasal, across children.

Distribution of nasals in the intake

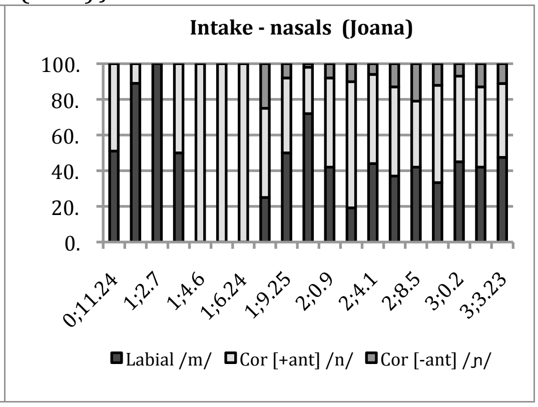
The five graphs provided in (75) present the frequency of nasals in the target words attempted by each child, per session.

(75) Distribution of nasals in the intake (C1 and C2 onset), per place feature (appendix E)

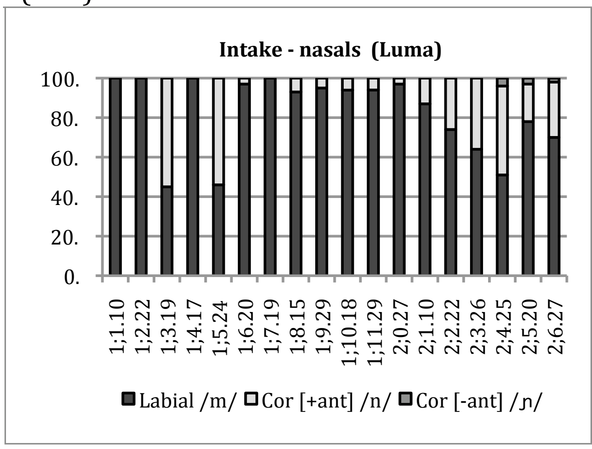
(75.a) *Inês*



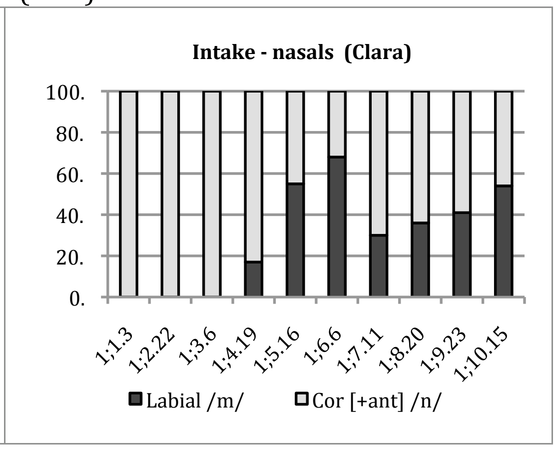
(75.b) *Joana*



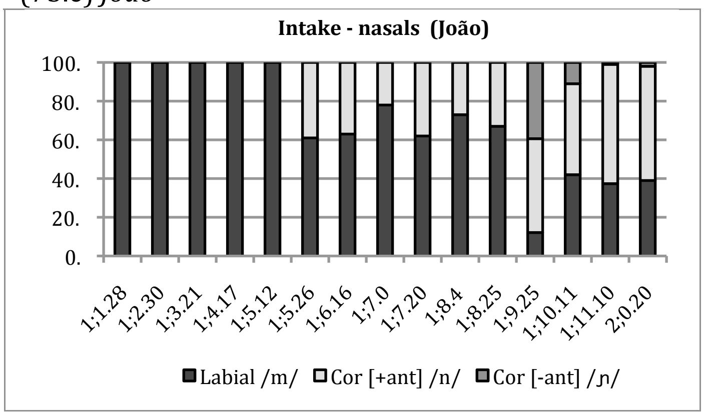
(75.c) *Luma*



(75.d) *Clara*



(75.e) *João*



As shown above, [ɲ] is infrequently attempted in all children's data. Note that there is no attempt of this consonant in Clara's speech, until the last session studied, at 1;10 (graph in (75.d)).

Similarly to what has been observed for stops, there are two different periods in the intake, in each child's *corpus*. For most children, the first period (intake 1) is characterized by the predominance (above 60%) of selection of one single nasal: [m] in the data of Inês, Luma and João and /n/ in the data of Clara. In Joana's *corpus*, the first period is characterized by variability: /m/ predominates in the first sessions (0;11-1;2) then /n/ becomes the most frequent (1;4-1;8) and then /m/ outranks coronal (1;9-1;10). The early predominance of /m/ in intake patterns results from the fact that two of the most frequently attempted words in early sessions are *mamã* and *mãe*.

In the second period (intake 2), the frequency of selection of /m/ and /n/ becomes more evenly distributed, particularly in the data of Inês and Joana: labial /m/ is attempted in around 40% of the cases, coronal /n/ is attempted in around 45% and palatal /ɲ/ is selected in about 10 or 15% of the cases. As for the other three children, Clara and João tend to attempt /m/ in about 40% of the cases and /n/ in the other 60%; there are some attempts of the coronal [-ant] in João's data, but mostly at 1;9. As for Luma, the preference for /m/ carries on in intake 2 (around 60 to 70% of the cases), but there is an increase in the frequency of selection of /n/ (from less than 10% in intake 1 to around 30% in intake 2). The table given in (76) provides the time frame covered by each intake period, in each child's *corpus*.

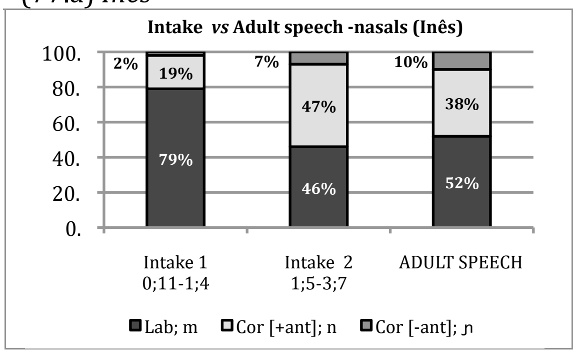
(76) Identification of two main periods in the selection of nasals

	Intake 1	Intake 2
Inês	0;11-1;4	from 1;5
Joana	0;11-1;10	from 2;0
Luma	1;1-2;2	from 2;3
Clara	1;1-1;4	from 1;8
João	1;1-1;8	from 1;9

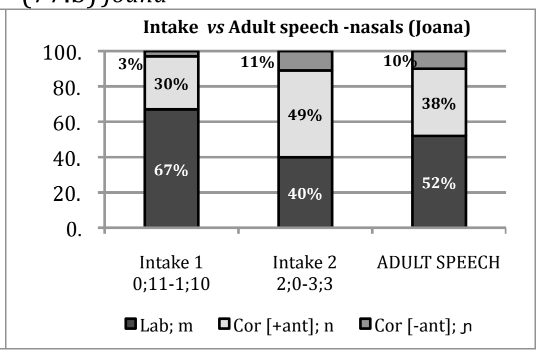
We will now compare the distribution of nasals in the two intake periods with the distribution of nasals in the sample of adult speech. Those distributional patterns are depicted in the five graphs given in (77).

(77) Distribution of nasals in adult speech and in children's intake (C1 and C2 onsets) (appendixes B and E)

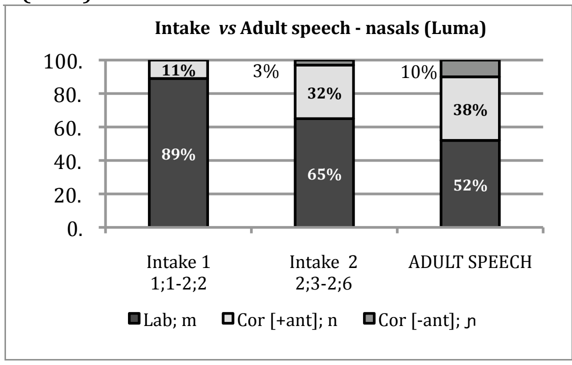
(77.a) *Inês*



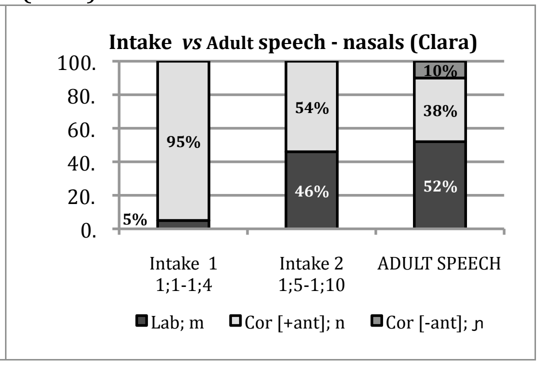
(77.b) *Joana*



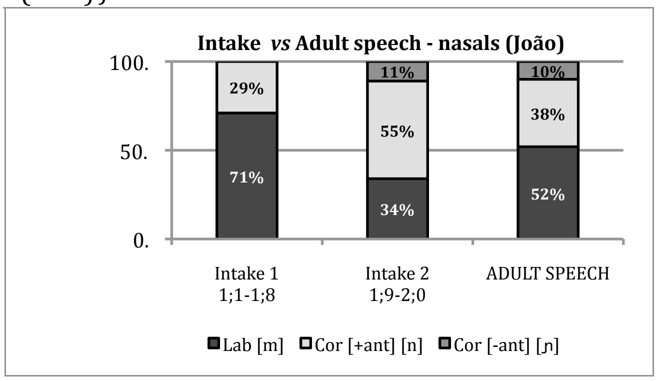
(77.c) *Luma*



(77.d) *Clara*



(77.e) *João*



In the sample of adult speech (see column at the right, in the graphs given above), 52% of all nasals produced are labial [m], while 38% correspond to coronal anterior [n] and only 10% refer to the coronal [-ant] [ɲ]. The distributional hierarchy of nasals in this *corpus* is as follows: [m]>>[n]>>[ɲ]. In (78), this hierarchy can be compared to the distribution of stops in the two intake periods observed in each child's *corpus*.

(78) Distribution of nasals in intake 1, intake 2 and adult speech

	Intake 1	Intake 2	ADULT
Inês	/m >> n >> ɲ/	/n >> m >> ɲ/	[m >> n >> ɲ]
Joana	/m >> n >> ɲ/	/n >> m >> ɲ/	
Luma	/m >> n/	/m >> n >> ɲ/	
Clara	/n >> m/	/n >> m/	
João	/m >> n/	/n >> m >> ɲ/	

At a first sight, it seems that intake 1 is closer to the distribution in adult speech than intake 2: except for Clara, /m/ is the most frequently attempted nasal in this initial period, followed by /n/ and finally by /ɲ/ (only Inês and Joana attempt the nasal [-ant] in this initial period). However, note that the frequency of selection of the labial nasal in this initial period is much higher than in adult speech (see graphs in (78)).

In intake 2, /n/ becomes the most frequently attempted nasal (except for Luma); the predominant frequency hierarchy in this period is /n >> m >> ɲ/, contrary to what is observed in adult speech. This sudden decrease of labial /m/ results from the expansion of the active vocabulary (which, in the first sessions, is very small). Even though words like *mamã* and *mãe* are still frequently attempted, there is also an increasing number of new target words attempted (namely the word *não*, which becomes frequently selected).

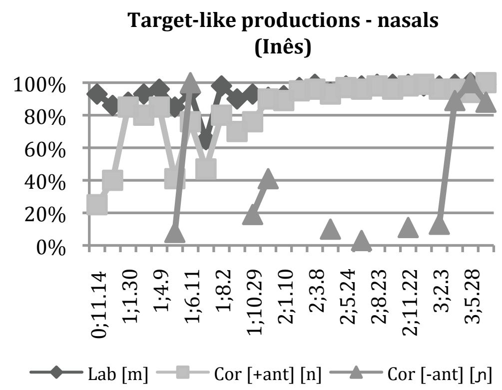
It is worth noticing that, despite of the sudden predominance of /n/ over /m/, intake 2 resembles adult speech more than intake 1, since the distribution of /m/ and /n/ becomes more even than in the previous period and the frequency of attempts of /ɲ/ increase (except for Clara).

The development of target-like productions

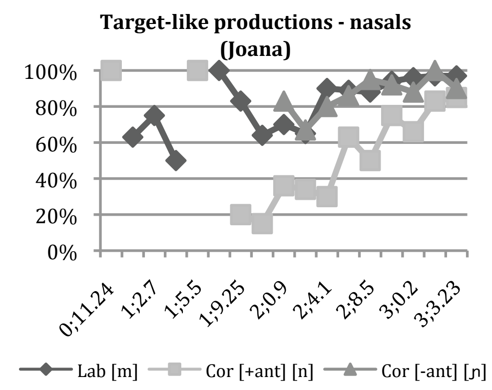
The graphs given in (79) show the percentage of target-like production of nasals (C1 and C2 onsets), per session, in each child's *corpus*.

(79) Target-like productions of nasals (appendix C)

(79.a) *Inês*

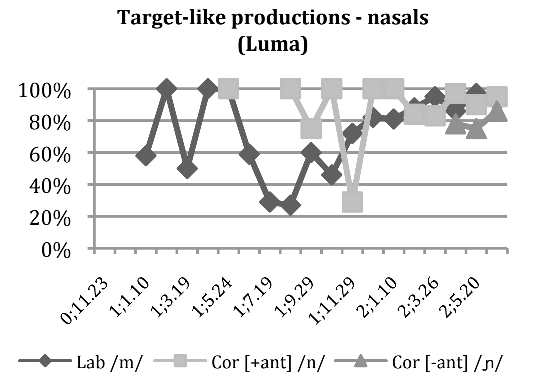


(79.b) *Joana*

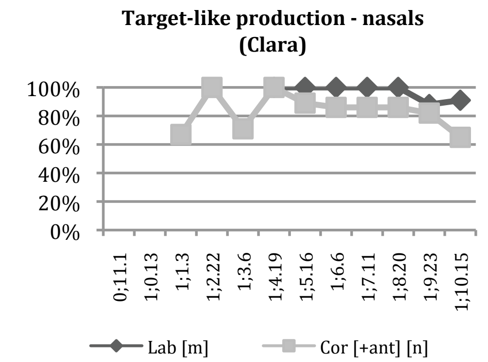


As shown in (79.a), Inês acquires nasals in the order Lab >>Cor [+ant] >> Cor [-ant]; she acquires [m] at 0;11, [n] at 1;1 and [ɲ] at 3;4. A different order is observed in the data of Joana (79.b): this child acquires labial [m] and coronal [ɲ] at the same age, at 2;4, followed by [n], at 3;2. In both cases, labial is either the first or amongst the first to be acquired.

(79.c) *Luma*

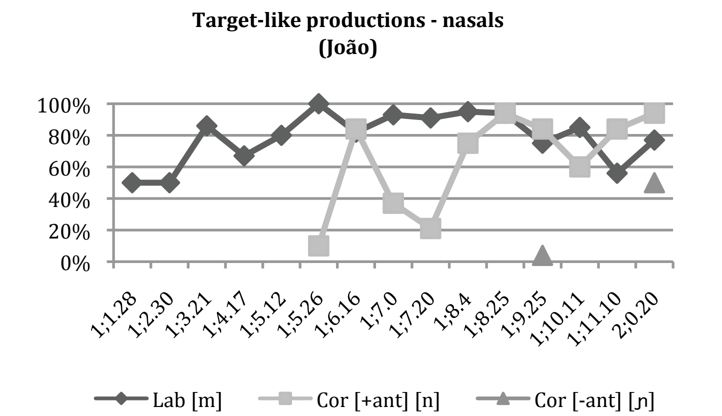


(79.d) *Clara*



As shown above, Luma and Clara do not acquire nasal [ɲ], until the last session studied. Luma acquires labial and coronal [+ant] nasals ([m n]) at the age of 2;0. As for Clara, she acquires [n] before [m], at 1;4 and 1;5, respectively.

(79.e) *João*



Similarly to Luma and Clara, João does not acquire nasal [ɲ] until the last session studied (at 2;0). Until that age, he acquires [m], at 1;5 and [n], at 1;8.

To sum up, there is a general preference for labial [m] and coronal [n] to be acquired first. On the contrary, the coronal [-ant] nasal tends to be the last to be acquired (except in Joana's data, where it is produced accurately before [n]).

Some examples of accurate productions of nasals are given in (80), taken from the five children's data.

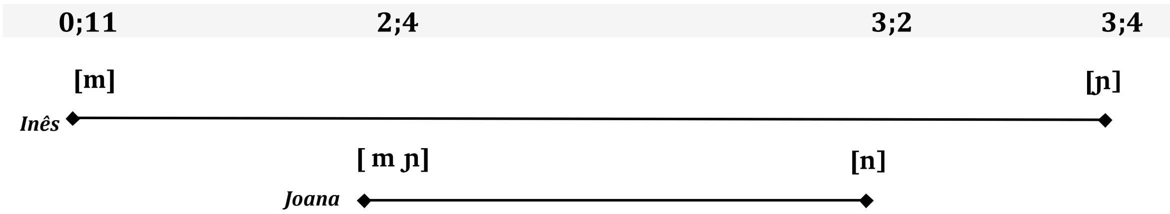
(80) Examples of target-like productions for nasals

	Child	Age	Orthogr.	Gloss	Target	Output			
(a)	Inês	0;11.14	mamã	mommy	/mɐˈmɐ̃/	[mɐˈmɐ̃]	/m/	->	[m]
(b)	Inês	1;1.30	Inês	Inês	/iˈneʃ/	[neˈne]	/n/	->	[n]
(c)	Inês	3;4.6	tenho	(I) have	/ˈtɐɲu/	[tɐɲu]	/ɲ/	->	[ɲ]
(d)	Joana	2;4.1	mala	bag	/ˈmalɐ/	[ˈmawɐ]	/m/	->	[m]
(e)	Joana	3;2.13	nove	nine	/ˈnɔvɨ/	[ˈnɔːfɨ]	/n/	->	[n]
(f)	Joana	2;4.1	Rosinha	prop.noun	/ʀɔˈziɲɐ/	[ɔˈʃiɲɐ]	/ɲ/	->	[ɲ]
(g)	Luma	1;4.17	mamã	mommy	/mɐˈmɐ̃/	[mɐmɐ]	/m/	->	[m]
(h)	Luma	2;0.27	não	no	/ˈnɐ̃w̃/	[ˈnõw̃]	/n/	->	[n]
(i)	Clara	1;5.16	irmão	brother	/ˈmɐnu/	[ˈmɐnu]	/m/	->	[m]
(j)	Clara	1;4.19	não	no	/ˈnɐ̃w̃/	[ˈnɐ̃w̃]	/n/	->	[n]
(k)	João	1;5.26	maçã	apple	/mɐˈsɐ̃/	[mɐmɐ̃]	/m/	->	[m]
(l)	João	1;8.25	banana	banana	/bɐˈnɐnɐ/	[ˈmɐnɐ]	/n/	->	[n]

Lag in the acquisition of nasals

Similarly to what has been observed for stops, there is a long period of time between the age of acquisition of the first nasal and the age of acquisition of the last element of this sound class. This lag is evident in the *corpora* of Inês and Joana, where we were able to identify the beginning and end of acquisition of nasals. This lag is depicted in (81).

(81) Lag between the acquisition of the first and the last nasal (Inês and Joana)(appendix C)



As shown above, there is a longer lag in Inês' data (two years and five months) than in Joana's data (one year and two months). Also, both children differ in the last nasal acquired: in Inês, the problematic consonant is the coronal [-ant], while in Joana it is the coronal [+ant]. Note that Inês acquires other coronal [-ant] consonants (fricatives) at the age of 2;11 but it is only at 3;4 that [ɲ] is acquired. This child acquires the combination of [Nas, Cor-ant] quite late. As for Joana, she acquires [n] only at 3;2, although she had already mastered other coronal [+ant] consonants (stops) from 2;2 onwards. Again, the problem seems to be not the place or manner features in isolation but the co-occurrence of both. As for the other three children, they had not yet acquired [ɲ] at the last session studied, thus it is likely that their developmental pattern will be similar to the one observed in Inês.

3.5.5 The acquisition of fricatives

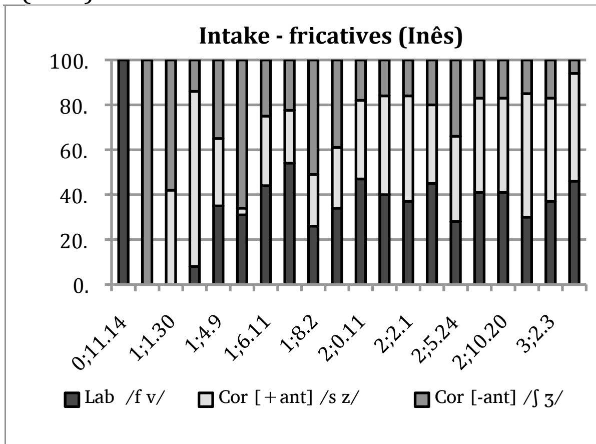
In this section, we analyze the acquisition of fricatives, in each child's *corpus*. We start by looking at the frequency of fricatives in the intake, comparing it to the distribution of fricatives in a sample of adult speech. Then, we describe the development of target-like productions and explore the time lag between the acquisition of the first and the last fricative, across children.

Distribution of fricatives in the intake

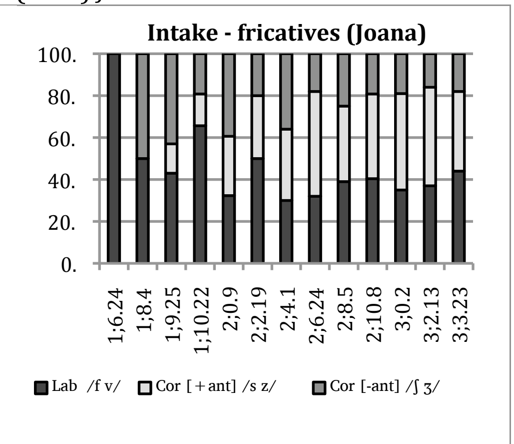
The graphs provided below show the distribution of fricatives, per place feature, in the target words selected by each child, per session.

(82) Distribution of fricatives in the intake (C1 and C2 onsets) (appendix E)

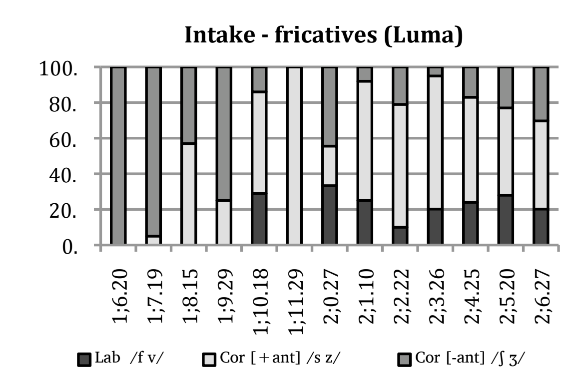
(82.a) *Inês*



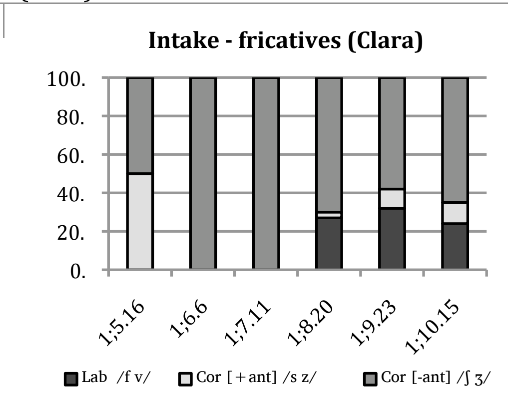
(82.b) *Joana*



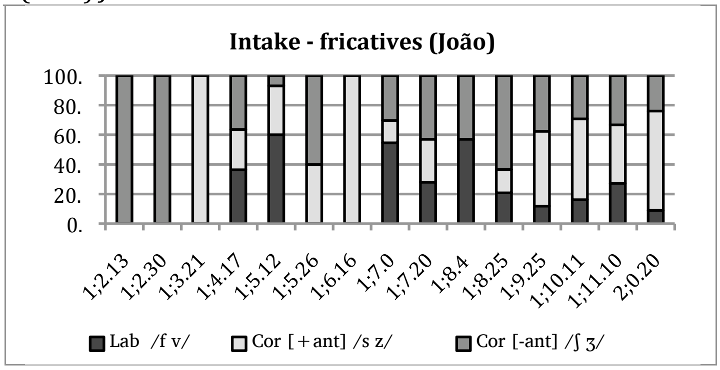
(82.c) *Luma*



(82.d) *Clara*



(82.e) *João*



Contrary to Inês and João, who start selecting fricatives from the first recording sessions, the other three children make their first attempts on fricatives slightly later: Clara at 1;5; Joana and Luma at 1;6.

Similarly to what was observed in the selection of stops and nasals, there are two different periods in the intake of each child. Intake 1 is mainly characterized by variability in the frequency with which individual fricatives are attempted, from one session to the other; there is, however, a tendency for coronal [-anterior] fricatives /ʃ/ and /ʒ/ to be selected more often. For most of the children, intake 2 is characterized by a decrease in the frequency of selection of /ʃ/ and /ʒ/ and by an increase in the selection of the coronal [+ant] /s z/. Clara carries on attempting coronal [-ant] more often than any other fricative (around 60%). The time frame covered by intake 1 and 2, in each child's *corpus*, is presented in (83).

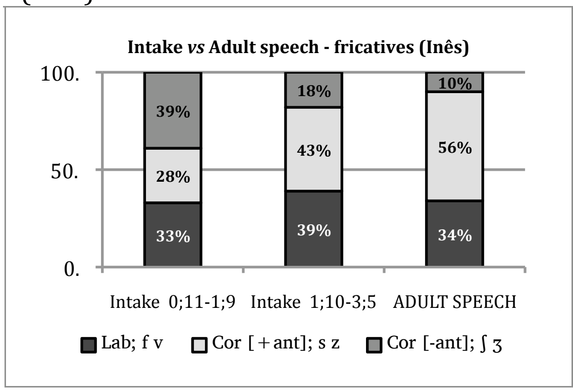
(83) Identification of two main periods in the selection of fricatives

	Intake 1	Intake 2
Inês	0;11-1;9	from 1;10
Joana	1;6 -2;4	from 2;6
Luma	1;6 -2;0	from 2;1
Clara	1;5 -1;7	from 1;8
João	1;2 -1;8	from 1;9

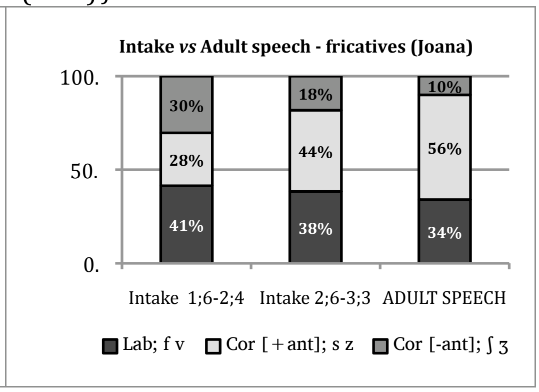
The graphs provided in (84) show the distribution of fricatives in the two intake periods (per child) and the distributional patterns of fricatives in the sample of adult speech.

(84) Distribution of fricatives in adult speech and in children's intake (C1 and C2 onsets) (appendixes B and E)

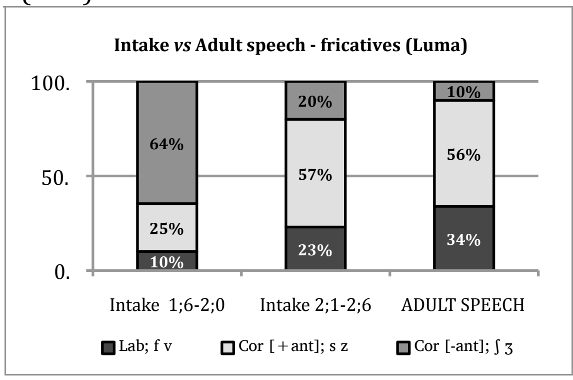
(84.a) *Inês*



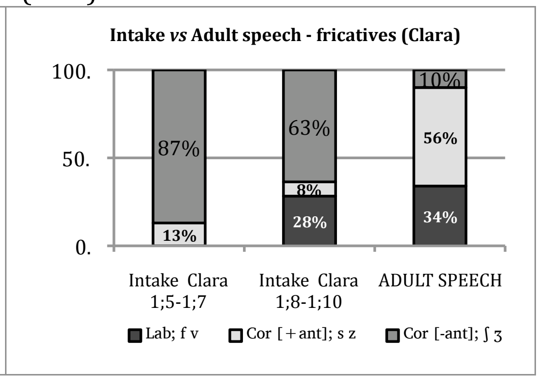
(84.b) *Joana*



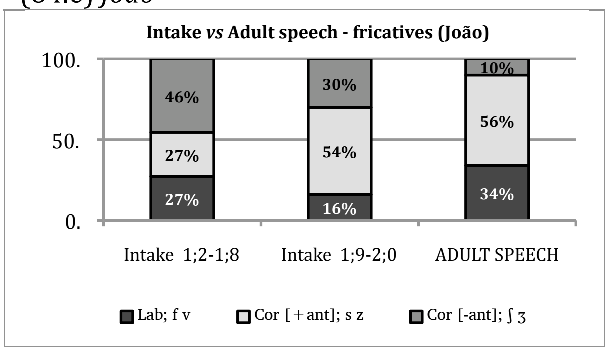
(84.c) *Luma*



(84.d) *Clara*



(84.e) *João*



As shown in the third column of the graphs depicted above, the most frequently produced fricatives in the sample of adult speech are the coronal [+ant] [s z], in 56% of the cases; the second most frequent are labials [f v] (34%). The least frequently produced fricatives are the coronal [-ant] [ʃ ʒ] (10%). The distributional hierarchy of fricatives in this speech sample is, then, the following: Cor [+ant]>>[Lab]>>[Cor-ant]. In (85), this hierarchy can be compared to the distribution of fricatives in the two intake periods observed in children's data.

(85) Distribution of fricatives in intake 1, intake 2 and adult speech

	Intake 1	Intake 2	ADULT
Inês	Cor[-ant] >> Lab >> Cor[+ant]	Cor[+ant] >> Lab >> Cor[-ant]	Cor[+ant] >> Lab >> Cor[-ant]
Joana	Lab >> Cor[-ant] >> Cor[+ant]	Cor[+ant] >> Lab >> Cor[-ant]	
Luma	Cor[-ant] >> Cor[+ant] >> Lab	Cor[+ant] >> Lab >> Cor[-ant]	
Clara	Cor[-ant] >> Cor[+ant]	Cor[-ant] >> Lab >> Cor[+ant]	
João	Cor[-ant] >> Cor[+ant]/Lab	Cor[+ant] >> Cor[-ant]>>Lab	

As shown above, there is no match between intake 1 and the distribution of fricatives in adult speech. In the adult speech sample, coronal [+ant] fricatives are more frequently produced, followed by labials. However, in the first sessions, children tend to attempt coronal [-ant] more often than any other fricative (all children, except for Joana, who selects labials more often). Four target words containing coronal [-ant] fricatives are recurrently attempted in the first sessions: *chichi* (pee), *já* (already), *João* (prop.noun) and *chupeta* (pacifier).

Contrary to what was observed in intake 1, children's preferences in the selection of fricatives in intake 2 match the distribution in the adult speech sample; this matching occurs in the data of Inês, Joana and Luma (see table above). As for Clara and João, there is already some resemblance with the adult sample in intake 2 (in Clara's data, labial becomes the second most frequently attempted fricatives and in João's data Coronal [+ant] becomes the most often selected), but there are still some discrepancies between both distributional hierarchies (cor [-ant] is still frequently attempted).

Development of target-like productions

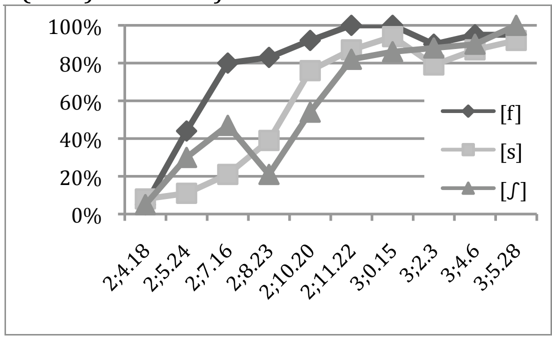
The current section describes the frequency of target-like productions for fricatives; since no (or very few) accurate productions for fricatives were found in the data of Clara and João (see appendix C), the analysis will be based on the *corpora* of Inês, Joana and Luma.

A. INÊS

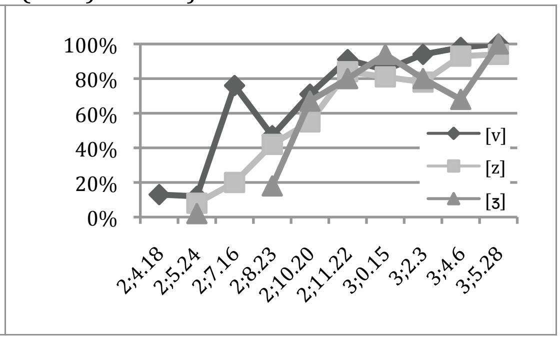
Inês acquires fricatives in two different moments: she acquires [f] at 2;7 and all other fricatives at the age of 2;11. The frequency of target-like productions for fricatives in this child's data is given in (86). In order to make the graphs visually intelligible, we will present the data in two different graphs: one for voiceless fricatives (86.a) and other for voiced fricatives (86.b).

(86) Target-like productions of fricatives – Inês (appendix C)

(86.a) *Voiceless fricatives*



(86.b) *Voiced fricatives*



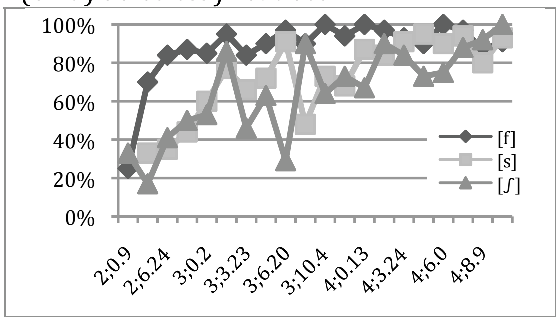
Regarding place features, the order of acquisition of fricatives in Inês' data is Labial>>Coronal.

B. JOANA

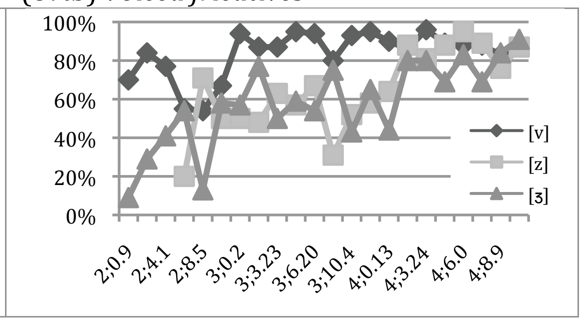
As for Joana, the graphs given in (87) show the frequency of occurrence of target-like productions of voiceless fricatives (87.a) and voiced fricatives (87.b).

(87) Target-like productions of fricatives – Joana (appendix C)

(87.a) *Voiceless fricatives*



(87.b) *Voiced fricatives*



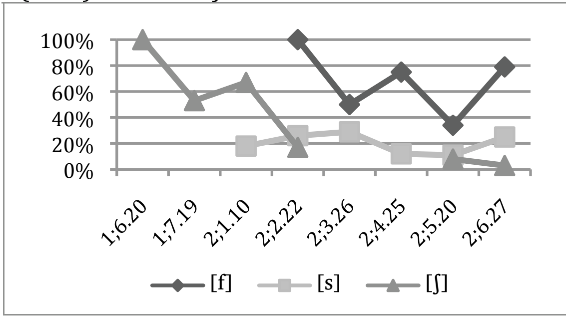
Similarly to Inês, the first fricative acquired by Joana is [f], at 2;10, followed by [v], at 3;0. It is only one year later, that the other fricatives become produced regularly above 80%: [s] at 4;0 and [z ʃ ʒ] at 4;2. As far as place features are concerned, the order of acquisition of fricatives in Joana's data is the following: Labial>>Cor [+ant]>>Cor[-ant].

C. LUMA

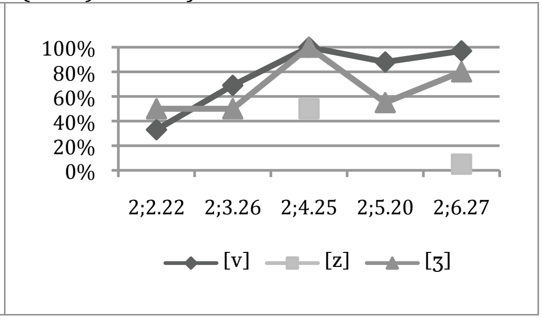
The graphs given in (88) show the frequency of occurrence of target-like productions of voiceless fricatives (88.a) and voiced fricatives (88.b), in Luma's data.

(88) Target-like productions of fricatives – Luma (appendix C)

(88.a) *Voiceless fricatives*



(88.b) *Voiced fricatives*



As shown in the two graphs provided above, only [v] is produced systematically above 80% in Luma's data (from 2;4 onwards).

Some examples of target-like productions of fricatives in the data of Inês, Joana and Luma are provided in (89).

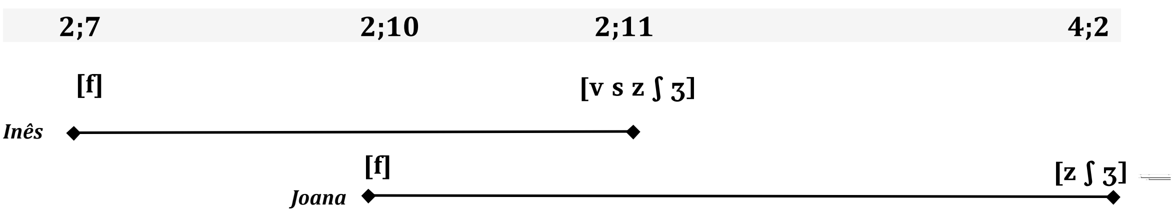
(89) Examples of target-like productions - fricatives

	Child	Age	Orthogr.	Gloss	Target	Output			
(a)	Inês	2;7.16	foi	went	/ˈfoj/	[ˈfoj]	/f/	->	[f]
(b)	Luma	2;4.25	voa	(she) flies	/ˈvoɐ/	[ˈvoɐ]	/v/	->	[v]
(c)	Inês	2;11.22	ursinho	little bear	/uɾˈsiɲu/	[uˈsiu]	/s/	->	[s]
(d)	Joana	4;2.12	César	prop.noun	/ˈsɛzaɾ/	[ˈsɛza]	/z/	->	[z]
(e)	Joana	4;2.12	bruxas	witches	/ˈbɾuʃɐʃ/	[ˈbuʃɐʃ]	/ʃ/	->	[ʃ]
(f)	Joana	4;2.12	magia	magic	/mɐˈʒiɐ/	[mɐˈʒiɐ]	/ʒ/	->	[ʒ]

Lag in the acquisition of fricatives

Focusing on the data of the two children that acquired the six fricatives within the time frame studied (Inês and Joana), we can see that there is variation as to the period of acquisition: Inês acquires fricatives in a shorter period of time than Joana; this chronology is depicted in (90).

(90) Lag between the acquisition of the first and the last fricative (Inês and Joana) (appendix C)



In Inês' *corpus*, the lag between first and last acquisition of fricatives comprehends a period of four months (between 2;7 and 2;11). As for Joana's data, the acquisition of fricatives takes place over a period of fifteen months (between 2;10 and 4;2). The protracted period of time in Joana's data seems to be related to the combinations [+cont, cor, voiced] and [+cont, coronal-ant], which are the last to be acquired.

3.5.6 The acquisition of liquids

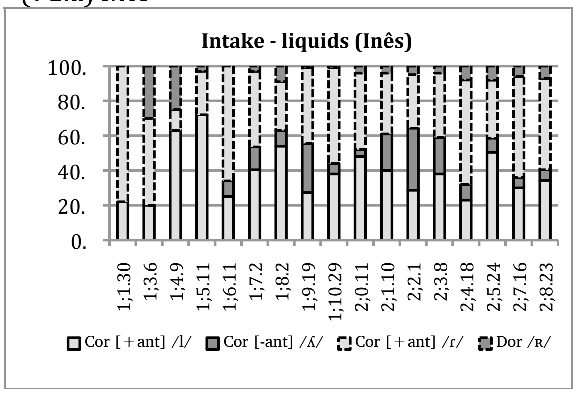
The current section describes the acquisition of liquids, in each child's *corpus*. First, we will present the distribution of these sounds in the target words selected by each child, comparing it with the distribution of liquids in a sample of adult speech. Then we analyze the order of acquisition and the time lag between the first and the last liquid acquired.

Distribution of liquids in the intake

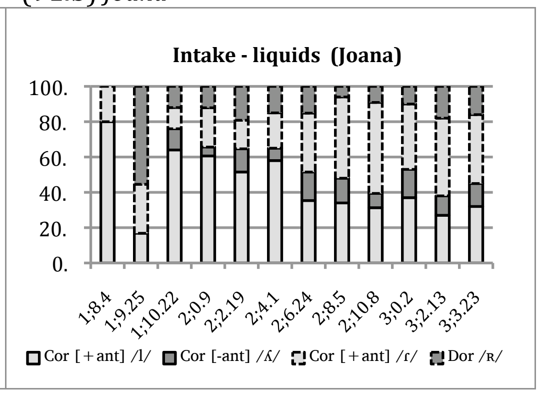
The graphs given below show the distribution of liquids in the intake of each child, per session.

(91) Distribution of liquids in the intake, per session (C1 and C2 onsets) (appendix E)

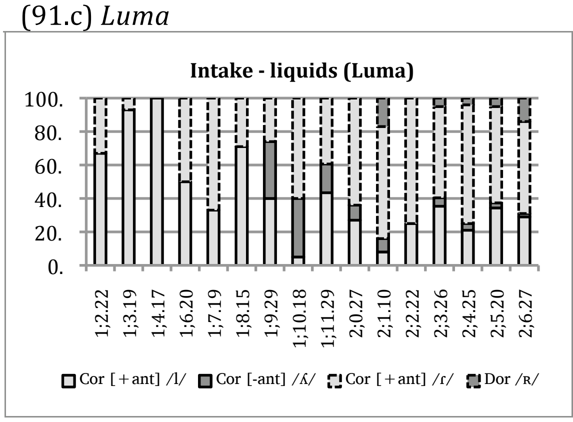
(91.a) *Inês*



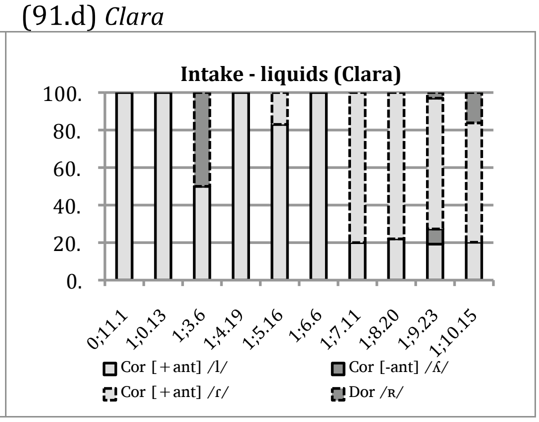
(91.b) *Joana*



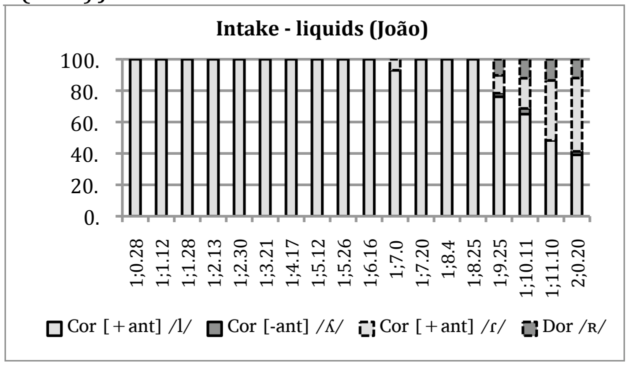
(91.c) *Luma*



(91.d) *Clara*



(91.e) *João*



Similarly to what has been observed in the selection of the other consonantal classes, intake patterns concerning liquids show different characteristics in the first sessions. Two main periods can be found in each child's *corpus*. The first period (intake 1) is mostly characterized by the predominance of /l/; this pattern is evident in the data of Clara and João (where the percentage of selection of /l/ is around 100%, in most sessions) but it is also observed in Joana's data, where the frequency of attempts of /l/ is above 50% in the majority of sessions. In the data of Inês and Luma, the first period is mostly characterized by variability in the selection of individual consonants: Inês selects /l/ more often (at 1;3), but in some of the sessions prefers /ɾ/ (at 1;4, see (91.a)); Luma starts by selecting /l/ more often (between 1,2 and 1;4) but then prefers /ɾ/ or even /ʎ/ (at 1;19-1;10).

The second period (intake 2) is characterized by a predominance of selection of the coronal rhotic /ɾ/; the second most frequently attempted liquid in this period is /l/. As for the trill and for the lateral [-anterior], they are selected less often, in about 10 or 15% of the cases.

The time frame covered by intake 1 and intake 2 in each child's *corpus* is given in (92).

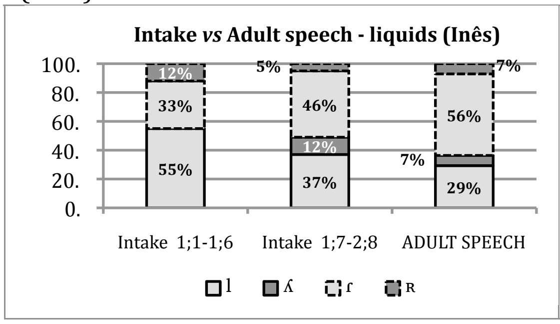
(92) Identification of two main periods in the selection of liquids

	Intake 1	Intake 2
Inês	1;3 -1;6	from 1;7
Joana	1;8 -2;4	from 2;6
Luma	1;2 -1;11	from 2;0
Clara	0;11-1;6	from 1;7
João	1;0 -1;10	from 1;11

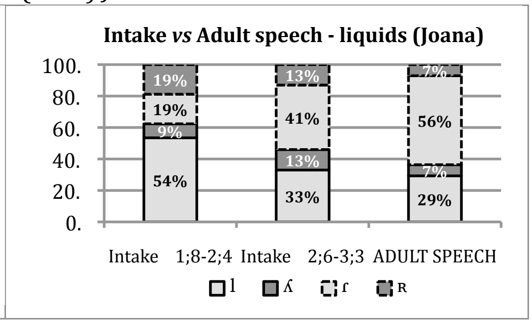
The graphs provided in (93) show the distribution of each liquid in the two intake periods, compared to the distribution of liquids in the sample of adult speech.

(93) Distribution of liquids in children's intake and in the adult speech sample (appendixes B and E)

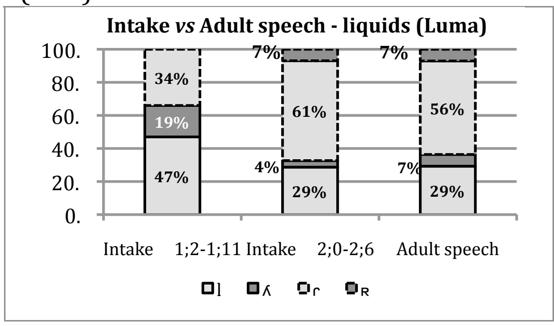
(93.a) *Inês*



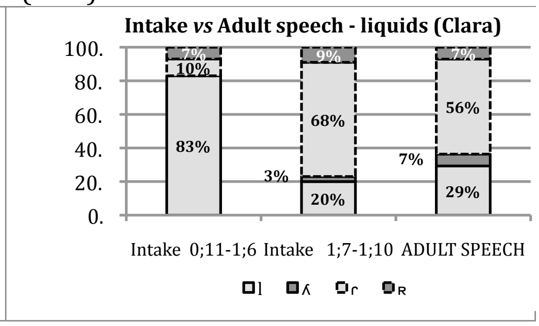
(93.b) *Joana*



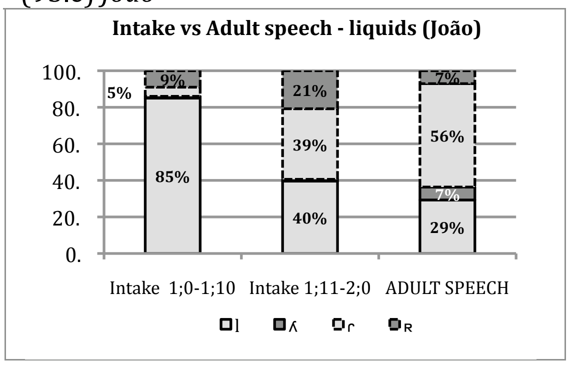
(93.c) *Luma*



(93.d) *Clara*



(93.e) *João*



In the sample of adult speech (see column at the right in the graphs above), 56% of all liquids produced correspond to the coronal rhotic [ɾ], 29% to the lateral [l], 7% to the dorsal rhotic [ʀ] and other 7% to the lateral [-ant] [ʎ]. Thus, the distributional hierarchy in this sample is [ɾ]>>[l]>>[ʀ ʎ]. In (94), this hierarchy can be compared to hierarchies in the two intake periods, in each child's *corpus*.

(94)   Distribution of liquids in intake1, intake2 and adult speech

	Intake1	Intake2	ADULT
Inês	/l >> ɾ >> ʀ/	/ɾ >> l >> ʎ >> ʀ/	[ɾ >> l >> ʀ ʎ]
Joana	/l >> ɾ ʀ >> ʎ/	/ɾ >> l >> ʎ ʀ/	
Luma	/l >> ɾ >> ʎ/	/ɾ >> l >> ʀ >> ʎ/	
Clara	/l >> ɾ >> ʀ/	/ɾ >> l >> ʀ >> ʎ/	
João	/l >> ʀ >> ɾ >> ʎ/	/l >> ɾ >> ʀ >> ʎ/	

In intake 1, the most frequently attempted liquid is /l/, in all children's data. On the contrary, in intake 2, the flap becomes the most frequently attempted liquid (except in João's *corpus*). In this respect, the second intake period resembles frequency in adult speech more clearly than intake 1.

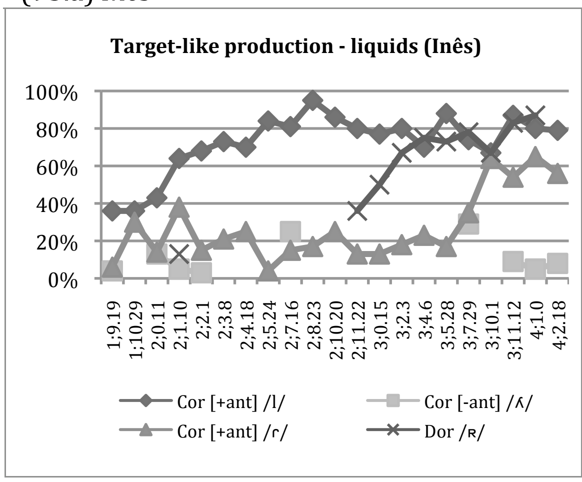
Development of target-like productions

This section presents a description of the order of acquisition of liquids in the data of Inês and Joana. As already referred to in section 3.5.1, Inês and Joana are the only two children who acquire at least some liquids, in the period studied: Inês acquires [l] and [ʀ] and Joana acquires [ʀ]. The other three children were studied for a shorter period of time (Clara until 1;10, João until 2;0 and Luma until 2;6) and no liquid was acquired within that period (see appendix C).

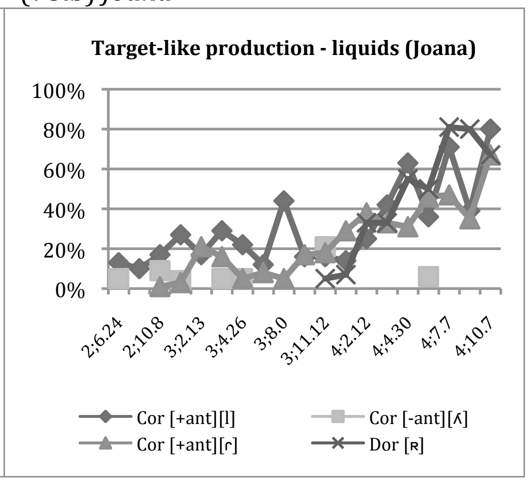
The graphs given in (95) provide the distribution of target-like productions of liquids, in the data of Inês (95.a) and Joana (95.b).

(95)   Target-like productions of liquids (appendix C)

(95.a) *Inês*



(95.b) *Joana*



Inês acquires lateral [l] at the age of 2;5 and rhotic [ʀ] at 3;11 (see 95.a). At the time [l] is being produced accurately in above 80% of the attempts, [ʎ] is being produced correctly (mostly) below 20%. As for the rhotic [ɾ], although from 3;10 onwards it is produced accurately around 60%, it does not reach 80% until the last session studied, at 4.2.

As for Joana, until 3;11, the percentage of accurate production of liquids is most often below 20% of the attempts (see 95.b). From 4;4 onwards, accurate productions for [l], [ɾ] and [ʀ] are between 45 to 65%, but the only consonant that reaches the 80% in two consecutive months is [ʀ], from 4;7 onwards ([l] reaches 80%, but only at the last session, so the criteria of at least two consecutive months is not met here). Some examples of target-like production of liquids in the data of Inês and Joana are given in (96).

(96) Examples of target-like productions for liquids - Inês and Joana

	Child	Age	Orthogr.	Gloss	Target	Output		
(a)	Inês	2;5.24	Filipe	prop.nou	/fiˈl̲ipɨ/	[pɨˈl̲ipi]	/l/ ->	[l]
(b)	Inês	2;5.24	ali	there	/ɐˈl̲i/	[ˈl̲i]	/l/ ->	[l]
(c)	Inês	3;11.12	rei	king	/ˈʀ̲ɐj/	[ˈʀ̲ɐj]	/ʀ/ ->	[ʀ]
(d)	Inês	3;11.12	correr	to run	/kuˈʀ̲eɾ/	[kuˈʀ̲elɨ]	/ʀ/ ->	[ʀ]
(e)	Joana	4;7.7	rosas	roses	/ˈʀ̲ɔzɐʃ/	[ˈʀ̲ɔzɐʃ]	/ʀ/ ->	[ʀ]
(f)	Joana	4;7.7	burro	donkey	/ˈbuʀ̲u/	[ˈbuʀ̲u]	/ʀ/ ->	[ʀ]

Lag in the acquisition of liquids

None of the children studied acquired the whole set of four liquids; Inês acquires two liquids until the last session studied, at 4;2 and Joana acquires one, until 4;10. For this reason, it is not possible to determine the lag between the first and the last acquisition of liquids. However, we can predict that the lag will be quite extended at least in Inês' data, since she acquires her first liquid at the age of 2;5. As for Joana, she acquires her first liquid quite late, at 4;7 and it is not possible to determine the extension of the period of acquisition, since she was studied only until the age of 4;10. This chronology is depicted in (97); the discontinuous line indicates that the acquisition of liquids is still not complete.

(97) Age of acquisition of the <u>first</u> and the <u>last</u> liquid, within the period studied (Inês and Joana)(appendix C)

3.5.7 Further comments on the intake

As discussed in previous sections, children present two main periods in their intake: intake 1 is generally characterized by a higher degree of variation in the distribution (between children and from one session to the other, in each child's corpus) and less resemblance to the distribution in adult speech. Intake 2, on the other hand, tends to show less variation from one session to the other and the distribution is closer to the distribution in adult's productions. The question that will be explored in this section is if the difference between both periods can be related to changes in the number of words (types) attempted.

As previously shown, intake 1 occurs in the first sessions and its duration is variable, depending on the child and on the manner involved (intake 1 is longer for fricatives and liquids, which also start being attempted later). The age-period most often covered by intake 1 in each child's *corpus* is provided below.

- Inês: 0;11-1;6
- Clara: 0;11-1;7
- João: 1;0-1;8
- Joana: 0;11-1;10
- Luma: 0;11-2;2

In (98), we provide the number of different target-words (types) attempted by each child, per session. The shaded cells correspond to the beginning of intake 2.

(98) Number of target-words (types) attempted per session

	0;11	**1;0**	**1;1**	**1;2**	**1;3**	**1;4**	**1;5**	**1;6**	**1;7**	**1;8**	**1;9**	**1;10**	**2;0**	**2;2**	**2;3**
Inês	6	8	25		36	31	53	48	56	95	118				
Clara	2	2	5	5	7	6	14	9	13	26	55	51			
João		2	4	5	9	13	18	17	16	24	62	81			
Joana	2	1		4		2	2	10		10	33	50	102		
Luma	2	2	4	7	7	3	6	8	7	11	17	17	25	31	70

As shown above, the number of target words attempted in early sessions is very low; it increases gradually until a point where more than fifty words are attempted per session.

One interesting finding emerges from the comparison between the time frame covered by intake 1 and data in table (98): in general, the end of intake 1 matches the age at which the number of target words attempted surpasses the level of 50. In Luma, for instance, intake 1 goes mostly until 2;2 and it is precisely at 2;3 that a sudden increase in the number of types occurs (from 31 to 70).

In sum, the high degree of variation in intake 1 and the less resemblance to frequencies in adult speech is, thus, associated to a very limited active vocabulary in early sessions. Similarly, the decrease in variability and closer relation to adult speech verified in intake 2 coincides with an expansion of the number of types in children's lexicon. This issue will be further discussed in section 3.6.

3.5.8 Summary

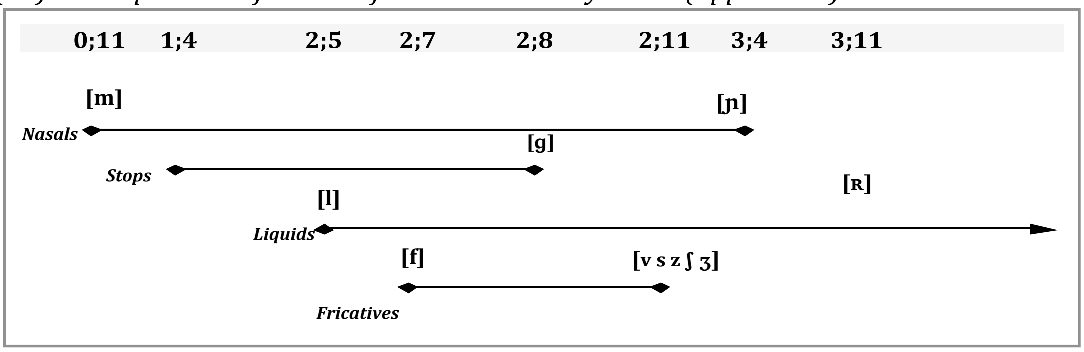
In this section, we present a summary of the main findings observed in this chapter.

A. Order of acquisition of manner features

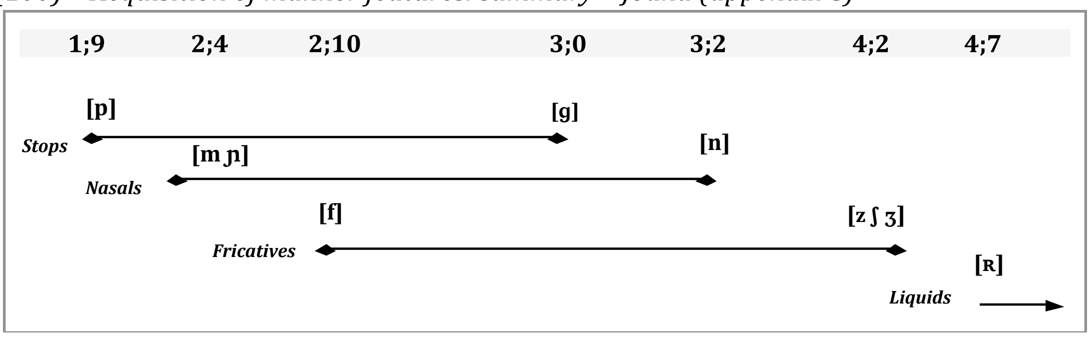
Four children acquired stops in the first place, followed by nasals. One of the children (Inês) acquired these two natural classes in the reverse order: first Nasal, then Stop. Only three children acquired fricatives; two of them (Joana and Luma) acquire those features in the order Stop>>Nas>>Fric. The other child (Inês) acquires Lateral before Fricative, in the order Nas>>Stop>>Lat>>Fric. Only Inês and Joana acquired rhotics; this is the last sound class acquired by Inês and the penultimate acquired by Joana (since this child has not yet acquired laterals at the last session studied).

Manner features are most often acquired in overlapping periods: children start acquiring a new sound class before all members of the previous class have been acquired. This overlap is summarized in the diagrams given from (99) to (103).

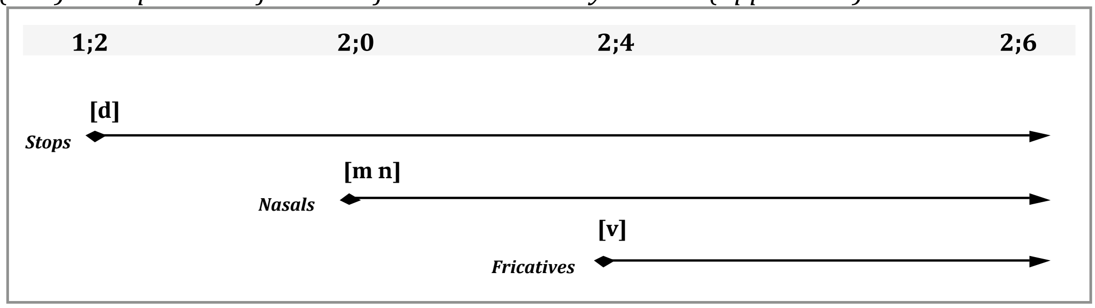
(99) Acquisition of manner features: summary – Inês (appendix C)



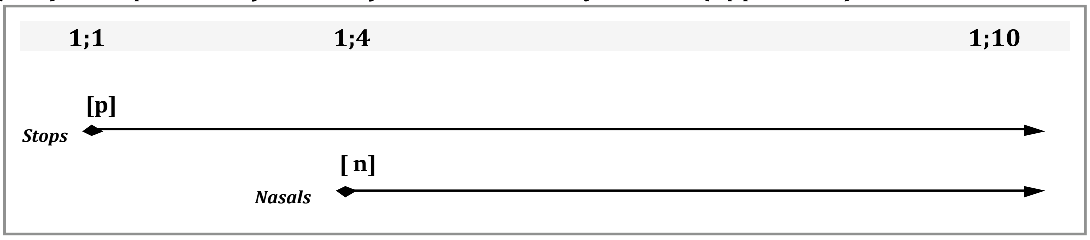
(100) Acquisition of manner features: summary – Joana (appendix C)



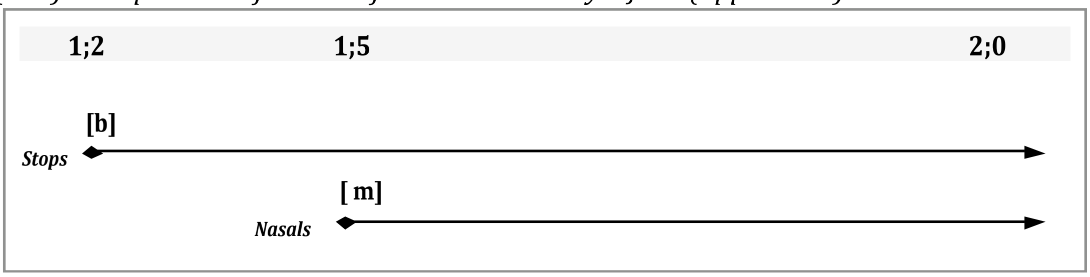
(101) Acquisition of manner features: summary – Luma (appendix C)



(102) Acquisition of manner features: summary – Clara (appendix C)



(103) Acquisition of manner features: summary – João (appendix C)



The protracted period of acquisition observed in some of the natural classes seems to be related to problematic combinations of place, manner or voicing specifications. The most difficult feature co-occurrences are the following:

- [dorsal, +voiced] in stops, resulting in a late acquisition of [g] in most children's data;
- [+nasal, coronal-ant], causing a late acquisition of [ɲ] in the majority of children's speech;
- [+continuant, coronal], causing a late acquisition of coronal fricatives, even though labial [f] or [v] are already mastered;
- [+lateral, cor-ant], causing an extended lag between the acquisition of [l] and [ʎ], in the data of Inês (the only child who acquires the set of laterals);
- [+sonorant, -lateral, -nasal, coronal], resulting in a late acquisition of [ɾ], even though the dorsal trill has already been acquired (Inês and Joana).

B. Order of acquisition of place features *(appendix C)*

The acquisition of place features tends to obey the following order: anterior>>non-anterior; in other words, labial and coronal [+ant] features tend to be acquired before coronal [-ant] and dorsal.

Within stops, labial [p b] and cor [+ant] [t d] are always acquired before dorsal [k g], even though that development can take place within subgroups determined by voicing (for instance, first voiceless [p>>t>>k], then voiced [b d>>g] (Inês)).

Within nasals, the most common pattern is that labial and cor [+ant] ([m n]) are acquired before coronal [-ant] [ɲ] (except for Joana's data, where [n] is the last to be acquired).

Within fricatives, the order is labial >> coronal. Within coronals, the [-ant] sounds tend to be acquired last (Inês, Joana, Luma).

Within laterals, coronal [+ant] [l] is acquired before cor [-ant] [ʎ] (Inês).

Within rhotics, the general order anterior>>non-anterior is reversed: the dorsal trill is acquired before the coronal [ɾ] (Inês and Joana).

C. Substitution patterns affecting place and manner features (appendix D)

SUBSTITUTION PATTERNS AFFECTING MANNER FEATURES

Since stops and nasals are acquired early, they tend not to be submitted to manner substitution patterns. On the contrary, fricatives, laterals and rhotics tend to be submitted to substitution patterns that cause manner change.

- Fricatives: the predominant manner substitution pattern is Fric->Stop.
- Laterals: they are more frequently replaced by another sonorant (mostly glides and nasals).
- Rhotics: they tend to be replaced by another sonorant (mostly a lateral or a glide). However, there are also cases of substitutions of rhotics by stops (particularly in the *corpora* of Inês and Joana).

The trill tends to be more often replaced by a stop (particularly in the data of Inês, Joana and Clara), while the flap is more frequently replaced by another sonorant.

In word-initial position, the substitution of liquids by a non-sonorant (stop or fricative) is the predominant pattern. In an intervocalic position, the predominant substitution pattern is of the type liquid->sonorant.

The rhotic [ʀ] is more often replaced by a stop or a fricative if it is in C1 position, while it tends to be replaced by another sonorant, when in C2. However, for two of the children (Inês and Joana) the predominant pattern is [ʀ]->Obstruent in both word-positions.

SUBSTITUTION PATTERNS AFFECTING PLACE FEATURES

Since the three major features Labial, Coronal and Dorsal are acquired early, there are few cases of substitutions that involve place change. Based on the few cases observed, the following observations can be made:

- Labial is the least affected feature, across children;
- Coronal is the second least affected, although there are some cases of substitution of coronals by labials or of cor[-ant] produced as [+ant];
- the most affected feature across children is Dorsal, members of which are most frequently replaced by coronals.

D. Relation between distribution in adult speech and acquisition data

DISTRIBUTION IN ADULT SPEECH AND GENERAL ORDER OF ACQUISITION

No direct link was found between the order of acquisition and the distribution of each consonant in the sample of adult speech; some frequent sounds in adult's productions are acquired early ([p t d k]), but other frequent sounds are acquired quite late ([s], [ɾ]).

Focusing of manner features, we observed that stops are the most frequent sounds in adult speech and are acquired earlier by the five subjects, while liquids are the least frequent in the adult sample and are the last to be acquired. However, based on distribution in adult speech, fricatives should be acquired earlier than nasals, and this is not the case, in any of the children's data. In fact, nasals are the second sound class acquired by four children (after stops) and are the first acquired by the other child (Inês).

As for place features, we observed that labial and coronal are more frequent than dorsal in adult speech and are also acquired early. However, even though coronal is far more frequent than labial in adult speech, labial is the first place feature acquired by the majority of children. In sum, no straightforward relation was observed between the distribution of features in adult speech and the acquisition patterns.

DISTRIBUTIONAL PATTERNS: CHILDREN'S INTAKE *VS* ADULT SPEECH

Two main periods were found in the children's intake; intake 1 covers the first sessions and is characterized by a higher degree of variation in the selection of consonants, from one session to the other; in general, the distribution in this initial period differs substantially from the distribution in the adult's speech sample. In Intake 2, on the other hand, the distribution of the different consonants and features becomes more stable and resembles the distribution in adult speech (with variation, though).

A strong relation was also found between the two intake periods and development in children's active vocabulary: throughout intake 1, children's vocabulary (types) is very small (far below 50 words) and the beginning of intake 2 matches with an expansion in children's vocabulary (most often, to above 50 words).

3.6 Discussion

This section presents a discussion of the acquisition patterns described in the preceding sections, in the light of the trends and theoretical issues referred to in the beginning of this chapter (section 3.1).

A. Order of acquisition of place and manner features: EP *vs* other languages

As far as manner features are concerned, research in different languages has shown that stops are accurately produced from early ages on (Jakobson, 1941/68; Vihman, 1992; Stoel-Gammon, 1993; Robb & Bleile, 1994). Nasals also tend to be acquired early, although not universally (Fikkert, 1994; Bernhardt & Stemberger, 1998). As for fricatives and liquids, they are infrequent in early words and tend to be acquired in protracted periods of time (Bernhardt, 1990; Matzenauer, 1990; Dinnsen, 1992; Beers, 1995).

The trends in acquisition of manner features referred to above have been attested in the data of EP children: stops and nasals are the two first sound classes acquired (most often in the order Stop>>Nasal), followed by fricatives and finally by liquids (see section 3.5.1). In sum, [-continuant] and [+nasal] tend to be amongst the first manner features acquired, while features such as [+continuant] and [+sonorant, -nasal] tend to be acquired later. This order also matches the acquisition patterns observed in Brazilian children's data (Matzenauer, 1990; Lamprecht et.al, 2004).

Regarding place feature specification, research has shown that anterior features (Labial and Coronal [+ant]) tend to be acquired before non-anterior (Coronal [-ant] and Dorsal) (Jakobson, 1941/68; Ingram, 1992; Beers, 1996). Some studies have also shown that place features may be acquired within subcategories determined by voicing (Dos Santos, 2007; Oliveira, 2004).

Corroborating results were observed in EP children's data: (i) labial and coronal [+ant] consonants tend to be acquired before coronal [-ant] and dorsal; (ii) particularly within stops, some children tend to acquire voiceless sounds before voiced, but obeying to the order anterior>>non-anterior (section 3.5.3).

In sum, EP children acquire stops, nasals, labials and coronals [+ant] at an early age. Since early-acquired sounds are usually classified, in the literature, as unmarked or default (Jakobson 1941/68), we could conclude that those four sets of sounds have an unmarked status in EP children's systems. However, as will be discussed further below, not all early-acquired sounds emerge in substitutions for consonants that are acquired later. It might be the case, then, that early-acquired sounds have different degrees of unmarkedness; this issue will be further explored in subsection B, where we focus on substitution patterns.

FEATURE CO-OCCURRENCE

Another aspect that is worth discussing here is that some place/manner (or voicing) feature co-occurrences have proven to be difficult for EP children, leading to an extended time lag between the acquisition of the first and the last element of a given sound class (see sections 3.5.3-3.5.6). The first problematic combination is [dorsal, +voiced], which results in a late acquisition of [g] for all children. Note that this difficulty is not related to manner or place specification, but to the combination of features Dorsal and [+voiced]. Another challenging combination for the majority of children (all except for Joana) is [+nasal, coronal-ant], which causes a delay in the acquisition of nasals, as a class. The feature co-occurrence [-sonorant, +continuant, coronal] also poses some problems to EP learners: all subjects that acquire fricatives (Inês, Joana and Luma) start with a labial and master coronals only later; in Joana's data, mastery of coronal fricatives occurs more than a year after the acquisition of labial [f].

Two other feature co-occurrences can be observed in EP data: Inês acquires [l] at 2;5 but the [+lateral, cor-ant] [ʎ] is not yet mastered at the last session studied, at 4;2. Also within liquids, both Inês and Joana acquired the dorsal trill ([+sonorant, -lateral, -nasal, dorsal]) but do not master the flap ([+sonorant, -lateral, -nasal, coronal]) in the time frame studied (until 4.2 in Inês and 4;10 in Joana).

Note that similar restrictions regarding feature combinations have been observed in other languages (sections 3.1.1 and 3.1.2); in BP, for instance (Lamprecht et. al., 2004), it has been observed that consonants characterized by the feature combinations listed above tend to be acquired last: (i) voiced dorsal [g], within stops; (ii) palatal [ɲ] within nasals; (iii) coronals, within fricatives; (iv) [ʎ] within laterals; (v) coronal [ɾ], within rhotics. Thus, as far as general order of acquisition of place and manner features are concerned, both varieties of Portuguese (EP and BP) show similar developmental patterns. It is worth emphasizing, however, that the five EP children differ from BP subjects as to the age of acquisition, particularly in liquids: according to Lamprecht et.al (2004), the two laterals tend to be acquired until 4;0 and the two rhotics until 4;2. This is not, however, the case in EP: none of the two children studied for a longer period of time (Inês until 4;2 and Joana until 4;10) acquired the complete set of four liquids; Inês acquired only [l] and [ʀ] and Joana acquired only [ʀ]. This discrepancy between BP and EP requires further investigation, one the basis of a larger sample of EP data.

B. Substitution patterns: EP *vs* other languages

MANNER FEATURES

According to the literature in the field, stops and nasals are less prone to be submitted to substitution patterns (Yavas, 1988; Bernhardt & Stemberger, 1998; Lamprecht et. al., 2004). This trend could also be shown for EP: stops and nasals are acquired early (mostly before 2;0) and tend not to be affected by manner substitutions.

Several studies have shown that fricatives tend to be replaced by stops (Edwards, 1996; Dos Santos, 2007), while liquids tend to be substituted by another sonorant, namely a nasal or a glide (Mezzomo & Ribas, 2004). Similar results were attested in this chapter: in the data of EP children, manner substitutions that affect fricatives are mostly of the type Fric->Stop, while liquids are often produced as a glide, a nasal or another liquid (in lateral/rhotic interchanges). However, liquids can also be replaced by stops, particularly the dorsal trill (section 3.5.2).

In sum, EP data show that stops are the most common substitutes in manner changing substitutions, since they can replace fricatives (Fric->Stop) or sonorants (Liq->Stop). As for sonorants (nasals, liquids), they mostly replace other sonorant sounds (Lat->Nas; Rhot->Lat; Liq->Glide). It thus seems that stops are the least marked consonants, since they can replace both sonorants and non-sonorants. As for nasals and glides, they act as the least marked sounds within the sonorant subcategory.

Similarly to what has been observed in other languages (Bernhardt & Stemberger, 1998), EP children tend to maintain the specification of [sonorant] of the target consonant: [-sonorant] (obstruents) are most often replaced by an obstruent and [+sonorant] (liquids) tend to be substituted by a sonorant (except for the dorsal trill, as will be discussed below). These substitution patterns may provide insights into the organization of manner features in children's developing phonology: assuming that the preserved features in children's speech are the ones that occupy a higher level in their systems, it seems that a [sonorant] *node* (in feature geometry models) or a faithfulness *constraint* to [sonorant] (in OT approaches) is higher ranked in children's phonological systems than those pertaining to [continuant] or [lateral], for instance.

It is, however, not always the case that liquids are replaced by another sonorant. As shown in section 3.5.2, EP children tend to replace the trill by a stop. Miranda (1996; 2007) reports on similar results in the acquisition of BP. According to this author, the substitution of the trill by a stop constitutes evidence that children assign different degrees of sonority to the two rhotics, with the trill being closer to obstruents and the flap closer to glides. Miranda argues that, as far as the acquisition of rhotic is concerned, BP data is best accounted for in a sonority scale such as the one proposed by Bonet & Mascaró, given below (see section 3.1.2).

(104) Sonority scale (Bonet & Mascaró, 1996; Apud Miranda, 2007)

0	1	2	3	4	5
Stops	Fricatives +[ʀ]	Nasals	Laterals	Glides +[ɾ]	Vowels

Following the scale depicted above, substitution patterns such as [ɾ] ->[j] are more frequent than [ʀ] ->[j] and patterns such as [ʀ] ->[g] occur more often than [ɾ] ->[d] because [ɾ] flanks glides and [ʀ] is close to obstruents, in terms of sonority.

As far as acquisition of rhotics is concerned, BP and EP present similar results: (i) the trill is acquired before the flap; (ii) the trill tends to be replaced by a stop and the flap is most often substituted by a sonorant (a glide or a lateral). We could then, argue that a sonority scale such as the one given in (104) is underlying EP acquisition data. There is, however, an additional factor that is worth considering: word-position. In section 3.5.2, it was shown that the trill is most often replaced by a stop in word-initial position, but that the number of trill->sonorant substitutions increased in intervocalic onset. It thus seems that context plays an important role in substitution patterns, since intervocalic trills are more prone to surface as a sonorant than C1 trills. Since, both in EP and BP, onset flaps can only appear in intervocalic position, while the trill can appear both in C1 and in C2, it seems that distributional patterns are playing a role in the type of substitution that occurs: C2 rhotics (trill and flap) tend to be replaced by sonorants while C1 rhotics (trill) tend to be substituted by a stop. The effect of word-position in developmental patterns will be further explored in chapter 5.

PLACE FEATURES

Research in the field has shown that labial and coronal consonants are not often submitted to substitution patterns, although some studies have reported on (i) labial->coronal replacements, mostly affecting labial fricatives; (ii) interchanges between coronal [+ant] and [-ant] sounds (Ingram et al. 1980; Stoel-Gammon & Dunn, 1985; Bernhardt, 1990). Regarding substitutions, Dorsal tends to be the most affected place feature; a frequently observed phenomenon is the replacement of dorsals by coronals, commonly termed as velar fronting (Stoel-Gammon, 1996; Stoel-Gammon & Stemberger, 1994; Inkelas & Rose, 2003).

In general, EP children's data show the trends observed across languages: the early-acquired labial and coronal [+ant] sounds tend to be less submitted to place substitutions than Coronal [-ant] and Dorsal. In most substitution patterns, Coronal [+ant] stands out as the most frequent substitute: dorsals, labials and coronals [-ant] tend to be produced as coronal [+ant] consonants (section 3.5.2). These patterns constitute evidence that Cor [+ant] has a default status in children's systems. In this respect, the five children's data provided additional support for the analysis proposed by Mateus & d' Andrade (2000) for the target system, where it is assumed that coronal [+ant] consonants are unmarked in the phonological system.

As for Labial, although it is an early-acquired place feature, it is not often used as a default substitute; these patterns show that the early acquisition of a given feature does not necessarily imply a default status in children's systems; at least as far as substitution patterns are concerned.

C. Relation between distribution of consonants in adult speech and acquisition data

Focusing on place and manner features, we observed that the most frequently produced sounds in the input are acquired early, namely stops and coronals, and the least frequently produced are acquired late, namely liquids and dorsals. However, there are discrepancies between both *corpora*: in the adult speech sample, fricatives are more frequent than nasals, but the order of acquisition of these two consonantal classes is nasals>>fricatives. Furthermore, coronals are more frequent than labials in adult speech but the majority of children acquired these two features in the order labials>>coronals.

In sum, no straightforward relation was found between distribution in adult speech and order of acquisition.

A stronger relation between developmental data and distribution in the input was found when we looked at intake patterns, in a longitudinal perspective. It was shown that there are two main periods in children's set of words selected; intake 1 covers the first sessions and is characterized by a higher degree of variation in the number of times a given feature is attempted, from one session to the other (within and across children's corpora). In general, frequency of selection in this initial period differs substantially from frequency of production in the adult speech sample. In intake 2, on the other hand, the selection of features becomes more stable from one session to the other and starts resembling distributional patterns in adult speech.

A strong relation was also found between the two intake periods and developments in children's active vocabulary (word types): throughout intake 1, children's vocabulary is very limited, far below 50 words, and the beginning of intake 2 coincides with an expansion in the children's vocabulary, most often, to above 50 words. These findings corroborate the findings observed in French (Dos Santos, 2007) and in Dutch (Fikkert & Levelt, 2008), where it was shown that distributional patterns in acquisition start resembling those in adult speech only from a certain stage on, in which the young learner's vocabulary is also increasing significantly.

Developmental patterns in the first sessions are very idiosyncratic (between 0;11 and 1;8, approximately): the set of words attempted is very limited at this age, as well as the production strategies used. This early developmental period will constitute the focus of analysis of the next chapter.

It is worth emphasizing that the discrepancies observed between the order of acquisition of features and its distribution in the adult speech sample might result from the fact that we did not distinguish between early and later recording sessions, in the analysis. It could be the case, then, that the order of acquisition of the later acquired features resembles its distribution in the adult speech and discrepancies are found only in the first sessions. This separate analysis (relation between early acquired features and adult speech *vs* relation between later acquired features and adult speech) will be performed in chapters 4 and 5 (see section 4.8 and 5.8, for a discussion of the results).

3.7 Concluding remarks

The acquisition of the consonantal inventory in EP can be characterized best in terms of features: stops, nasals, labials and coronal [+ant] are amongst the first sounds to be acquired, while fricatives, liquids, coronal [-ant] and dorsals tend to be acquired later. The acquisition periods of the different features tend to overlap, mostly due to problematic feature co-occurrences within segments and the time it takes to overcome these difficulties extends the period of acquisition of some sound classes.

The analysis of the substitution patterns that affect place and manner features showed that not all early-acquired sounds develop a default status in children's systems. Only coronal [+ant] stops can be viewed as default segments, since those are the consonants that most often replace other non-acquired consonantal sounds. These findings provide evidence for the unmarked status assigned to coronal [+ant] consonants in the target system, as proposed in Mateus & d' Andrade (2000).

Substitution patterns showed some interesting differences between the two rhotics: the flap is mostly replaced by a sonorant (glide or lateral), while the trill can be replaced both by stops and by sonorants. The trill tends to be replaced by stops in word-initial position, while it can be replaced by stops and sonorants in intervocalic context. As for the flap, it occurs only in C2 onset position. One could account for the differences between trill and flap by assuming different degrees of sonority for both rhotics, in line with the proposal in Miranda (1996; 2007), for BP. Another hypothesis would be that differences are caused by the distributional properties of each rhotic: onset flaps occur only in a context that promotes sonority, namely in intervocalic position, C2, while the trill can appear both in C1 and in C2. A third account would be that both differences in sonority and distributional properties are playing a role in substitution patterns. This issue needs further investigation, on the basis of more data, since only two of the five children studied acquired rhotics.

As for the relation between the distribution of consonants in adult speech and developmental patterns, the two main findings presented in this chapter were that (i) there is no straightforward relation between order of acquisition and frequency in adult speech, though there are some correlations, particularly if we focus on features; (ii) initial intake patterns do not reflect frequency in adult speech, but a closer resemblance is achieved gradually, as children's vocabularies expand.

In general, the developmental patterns observed in EP corroborate the trends observed across languages, both in the order of acquisition of place and manner features and in substitution patterns.

Chapter 4 – Place and manner features in early words

Introduction

In the preceding chapter, we analyzed the order of acquisition of the consonantal inventory in the data of five Portuguese children and reported a high degree of variability in the distribution of target-like productions in the first recording sessions. Other idiosyncrasies of early acquisition patterns were also pointed out, namely that intake patterns differ substantially from adult speech patterns, in terms of distribution of place and manner features and that these differences become less noticeable as soon as children' s vocabularies expand.

In the current chapter, early acquisition patterns in Portuguese will be explored in further detail; we will report on the feature architecture of first words, focusing not on individual features but on feature patterns at the word level. It will be shown that Portuguese learners go through an initial developmental stage, where all consonants in output forms share place and/or manner features. These results will be discussed in the light of a suprasegmental approach to the development of early output representations, where the word plays a central role as an organizing unit, as proposed for the acquisition of other languages by Macken (1979), Levelt (1994), Langeslag (2007) and Fikkert & Levelt (2008), among others.

This chapter is organized as follows. Section 4.1 presents an overview of the literature on the development of place and manner feature patterns in early words, focusing primarily on models proposed for Dutch child language. Section 4.2 provides information on the feature classification of consonants and vowels in EP, which will be used as descriptive tools for the analysis of children's data. Section 4.3 presents a summary of theoretical issues and outlines the aims and research questions underlying the current chapter. Section 4.4 explores the methodological issues. Sections 4.5 and 4.6 present the results of the Portuguese data analysis, describing the development of place feature patterns and manner feature patterns, respectively. A summary of the main findings is given in 4.7, followed by a general discussion in 4.8. Some concluding remarks are presented in 4.9.

4.1 Studies on the development of feature patterns in early words

Research on segmental acquisition across languages has reported an initial developmental stage in which children's output forms are overwhelmingly characterized by a [C=C] format, where consonants are identical for place and/or manner features (Smith, 1973; Macken, 1979; Bernhardt & Stemberger, 1998; Stoel-

Gammon, 2002; Fikkert & Levelt, 2008, among others).

In a study of the first words produced by 52 typically developing English children, Stoel-Gammon (2002) reports that 85% of the 205 CVCV output forms display identical consonants and that words where consonants differ in manner or place features constituted only 8% and 0.5%, respectively. According to Stoel-Gammon, the patterns observed result, in part, from children's early vocabulary, mostly constituted by words with reduplicated consonants like *mommy*, *daddy*, *baby*, but is also the outcome of assimilations and substitutions, for instance a word like *doggie* is produced as [gagi], *kitty* rendered as [titi] and *bottle* as [baba] or [babu] (Stoel-Gammon, 2002:159). The author also mentions that stops and nasals are predominant in these early [C=C] productions.

In a comparative study on the acquisition of manner feature patterns in German, Dutch and French, Altvater-Mackensen, Dos Santos & Fikkert (2008) report that all subjects (4 German, 6 Dutch, 2 French) go through an initial stage where all consonants in the words produced are identical in manner specification. Early CVC and CVCV words are of the type [Stop…Stop][20] in the three groups; additionally, in German [Nas…Nas] also appears in early [C=C] patterns (Altvater-Mackensen & Fikkert, 2009) and in French both [Nas…Nas] and [Lat…Lat] have been observed. These early manner patterns are illustrated in (105).

(105) Early manner word-patterns in German, Dutch and French

(Alvater-Mackensen, Dos Santos & Fikkert, 2008; Alvater-Mackensen & Fikkert, 2009)

Gloss	Orthography	Target	Output	Output PoA pattern	Child/age	
frog	kikker	/kɪkəɹ/	[tɪka]	[Stop…Stop]	Noortje, 2;0	Dutch
man	mann	/man/	[man]	[Nas…Nas]	Hannah 1;05	German
bed	bett	/bɛt/	[batʰ]	[Stop…Stop]	Hannah 1;06	German
sore	bobo	/bobo/	[bobo]	[Stop…Stop]	Marilyn, 1;10	French
teddy	nounours	/nunuʁs/	[nunu]	[Nas…Nas]	Marilyn, 1;10	French
shoe	chaussure	/ʃosuʁ/	[lyly]	[Lat…Lat]	Marilyn, 1;10	French

Several studies have approached early [C=C] output patterns as a result of Consonant Harmony (Smith, 1973; Vihman, 1978; Stoel-Gammon & Stemberger, 1994; Pater, 1997; see chapter 6 for further discussion on this topic). Other studies, however, suggest that the preference for [C=C] output forms is an epiphenomenon of an initial holistic stage, in which features are associated to the word, and not to individual segments (Menn, 1978; Iverson & Wheeler, 1987; Levelt, 1994, to appear; Langeslag,

[20] For uniformity reasons, we converted the notation criteria used in these studies into the ones used in the current dissertation; for instance, [PVP] has been converted into [Stop...Stop], [NVN] into [Nas...Nas].

2007, Fikkert & Levelt, 2008).

This suprassegmental approach to early [C=C] outputs will be explored in further detail in the next two subsections, based on research in the acquisition of Dutch: in subsection 4.1.1, we present an outline of the model proposed by Levelt (1994), further developed in Fikkert & Levelt (2008), for the acquisition of place word patterns and in subsection 4.1.2, we will focus on the findings described by Langeslag (2007), regarding the acquisition of manner feature patterns. In 4.1.3, we present a brief overview of the relation between early lexicon and early output representations.

4.1.1 A model for the development of place feature patterns

Based on longitudinal acquisition data of five Dutch children (age range between 1;0-2;11),[21] Levelt (1994; to appear) and Fikkert & Levelt (2008) propose a model for the acquisition of place feature patterns. The authors adopt the feature geometry model put forward by Lahiri & Evers (1991), arguing that both consonants and vowels can be addressed through a single set of place of articulation features: (i) Labial includes round vowels and labial consonants; (ii) Coronal refers to front vowels and coronal consonants; (iii) Dorsal refers to back vowels and Dorsal consonants. This unified description is summarized in (106).

(106) Place feature characterization of vowels and consonants (Levelt, 1994)

(a)	Labial	Labial consonants	[p b β f v m]
		Round vowels	[o u ɔ]
(b)	Coronal	Coronal consonants	[t d ð s z n l ɾ ʃ ʒ ʎ ɲ]
		[-back] vowels	[i e ɛ]
(c)	Dorsal	Dorsal consonants	[k g ʀ ɣ]
		Back vowels	[o u ɔ]
(e)	Low	Low vowels	[a ɑ]

According to this model, round vowels such as [ɔ u o] have a complex structure, since they are both Labial and Dorsal. However, based on Dutch acquisition data, Levelt (1994) suggests that, at early phonological development, these segments are only specified as Labial in children's output representations, due to an initial constraint on dorsal features.

According to Levelt (1994) and Fikkert & Levelt (2008), low vowels can be identified only on the basis of height features and, for this reason, are not specified for place (see (e), above). Levelt (p.c) argues for a similar characterization of central vowels (for instance, [ɐ ə ɨ]): they are neither front nor back or round, thus lacking place

[21] CLPF database (Levelt, 1994; Fikkert, 1994).

specification.

In the first developmental stage identified by Levelt (1994), consonants within the words produced are identical for place features and vowels either carry the same specification as consonants or are low ([$C_iV_iC_i$ or $C_iV_{low}C_i$]); see also Fikkert & Levelt, 2008 and Levelt, to appear). Some examples of early words in Dutch children's productions are given in (107).

(107) Stage I in the development of place feature patterns in Dutch: examples (Levelt, 1994)

	Gloss	Orthography	Target	Output	Output PoA patterns	Child/Age
(a)	bed	bed	/bɛt/	[dɛt]	[$C_{cor}V_{cor}C_{cor}$]	Eva, 1;4
(b)	look	kijk	/kɛik/	[tɛit]	[$C_{cor}V_{cor}C_{cor}$]	Eva, 1;4
(c)	cat	poes	/pus/	[puf]	[$C_{lab}V_{lab}C_{lab}$]	Eva, 1;4
(d)	mommy	mamma	/mɑma/	[mɑma]	[$C_{lab}V_{low}C_{lab}V_{low}$]	Robin, 1;5
(e)	television	television	/teləvisi/	[zizi]	[$C_{cor}V_{cor}C_{cor}V_{cor}$]	Robin, 1;5-1;6
(f)	ball	bal	/bɑl/	[bɑo]	[$C_{lab}V_{low}V_{lab}$]	Robin, 1;5-1;6

As illustrated above, the first words produced by Dutch children all fit into one of two types: [$C_iV_{low}C_i$], where consonants share place features and vowels are specified as low (unspecified for place) (see examples (d) and (f)) or [$C_iV_iC_i$], where consonants and vowels share place features (see examples from (a) to (c) and (e)).

According to Levelt (1994), the most frequent place feature patterns in early productions are [Cor...Cor] and [Lab...Lab], since some children have an initial constraint on [Dor...Dor] output forms. The author argues that Coronal is the default feature, underspecified in Dutch children's output representations.

In a second developmental stage, Dutch children start producing words where consonants still share place features but vowels can already be differently specified ([$C_iV_jC_i$]). Some examples are given in (108).

(108) Stage II in the development of place feature patterns in Dutch: examples (Levelt, 1994)

	Orthography	Gloss	Target	Output	Output PoA patterns	Child/Age
(a)	stoel	chair	/stul/	[tul]	[$C_{cor}V_{lab/dor}C_{cor}$]	Robin, 1;9
(b)	neef	cousin	/nef/	[mef]	[$C_{lab}V_{cor}C_{lab}$]	Robin, 1;10
(c)	zeep	soap	/zep/	[fep]	[$C_{lab}V_{cor}C_{lab}$]	Robin, 1;10

Assuming the unified place feature description of consonants and vowels, the three output forms given above are already of the type [$C_iV_jC_i$]: in (a), Robin combines coronal consonants with a labial/dorsal vowel ([u]) and in (b) and (c), he combines labial consonants with a coronal vowel ([e]).

Fikkert & Levelt argue that lexical representations are not target-like from the start; according to these authors, [C=C] output patterns result from the fact that, in children's phonological representations, only the unit WORD is available for place feature specification. Children start with WORD as an unanalyzed whole that needs to be segmentalized. The term WORD is used by Levelt (1994) and Fikkert & Levelt (2008) as an abstract category; it can be constituted by <u>CVC</u> in monosyllables or by <u>CVC</u>V in disyllables (Levelt, 1994: 84-85).

According to Fikkert & Levelt (2008), place specification of the unit WORD is provided by the target stressed vowel (non-low), in the first stage of development. This procedure is illustrated in (109).

(109) Place feature assignment at the level of the WORD (Fikkert & Levelt, 2008)

Incomplete lexical representation	
prik (injection)	
Adult output:	[pr ɪ k]
	⇩
Child's Lexical representation:	WORD *Cor*

As depicted above, the Dutch target word *prik* is mapped to the child's lexical representation in the following way: the child accurately perceives the coronality of the target stressed vowel and assigns that place feature to the holistic representation. According to Levelt (to appear) the above procedure takes place only in the first developmental stage and only when target stressed vowels are non-low (or non-central, Levelt, p.c). Otherwise, place feature specification is provided by one of the target consonants.

The first two stages observed in the development of place feature patterns in Dutch are summarized in (110), according to the model proposed by Fikkert & Levelt (2008).

(110) Stages I and II in the development of place feature patterns – Dutch (Fikkert & Levelt, 2008)

(Cumulative)

Stage I: [$C_iV_{low}C_i$] or [$C_iV_iC_i$]

Stage II: [$C_iV_jC_i$]

The stages that follow in the development of place feature patterns (stages III, IV and V) correspond to the appearance of [C≠C] patterns in production. Those stages will be explored in chapter 5.

4.1.2 A model for the development of manner feature patterns

Based on longitudinal data of six Dutch children[22] Langeslag (2007) proposes a model for the acquisition of manner features; in the current chapter, we will only focus on the first stage of this model, for CVCV forms (see chapter 5 for a description of the following stages).

Langeslag shows that, as far as CVCV words are concerned, four of the six children studied go through an initial stage of exclusive manner harmony ([$C_{MoA}=C_{MoA}$]), until 2;6, approximately. Only obstruents are produced at this stage: [Stop...Stop] and [Fric...Fric]. Some examples of these harmonic productions are given in (111).

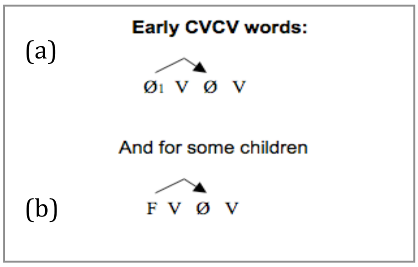
(111) Stage I in the development of manner patterns in Dutch – examples (Langeslag, 2007)

	Gloss	Orthography	Target	Output	Output MoA patterns	Child/Age
(a)	table	tafel	/tafəl/	[tatø]	[Stop…Stop]	Tom, 1;6
(b)	to walk	lopen	/lopə/	[paupə]	[Stop…Stop]	Noortje, 2;6
(c)	to read	lezen	/lezə/	[sesə]	[Fric…Fric]	Jarmo, 2;0

As shown in the examples above, the attempted forms display non-harmonic manner combinations ([/Stop...Fric/ in example (a), /Lat....Stop/ in example (b) and /Lat...Fric/ in example (c), but Dutch children render all these forms into two types of [$C_{MoA}=C_{MoA}$] formats: [Stop...Stop] and [Fric...Fric].

As to where children select the produced manner feature from, Langeslag hypothesizes that, at the moment children start producing disyllables, the initial position of the word (C1) is already a specifiable unit,[23] but C2 position is still not acquired. Thus, children would get manner specification from the C1 and copy it to the other positions in their lexical representation (see example in ((111.a)), above). This procedure is illustrated in (112), where ø stands for unspecified position and ø$_1$ for the default manner feature (stop).

(112) Manner specification of disyllabic output forms in Dutch (Langeslag, 2007:59)



[22] Also from the CLPF database (Fikkert, 1994; Levelt, 1994).

[23] According to Langeslag, at the time children start producing disyllables, they already produce C1 *vs* Coda contrasts in CVC forms. Thus, the child already recognizes the C1 position as a specifiable unit; the intervocalic position, however, is new to the child (the opposition C1-C2 is still not acquired).

According to Langeslag, when the target C1 displays a still non-acquired manner feature (see examples in (111.b) and (111.c), children choose one of two options: (i) manner specification is inserted by default (stop) in C1 and then copied to the other non-vocalic elements of the representation (see (112.a)); (ii) a fricative is inserted in C1 and this manner is then copied to all other positions (see (112.b)). Langeslag argues that the two procedures outlined above can account for the first output forms in Dutch children's data (Langeslag, 2007:63-64).

The first stage of the development of manner features in CVCV forms, as proposed by Langeslag (2007), is summarized in (113).

(113) Stage I in the development of manner feature patterns in CVCV forms (Langeslag, 2007)

a) Predominance of [C_{MoA}=C_{MoA}] output forms, of two types: [Stop…Stop] and [Fric…Fric]

4.1.3 Holistic representations and children's lexicon

Overall, the model proposed by Langeslag (2007) for manner acquisition matches the one suggested by Levelt (1994) and Fikkert & Levelt (2008) for place feature development: Dutch children seem to begin the process of feature assignment at the global or partially unanalyzed level of the word.

The idea that early patterns are best accommodated within an approach where the word has a central role had already been put forward in previous studies, namely by Macken (1979), who argues that early production patterns of Spanish learner Si until the age of 2;1 are best accounted for in a theoretic approach that views the word as the basic organizational unit for segmental features. Similar claims were made in Ferguson & Farwell (1975) and Menn (1971), who suggest that the central unit in early development is the word, not the phoneme.

According to Langeslag (2007) and Fikkert & Levelt (2008), the initial [C=C] (and [C=V], for place) stage represents the beginning of phonological acquisition, where holistic representations are enough to distinguish between the few words that make up the early lexicon; the need for more detailed specification will only emerge with the increase of the number of words that are stored in the child's mental lexicon, leading to developments in the feature make-up of output forms.

The idea that phonological development is dependent, at least in part, on the number and nature of the words in children's early lexicon has often been put forward in the literature. Children's early lexicon is small and idiosyncratic (Macken, 1979; Stoel-Gammon, 2002); quite often, the composition of these words, in terms of place and manner features, does not resemble the distribution of feature patterns or individual features in the input language (Dos Santos, 2007; Fikkert, Levelt & van de Weijer, 2002), as shown in chapter 3. The most common assumption in the literature is that, as the child's active vocabulary expands and becomes less idiosyncratic, his/her underlying representations become more segmentalized and closer to the adult system (Storkel & Morrisette, 2002; Sosa & Stoel-Gammon, 2006, Fikkert & Levelt, 2008; Levelt, to appear).

4.2 The target system

This section provides general information on the consonantal system in EP, namely on place and manner feature characterization and on the distribution of feature word-patterns in adult speech (for further information, see chapter 3, section 3.2). Additionally, we will present the feature characterization of the vocalic system in EP, since that classification will be used to analyze the relation between consonants and vowels in early productions.

The characterization of consonants in EP is provided in (114) and (115), for place and manner features, respectively.

(114) General place feature characterization of consonants in EP (Mateus & d' Andrade, 2000)

a) Labial	[p b m f v]
b) Coronal	[t d n ɲ s z ʃ ʒ l ʎ ɾ]
c) Dorsal	[k g ʀ]

(115) General manner feature characterization of consonants in EP (Mateus & d' Andrade, 2000)

a) Stop	[p b t d k g]
b) Nasal	[m n ɲ]
c) Fricative	[f v s z ʃ ʒ]
d) Lateral	[l ʎ]
e) Rhotic	[ʀ ɾ]

In (116), we provide the feature characterization of vowels in EP, based on the classification presented in Mateus & d' Andrade (2000).

(116) Feature characterization of the vocalic system in EP (Mateus & d' Andrade, 2000)

a) High	[i ɨ u]
b) Low	[ɛ a ɔ]
c) Back	[a ɐ ɨ ɔ o u]
d) Round	[ɔ o u]

Two aspects have to be emphasized in the above classification: (i) vowels [ɛ ɔ] are classified as low, together with [a]; (ii) [ɨ ɐ] are referred to as [+back] and not as central. In these two respects, this classification differs from the general characterization of vowels in the IPA system (Ladefoged, 1992, among others), as well as from the model adopted by Levelt (1994) for the description of consonants and vowels (see section 4.1.1).

According to Mateus, Falé & Freitas (2005), languages may differ in the feature characterization of segments (in this case, vowels), not necessarily based on their physical properties but on their relative distance to the other segments in the system. The authors refer that vowels [ɛ ɔ e o] are all [-high, -low], but the need for the distinction between [ɛ ɔ] and [e o] in EP leads to the classification of [ɛ ɔ] as low, together with [a] (they are less low than [a], but are 'more low' than [e o], which are closer to [i u]). A similar perspective may be underlying the classification of [ɨ ɐ] as [+back] and not as central in EP:[24] relatively to [i] and [a], these two vowels are [+back]; however, in relation to vowels such as [ʊ ɑ], they would have to be considered central.

Since one of the main goals of the current chapter is to compare EP acquisition patterns to Dutch data, we will adopt a feature characterization of vowels similar to the one proposed in Levelt (1994), where [ɛ ɔ] and [ɨ ɐ] would be considered non-low and central, respectively. This classification is, at least partially, supported by Mateus, Falé & Freitas (2005) and is summarized in (117).

(117) Characterization of vowels assumed in the current dissertation

a) High	[i ɨ u]
b) [-low]	[ɛ ɔ]
c) Low	[a]
d) Back	[a ɔ o u]
e) [-back]	[i ɛ e]
f) Central	[ɨ ɐ]
g) Round	[ɔ o u]

Feature patterns in EP adult speech

In chapter 3, we compared children's acquisition patterns to the distribution of place and manner features in a sample of adult speech. A similar study will be performed in the current chapter, but now the comparison will focus not on individual features but on feature patterns in words. In order to establish this comparison, we

[24] However, we did not find any discussion of this issue in the literature on the vocalic system in EP.

extracted the 100 most frequent CVCV words from a sample of Spoken Portuguese (constituted by 22.842 words, see section 4.4) and identified the distribution of consonantal place and manner feature patterns in those words. For instance, a word like *muito* (plenty) was classified as [Lab…Cor], for place and as [Nas…Stop], for manner. The results are given in graphs (118) and (119).

(118) *Distribution of place feature patterns in EP adult speech – Onsets C1; C2 (appendix B)*

[C_{PoA}…C_{PoA}] forms	%
[Lab…Cor]	26%
[Cor…Cor]	23%
[Dor…Cor]	17%
[Cor…Lab]	16%
[Lab…Dor]	5%
[Cor…Dor]	5%
[Dor…Lab]	4%
[Lab…Lab]	3%
[Dor…Dor]	1%

(119) *Distribution of manner feature patterns in EP adult speech – Onsets C1; C2 (appendix B)*

[C_{MoA}…C_{MoA}] forms	%
[Stop…Stop]	32%
[Nas…Stop]	13%
[Stop…Fric]	12%
[Stop…Nas]	9%
[Nas…Nas]	5%
[Stop…Lat]	5%
[Fric…Stop]	5%
[Fric…Fric]	4%
[Stop…Rhot]	4%
[Fric…Nas]	3%
[Lat…Stop]	2%
[Nas….Lat]	2%
[Fric…Rhot]	1%
[Lat…Nas]	1%
[Nas…Fric]	1%
[Fric…Lat]	1%

As shown in (118), [Lab…Cor] is the most frequently produced place feature pattern in the sample of the 100 most frequent CVCV words in EP adult speech; it corresponds to 26%, followed by [Cor…Cor] (23%). The patterns [Dor…Cor] and [Cor…Lab] also occur with a relatively high frequency (17% and 16%, respectively). Other place patterns are produced less often, below 6%. Focusing on the homorganic patterns ([C_{PoA}=C_{PoA}]), we can see that [Cor…Cor] is the most frequent (23%), while [Lab…Lab] and [Dor…Dor] are quite infrequent (3% and 1%, respectively).

As for manner word-patterns (see (119)) the most frequent pattern is of the type [C_{MoA}=C_{MoA}]: [Stop…Stop] occurs in 32% of the cases. Other manner patterns occur relatively often: [Nas…Stop] (13%), [Stop…Fric] (12%) and [Stop…Nas] (9%). Several other manner patterns are produced, but all below 6%. Focusing on [C_{MoA}=C_{MoA}] combinations, the most frequent is [Stop…Stop] (32%), followed by and [Nas…Nas] (5%) and [Fric…Fric] (4%). Homogeneous manner sequences that include liquids do not occur in the sample studied.

In section 4.8, the distribution of feature patterns in adult speech referred to above will be compared to feature patterns observed in early productions, in order to discuss if EP children's early production forms can be related to the frequency of feature word-patterns in the input.

4.3 Summary and research questions

Research on phonological acquisition has shown that children's early productions tend to be harmonic for place and/or manner features: [C_{PoA}=C_{PoA}] and [C_{MoA}=C_{MoA}].

According to the model proposed by Levelt (1994) and Fikkert & Levelt (2008), Dutch children go through an initial *one place feature for the whole WORD* stage, where all consonants and vowels share a single place specification, or vowels are low or central ([$C_iV_{low}C_i$]; [$C_iV_iC_i$]). In a second stage, vowels can be independently specified for place, but consonants still share place features ([$C_iV_jC_i$]). In the initial stage, the two most frequently occurring place features in Dutch children's outputs are Labial and Coronal. The authors assume that in this initial period, children tend to extract the place specification of the target stressed vowel (non-low, non-central) and assign it to the whole, unsegmentalized unit WORD.

In the model proposed by Langeslag (2007) for the acquisition of CVCV manner patterns, the first stage is characterized by the predominance [C_{MoA}=C_{MoA}] output forms, of the type [Stop…Stop] and [Fric…Fric]. The author argues that Stop is the default manner in children's systems.

The idea that children start with holistic representations that are gradually segmentalized has often been related, in the literature, to children's productive vocabulary: unanalyzed lexical representations are typical of an early stage, where children's lexicons are very small. The expansion of children's vocabulary is assumed to trigger the need for more detailed representations.

Based on the findings and theoretic issues outlined above, two main research questions were formulated for the current chapter, listed in (120).

(120) Research questions for the current chapter

1. Is there an initial [C=C] stage in EP, for place and/or manner features?
2. What insights can early place and manner feature patterns provide into Portuguese children's early representations?

Aiming to provide empirical evidence for the discussion of the two questions listed above, some specific goals have been formulated, outlined in (121).

(121) Specific goals of the current chapter

a) Describe the distribution of [C_{PoA}=C_{PoA}] and [C_{PoA}≠C_{PoA}] patterns, in intake (attempted words) and output forms.

b) Check if the [$C_iV_iC_i$] or [$C_iV_{low}C_i$] PoA stage identified in Dutch is confirmed in Portuguese child language data.

c) Describe the distribution of [C_{MoA}=C_{MoA}] and [C_{MoA}≠C_{MoA}] patterns, in intake and output forms.

d) Identify the most frequent place and manner feature patterns in early word productions and compare them to the distribution of feature word-patterns in EP adult speech.

4.4 Method

The developmental patterns presented in the current chapter are based on spontaneous longitudinal data of 5 European Portuguese children (see chapter 2 for a detailed description of the database). The age period studied in this chapter, per child, is given in (122).

(122) Age-period studied in the current chapter

Clara	0;11.1	1;10.15
João	1;0.1	2;0.20
Inês	0;11.14	2;0.11
Joana	1;0.25	2;6.24
Luma	0;11.23	2;6.27

The place and manner features that constitute the focus of analysis in the current chapter are summarized in (123).

(123) Features studied in this chapter - consonants

MoA		PoA	
Stop	[p t k b d g]	Labial	[p b f v m]
Nasal	[m n ɲ]	Coronal	[t d n s z l ɾ ʃ ʒ ʎ ɲ]
Fricative	[f v s z ʃ ʒ]	Dorsal	[k g ʀ]
Lateral	[l ʎ]		
Rhotic	[ɾ ʀ]		

In order to compare Portuguese acquisition patterns to Dutch, we will adopt the theoretic tool used by Levelt (1994) for a unified description of consonants and vowels (as far as place features are concerned).

(124) Descriptive tool for the analysis of [C V] combinations, based on Levelt (1994)[25]

Labial	Labial consonants	[p b β f v m]
	Round vowels	[o u ɔ]
Coronal	Coronal consonants	[t d ð s z n l ɾ ʃ ʒ ʎ ɲ]
	[-back] vowels	[i e ɛ]
Dorsal	Dorsal consonants	[k g ʀ ɣ]
	Back vowels	[o u ɔ]
Low and Central	Low Central	[a] [ɐ ə ɨ]

In the analysis of output forms, we searched for all multisyllabic productions, in each child's *corpus*, per session. Within those multisyllabic productions, we calculated the number of occurrences of the patterns listed below.

(a) $[C_{PoA}=C_{PoA}]$ [Lab…Lab], [Cor…Cor] and [Dor…Dor]

(b) $[C_{MoA}=C_{MoA}]$ [Stop…Stop], [Nas…Nas], [Fric…Fric], [Lat…Lat] and [Rhot…Rhot]

(c) $[C_{PoA}\neq C_{PoA}]$ For instance, [Lab…Cor] or [Dor…Lab]

(d) $[C_{MoA}\neq C_{MoA}]$ For instance, [Stop…Nas] or [Fric…Stop]

In the analysis of intake forms, only the patterns listed in (a) and (b) above were analyzed.[26] Target words with branching onsets were not studied, in order to minimize potential effects of (complex) syllabic structure on the segmental/featural developmental patterns.

Similarly to what has been done in chapter 3, we will compare children's acquisition patterns to data of EP adult speech (sample constituted by 15702 lexical words and 7140 clitics, taken from the *corpus Spoken Portuguese* - *Português Falado*; TA90PE; CLUL/Instituto Camões; FrePOP database, see chapter 2). Since the focus of the current chapter is on feature patterns, we extracted a subsample of the *corpus* referred to above; using *FreP*,[27] an electronic tool developed at the Phonetics Laboratory, University of Lisbon (Frota, Vigário & Martins, 2006), we selected a list of the 100 most frequently produced CVCV words (see appendix B). These words were coded for both place and manner patterns, focusing only on the consonants (a word like *vida* was coded as [Lab…Cor] and [Fric…Stop]).

[25] And on Levelt, p.c., regarding central vowels.
[26] For the current chapter; but see chapter 5, for a description of the different types of [C≠C] patterns in intake and output forms.
[27] More information on this tool can be found at http://www.fl.ul.pt/LaboratorioFonetica/FreP.

4.5 Place feature composition of early words in EP: Results

In the current section, we describe the place feature composition of Portuguese children's intake and output forms. This section is organized as follows. Subsection 4.5.1 presents the frequency of homorganic ($/C_{PoA}=C_{PoA}/$) and non-homorganic ($/C_{PoA}\neq C_{PoA}/$) patterns in the intake (set of words attempted). Similarly, subsection 4.5.2 describes the distribution of homorganic and non-homorganic patterns in children's output forms. In 4.5.3, we explore the distribution of each place feature in children's harmonic productions. Lastly, subsection 4.5.4 focuses on the relation between consonants and vowels in early output forms.

4.5.1 Distribution of $/C_{PoA}=C_{PoA}/$ and $/C_{PoA}\neq C_{PoA}/$ patterns in intake forms

The analysis of the set of multisyllabic words attempted by each child, in a longitudinal perspective, showed that four of the five children (all except for Luma) have an initial preference for homorganic target forms. This early preference is illustrated in (125).

(125) Examples of target words selected in the first sessions

	Child	Age	Orthogr.	Gloss	Target	PoA pattern
(a)	Inês	0;11.14	bebé	baby	/bɛˈbɛ/	/Lab…Lab/
(b)	Inês	1;3.6	carro	car	/ˈkaʀu/	/Dor…Dor/
(c)	Joana	1;2.29	mamã	mommy	/mɐˈmɐ̃/	/Lab…Lab/
(d)	Joana	1;6.24	papa	baby food	/ˈpapɐ/	/Lab…Lab/
(e)	Clara	1;2.22	papá	daddy	/pɐˈpa/	/Lab…Lab/
(f)	Clara	1;3.6	cocó	poo	/kɔˈkɔ/	/Dor…Dor/
(g)	João	1;0.1	papa	baby food	/ˈpapɐ/	/Lab…Lab/
(h)	João	1;1.28	mamã	mommy	/mɐˈmɐ̃/	/Lab…Lab/

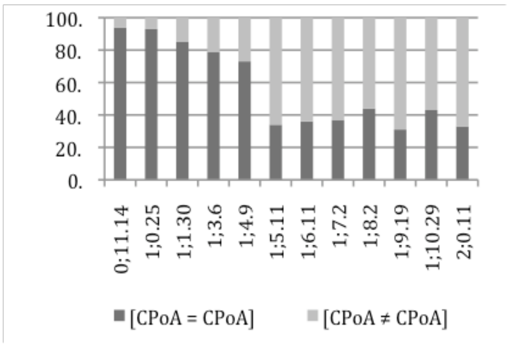
Most of the words that constitute children's early lexicons are of the type /Lab…Lab/, as illustrated above (this preference will be reflected in production; see section 4.5.3).

The duration of an early preference for homorganic targets varies from one child to the other, as will be shown next.

A. Inês

In Inês' data, the predominance of homorganic words in the intake is present from the first session studied, at 0;11, until the age of 1;4. The frequency of selection of $/C_{PoA}=C_{PoA}/$ and $/C_{PoA}\neq C_{PoA}/$ in this child's *corpus* is given in graph (126). The corresponding quantitative data (tokens) is provided in (126.a).

(126) *Distribution of /C_{PoA}=C_{PoA}/ and /C_{PoA}≠C_{PoA}/ in the intake – Inês*



(126.a) *Quantitative data (tokens)*

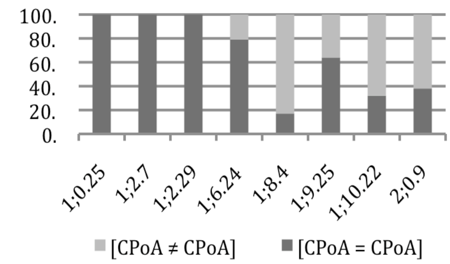
Inês	/C_{PoA}=C_{PoA}/		/C_{PoA}≠C_{PoA}/	
Age	Nº	%	Nº	%
0;11.14	16	94%	1	6%
1;0.25	40	93%	3	7%
1;1.30	40	85%	7	15%
1;3.6	61	79%	16	21%
1;4.9	60	73%	22	27%
1;5.11	31	34%	59	66%
1;6.11	55	36%	97	64%
1;7.2	37	37%	64	63%
1;8.2	70	44%	88	56%
1;9.19	75	31%	166	69%
1;10.29	138	43%	182	57%
2;0.11	108	33%	223	67%

As shown in (126), homorganic word-patterns constitute above or around 80% of all multisyllabic words attempted by Inês until 1;4. From 1;5 onwards, the frequency of homorganic targets decreases to around 40%, while non-homorganic patterns become predominant in intake forms.

B. Joana

In Joana's data, the preference for homorganic target words is predominant in the first four sessions (from 1;0 to 1;6). The distribution of homorganic and non-homorganic words in this child's intake is given in graph (127).

(127) *Distribution of /C_{PoA}=C_{PoA}/ and /C_{PoA}≠C_{PoA}/ in the intake – Joana*



(127.a) *Quantitative data (tokens)*

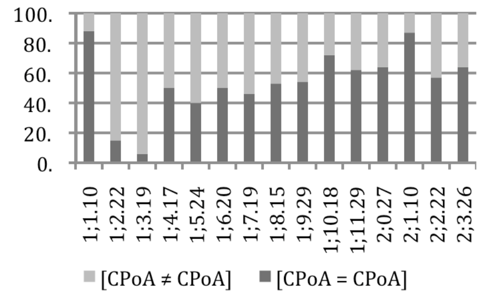
Joana	/C_{PoA}=C_{PoA}/		/C_{PoA}≠C_{PoA}/	
Age	Nº	%	Nº	%
1;0.25	4	100%		0%
1;2.7	2	100%		0%
1;2.29	3	100%		0%
1;6.24	15	79%	4	21%
1;8.4	1	17%	5	83%
1;9.25	25	64%	14	36%
1;10.22	12	32%	25	68%
2;0.9	30	38%	49	62%

As shown above, the selection of homorganic target words in Joana's data is of 100% until 1;2 and, at 1;6, it decreases to 80%. From 1;8 onwards, the attempts of homorganic targets become less frequent, most often below 40%. It is worth emphasizing the low number of tokens until the age of 1;8 (see 127.a). Contrary to Inês (see 126.a), Joana tends to avoid multisyllabic target forms.

C. Luma

The distribution of homorganic and non-homorganic forms in Luma's intake is given in (128).

(128) Distribution of /C_{PoA}=C_{PoA}/ and /C_{PoA}≠C_{PoA}/ in the intake – Luma



(128.a) *Quantitative data (tokens)*

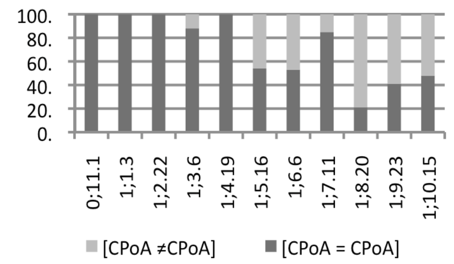
Luma	/C_{PoA}=C_{PoA}/		/C_{PoA}≠C_{PoA}/	
Age	Nº	%	Nº	%
1;1.10	7	88%	1	12%
1;2.22	2	15%	11	85%
1;3.19	2	6%	29	94%
1;4.17	2	50%	2	50%
1;5.24	6	40%	9	60%
1;6.20	14	50%	14	50%
1;7.19	33	46%	39	54%
1;8.15	20	53%	18	47%
1;9.29	37	54%	32	46%
1;10.18	55	72%	21	28%
1;11.29	50	62%	31	38%
2;0.27	43	64%	24	36%
2;1.10	72	87%	11	13%
2;2.22	59	57%	44	43%
2;3.26	127	64%	71	36%

As shown above, there is no clear pattern in the selection of multisyllabic targets, in Luma's data: at 1;1, homorganic forms are more frequently attempted than non-homorganic ones (88% and 12%, respectively) but then the reverse pattern occurs from 1;2 to 1;9: /C_{PoA}≠C_{PoA}/ are selected in more than 60% of all multisyllabic words attempted. Then, from 1;10 onwards, homorganics outrank non-homorganics again (/C_{PoA}=C_{PoA}/ in about 60% of the cases, from 1;10 to 2;3).

D. Clara

The distribution of /C_{PoA}=C_{PoA}/ and /C_{PoA}≠C_{PoA}/ patterns in Clara's intake is provided (129).

(129) Distribution of /C_{PoA}=C_{PoA}/ and /C_{PoA}≠C_{PoA}/ in the intake – Clara



(129.a) *Quantitative data (tokens)*

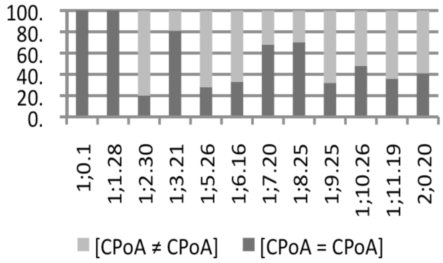
Clara	/C_{PoA}=C_{PoA}/		/C_{PoA}≠C_{PoA}/	
Age	Nº	%	Nº	%
0;11.1	1	100%		0%
1;1.3	12	100%		0%
1;2.22	10	100%		0%
1;3.6	7	88%	1	12%
1;4.19	4	100%		0%
1;5.16	7	54%	6	46%
1;6.6	9	53%	8	47%
1;7.11	17	85%	3	15%
1;8.20	17	21%	65	79%
1;9.23	45	41%	64	59%
1;10.15	58	48%	63	52%

As shown above, the frequency of homorganic patterns in Clara's intake is of 88% or 100% between 0;11 and 1;4. From then onwards, non-homorganic target words become more frequent, in around or above 50% of the cases (except for 1;7, where homorganics predominate again).

E. João

The preference for homorganic targets in João's data occurs mostly at the first two sessions, as shown in (130).

(130) Distribution of /C_{PoA}=C_{PoA}/ and /C_{PoA}≠C_{PoA}/ in the intake – João



(130.a) *Quantitative data (tokens)*

João	/C_{PoA}=C_{PoA}/		/C_{PoA}≠C_{PoA}/	
Age	Nº	%	Nº	%
1;0.1	6	100%		0%
1;1.28	3	100%		0%
1;2.30	5	20%	20	80%
1;3.21	21	81%	5	19%
1;5.26	15	28%	38	72%
1;6.16	15	33%	31	67%
1;7.20	52	68%	25	32%
1;8.25	23	70%	10	30%
1;9.25	37	32%	78	68%
1;10.26	54	48%	59	52%
1;11.19	61	36%	109	64%
2;0.20	67	41%	96	59%

Between 1;0 and 1;1, the frequency of selection of /C_{PoA}=C_{PoA}/ forms is of 100% (but see low number of occurrences, in 130.a). From 1;2 onwards, there is much variation in the frequency of selection of homorganic and non-homorganic forms, although /C_{PoA}≠C_{PoA}/ forms tend to be attempted more often than /C_{PoA}=C_{PoA}/, in most sessions (between 1;5-1;6 and 1;9-2;0).

To sum up, four children show an initial preference for homorganic target words: Inês between 0;11 and 1;4; Joana between 1;0 and 1;6; Clara between 0;11 and 1;4 and João between 1;0 and 1;1. In Luma's data, there is no clear selection pattern. Contrary to the other subjects, Luma attempts both harmonic and non-harmonic patterns in the first recording sessions. At least as far as /C=C/ and C≠C/ patterns are concerned, lexical selection is not a predominant strategy in this child's data.

4.5.2 Distribution of [C_{PoA}=C_{PoA}] and [C_{PoA}≠C_{PoA}] patterns in output forms

The current section explores the distribution of homorganic and non-homorganic patterns in children's productions. A preliminary analysis of the five children's *corpora* showed that, in the first sessions, all children present a similar production pattern for PoA features: the majority of multisyllabic outputs displays place feature identity between the consonants of the word ([C_{PoA}=C_{PoA}]). Some examples of these homorganic productions are given in (131).

(131) Examples of [C_{PoA}=C_{PoA}] forms in children's productions

	Child	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	Inês	1;3.6	babete	bib	/bɐˈbɛtɨ/	[bɛbɛbɛ]	[Lab…Lab]
(b)	Inês	1;5.11	queijo	cheese	/ˈkɐjʒu/	[keˈkɛ]	[Dor…Dor]
(c)	Inês	1;6.11	dinheiro	money	/diˈɲɐjɾu/	[ɲiˈɲɛ]	[Cor…Cor]
(d)	Joana	1;0.25	mamã	mammy	/mɐˈmɐ̃/	[ɐmɐˈmɐ̃ː]	[Lab…Lab]
(e)	Joana	1;10.22	escola	school	/ʃˈkɔlɐ/	[kɔˈkɔ]	[Dor…Dor]
(f)	Luma	1;3.19	banana	banana	/bɐˈnɐnɐ/	[ˈɲɐɲɨ]	[Cor…Cor]
(g)	Luma	2;3.26	lobo	wolf	/ˈlobu/	[ˈbobu]	[Lab…Lab]
(h)	Clara	1;2.22	bebé	baby	/bɛˈbɛ/	[beˈbe]	[Lab…Lab]

(i)	Clara	1;8.20	Clara	prop.noun	/ˈklaɾɐ/	[kaˈka]	[Dor…Dor]
(j)	João	1;3.21	papa	cereal	/ˈpapɐ/	[ˈpapɐ]	[Lab…Lab]
(k)	João	1;11.10	construtor	builder	/kõʃtɾuˈtoɾ/	[tutuˈto]	[Cor…Cor]

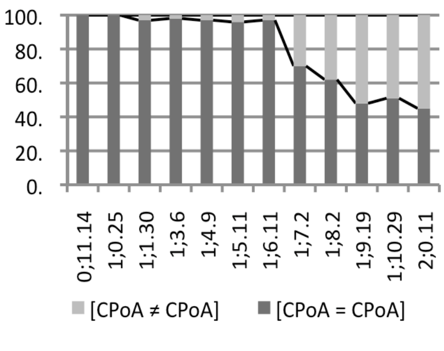
As illustrated above, homorganic productions can correspond to homorganic targets (see examples in (d), (h), (j)), but also to non-homorganic attempted forms (see examples in (g), (i) and (k), for instance). In the latter cases, [C_{PoA}≠C_{PoA}] targets are rendered as [C_{PoA}=C_{PoA}] through substitution patterns (see example in (g)) or reduplication strategies (see examples (a), (b), (i)).

The alternative strategies used to cope with problematic non-homorganic targets throughout development will be explored in chapter 6. For the current chapter, what is worth emphasizing is that in the initial stage, the predominant pattern in children's production is [C_{PoA}=C_{PoA}], independently of the feature composition of the target words attempted. The duration of this homorganic production stage varies across children, as will be shown below.

A. Inês

The graph provided in (132) shows the frequency of occurrence of homorganic and non-homorganic output forms, per session, in Inês' data; since the percentages sometimes correspond to low numbers, particularly in the first sessions, the graph is complemented with quantitative data (see 132.a).

(132) *Distribution of [C_{PoA}=C_{PoA}] and [C_{PoA}≠C_{PoA}] in Inês' productions*



(132.a) *Quantitative data (tokens)*

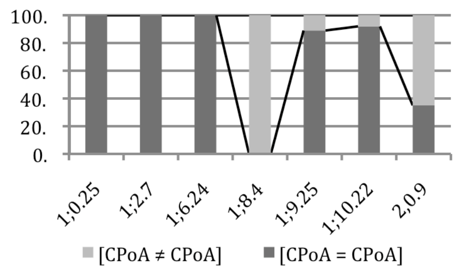
	[C_{PoA}=C_{PoA}]		[C_{PoA}≠C_{PoA}]	
	N.º	%	N.º	%
0;11.14	15	100%	0	0%
1;0.25	33	100%	0	0%
1;1.30	89	97%	3	3%
1;3.6	126	98%	2	2%
1;4.9	59	97%	2	3%
1;5.11	156	96%	7	4%
1;6.11	116	97%	4	3%
1;7.2	55	70%	24	30%
1;8.2	105	62%	63	38%
1;9.19	108	48%	117	52%
1;10.29	190	51%	182	49%
2;0.11	175	45%	217	55%

As shown above, [C_{PoA}=C_{PoA}] forms predominate in Inês' productions throughout the first sessions, constituting around 100% of the multisyllabic forms produced from 0;11 to 1;6. From 1;7 onwards, the percentage of homorganics in this child's data starts decreasing gradually, hovering around 50% from 1;9.

B. Joana

The graph given in (133) displays the frequency of occurrence of homorganic and non-homorganic output forms, per session, in Joana's data.

(133) *Distribution of [C_{PoA}=C_{PoA}] and [C_{PoA}≠C_{PoA}] in Joana's productions*



(133.a) *Quantitative data (tokens)*

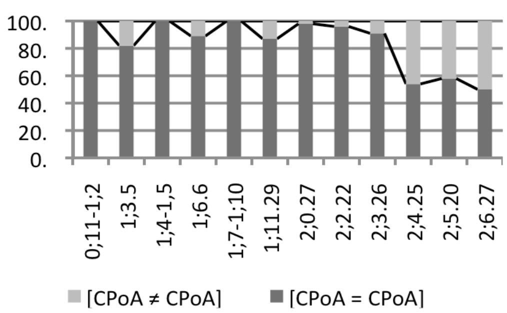
	[C_{PoA}=C_{PoA}]		[C_{PoA}≠C_{PoA}]	
	N.º	%	N.º	%
1;0.25	1	100%	0	0%
1;2.7	1	100%	0	0%
1;6.24	2	100%	0	0%
1;8.4	0	0%	1	100%
1;9.25	25	89%	3	11%
1;10.22	12	92%	1	8%
2,0.9	22	35%	40	65%

In Joana's data, the homorganic period is longer than in Inês; it goes from the age of 1;0 to 1;10. The sudden decrease at 1;8.4 corresponds to one single multisyllabic occurrence in that session /kɐpuˈʃiɲu/->[pɨˈdʒũ] (see (133.a). It is worth emphasizing that, as shown in (133.a), there are very few cases of multisyllabic outputs forms in Joana's data until the age of 1;9. In the first sessions, the majority of this child's productions is of type [VCV] or [CV]; Joana has a clear preference for truncation in early words (see chapter 6) added to an initial tendency to avoid multisyllabic targets (see section 4.5.1). Between 1;9 and 1;10, the preference for homorganic outputs still remains (around 90%). At 2;0, [C_{PoA}≠C_{PoA}] patterns decrease to 35% of all multisyllabic forms produced by this child.

C. Luma

The distribution of homorganic and non-homorganic output forms in Luma's *corpus*, per session, is provided in (134).

(134) *Distribution of [C_{PoA}=C_{PoA}] and [C_{PoA}≠C_{PoA}] in Luma's productions*



(134.a) *Quantitative data (tokens)*

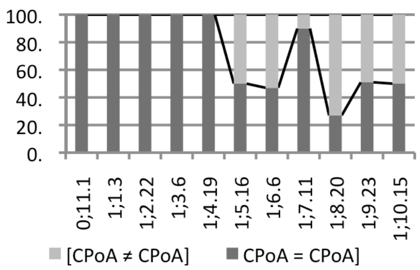
LUMA	[C_{PoA}=C_{PoA}]		[C_{PoA}≠C_{PoA}]	
	N.º	%	N.º	%
0;11.23	2	100%	0	0%
1;2.22	7	100%	0	0%
1;3.5	9	82%	2	18%
1;4.17	3	100%	0	0%
1;6.6	8	89%	1	11%
1;7.19	22	100%	0	0%
1;10.18	55	100%	0	0%
1;11.29	13	87%	2	13%
2;0.27	46	98%	1	2%
2;2.22	66	96%	3	4%
2;3.26	146	91%	15	9%
2;4.25	133	54%	112	46%
2;5.20	167	58%	120	42%
2;6.27	159	50%	158	50%

The homorganic production stage is longer in Luma's data than in the other children: it covers the period from the first session analyzed (at 0;11) to the age of 2;3. During this period, the frequency of [C_{PoA}=C_{PoA}] output forms is systematically above 80% of Luma's multisyllabic productions. It is only at 2;4 that the occurrence of homorganic outputs decreases below 80%.

D. Clara

Clara was studied until the age of 1;10. The distribution of homorganic and non-homorganic output forms in this child's *corpus*, per session, is provided in (135).

(135) Distribution of [C_{PoA}=C_{PoA}] and [C_{PoA}≠C_{PoA}] Clara's productions



(135.a) *Quantitative data (tokens)*

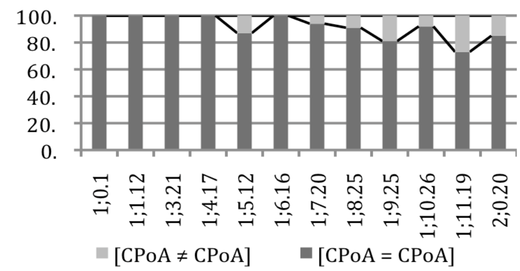
	[C_{PoA}=C_{PoA}]		[C_{PoA}≠C_{PoA}]	
	N.º	%	N.º	%
0;11.1	1		0	0%
1;1.3	10	100%	0	0%
1;2.22	11	100%	0	0%
1;3.6	5	100%	0	0%
1;4.19	3	100%	0	0%
1;5.16	6	50%	6	50%
1;6.6	7	47%	8	53%
1;7.11	17	90%	2	10%
1;8.20	21	27%	58	73%
1;9.23	49	51%	47	49%
1;10.15	52	50%	53	50%

Between 0;11 and 1;4, all multisyllabic output forms in Clara's data are homorganic. From 1;5 onwards, the frequency of [C≠C] productions decreases below 80%, in all sessions except for 1;7. Note that the number of tokens is low until the age of 1;8 (see 135.a).

E. João

João was studied until the age of 2;0. The distribution of homorganic and non-homorganic output forms in this child's *corpus*, per session, is provided in (136).

(136) Distribution of [C_{PoA}=C_{PoA}] and [C_{PoA}≠C_{PoA}] in João's productions



(136.a) *Quantitative data (tokens)*

	[C_{PoA}=C_{PoA}]		[C_{PoA}≠C_{PoA}]	
	N.º	%	N.º	%
1;0.1	5	100%	0	0%
1;1.12	1	100%	0	0%
1;3.21	3	100%	0	0%
1;4.17	3	100%	0	0%
1;5.12	14	87%	2	13%
1;6.16	40	100%	0	0%
1;7.20	49	94%	3	6%
1;8.25	20	91%	2	9%
1;9.25	81	81%	19	19%
1;10.26	132	92%	11	8%
1;11.19	114	73%	42	27%
2;0.20	128	85%	22	15%

Although some decreases in the occurrence of homorganic outputs can be observed from 1;9 onwards, the vast majority of João's multisyllabic productions are homorganic (always above or around 80%) until the last session studied, at 2;0.

Similarly to the other children, there are very few tokens in the first sessions (see 136.a).

In summary, all children show an initial stage where the vast majority of multisyllabic productions, above 80%, are homorganic. The duration of this [C_{PoA}=C_{PoA}] stage varies across children: it is shorter in Clara's data (until 1;4) and longer in Luma (until 2;3).

The time frame covered by homorganic predominance in intake and output forms, in each child's *corpus*, is summarized in (137).

(137) Time-frame covered by the predominance of homorganic patterns

[C_{PoA}=C_{PoA}]	Intake		Production	
Inês	0;11	1;4	0;11	1;6
Joana	1;0	1;6	1;0	1;10
Luma	----	----	0;11	2;3
Clara	0;11	1;4	0;11	1;4
João	1;0	1;1	1;0	2;0

As shown above, the duration of the homorganic stage is longer in production than in the targets attempted, except for Clara, for whom the [C_{PoA}=C_{PoA}] are predominant until 1;4, both in intake and output forms.

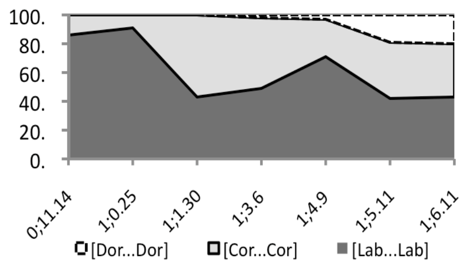
4.5.3 Distribution of place features in [C_{PoA}=C_{PoA}] productions

In the preceding section, it was shown that children go though an initial stage where the vast majority of the multisyllabic forms produced are homorganic. In the current section, we will present the frequency of each place feature within those homorganic productions.

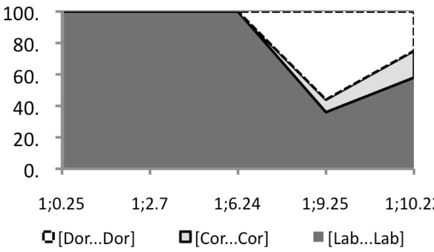
The graphs presented in (138) show the distribution of each primary place feature (Labial, Coronal, Dorsal) in the [C_{PoA}=C_{PoA}] output stage, for each child. As shown in the previous section, the duration of that stage is variable: from 0;11 to 1;6 in Inês (see graph 138.a), from 1;0 to 1;10 in Joana (graph 138.b); from 0;11 to 2;3 in Luma (graph 138.c); from 0;11 to 1;4 in Clara (graph 138.d); from 1;0 to 2;0 in João (graph 138.e).

(138) Distribution of place features in the [C_{PoA}=C_{PoA}] production stage (appendix F)

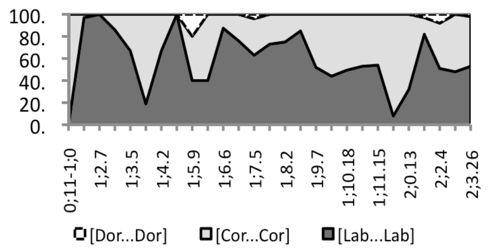
(138.a) *Inês*



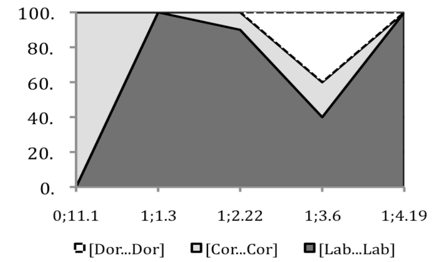
(138.b) *Joana*



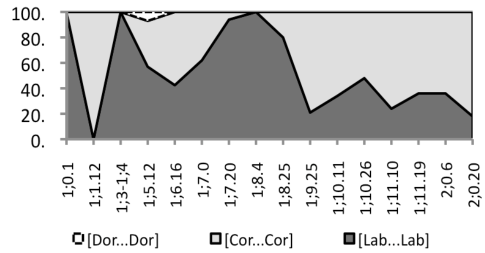
(138.c) *Luma*



(138.d) *Clara*



(138.e) *João*



In general, [Lab…Lab] patterns are more frequently produced in the first sessions - in Inês' data, until 1;0, in Joana until 1;6; in Luma until 1;9, in Clara until 1;2 and in João until 1;8 - while [Cor…Cor] and [Dor…Dor] are more often produced in later sessions. Some examples are provided in (139).

(139) Examples of [Lab…Lab], [Cor…Cor] and [Dor…Dor] output forms

	Child	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	Inês	0;11.14	mamã	mommy	/mɐˈmɐ̃/	[mɐˈmɐ̃]	[Lab…Lab]
(b)	Clara	1;3.3	bebé	baby	/bɛˈbɛ/	[pəbə]/[bɐpɐ]	[Lab…Lab]
(c)	João	1;3.21	papa	baby food	/ˈpapɐ/	[ˈpapɐ]	[Lab…Lab]
(d)	Inês	1;3.6	babete	bib	/baˈbɛtɨ/	[bɛbɛbɛ]	[Lab…Lab]
(e)	Inês	1;5.11	bombom	candy	/bõˈbõ/	[boˈbo]	[Lab…Lab]
(f)	Luma	1;3.19	banana	banana	/bɐˈnɐnɐ/	[ˈɲɐɲɐ]	[Cor…Cor]
(g)	Inês	1;5.11	boneca	doll	/buˈnɛkɐ/	[ɲeˈɲɛ]	[Cor…Cor]
(h)	João	1;9.25	Guida	prop.noun	/ˈgidɐ/	[ˈdita]	[Cor…Cor]

(i)	João	1;10.26	roda	wheel	/ˈʀɔdɐ/	[ˈdɔdɐ]	[Cor…Cor]
(j)	Luma	2;2.22	Tito	prop.noun	/ˈtitu/	[ˈtitu]	[Cor…Cor]
(k)	Joana	1;9.25	Raquel	prop.noun	/ʀɐˈkɛɫ/	[kɐkɛ]	[Dor…Dor]
(l)	Clara	1;3.6	carro	car	/ˈkaʀu/	[kakakaka]	[Dor…Dor]

As illustrated above, the place feature produced and the place feature of the consonant in the target stressed syllable are most often the same: Labial in examples (a) to (e); Coronal in examples (f), (g) and (j) and Dorsal in (k) and (l). In general, the cases where the PoA produced do not match the PoA of the consonant in the target stressed syllable, are the ones that involve non-acquired target consonants such as dorsals or fricatives; in these cases, children tend to insert a coronal consonant (see examples (h) and (i), above).

Based on the Dutch studies presented in section 4.1.1, we would expect the target stressed vowel to provide the place feature specification for children's representations, at least in the first few sessions. However, most of the first words attempted by Portuguese learners contain a low or central vowel in the target stressed syllable (*p<u>a</u>pa, pap<u>á</u>, mam<u>ã</u>*). In these cases, both the consonant and the vowel of the target stressed syllable tend to be preserved in children's productions. Further note that in some cases, children can change the quality of the target stressed vowel (rendering coronal vowels as low or central), while still preserving the place feature specification of the target stressed onset (see example in (b), above). It thus seems that Portuguese children tend to preserve place specification of the consonant in the target stressed syllable more often than the place specification of the vowel. This issue will be further discussed in section 4.8.

4.5.4 Vowel specification in early words

In section 4.1.1, it was shown that studies on the acquisition of Dutch (Levelt, 1994; Fikkert & Levelt, 2008) have argued for an initial stage in the development of place feature patterns where consonants and vowels in the words produced share PoA features.

The question addressed in the current section is if Portuguese children present patterns similar to Dutch learners, as far as consonant-vowel place features are concerned. In order to make such comparisons, we will adopt the same theoretic tools as Levelt (1994) and Fikkert & Levelt (2008). Those tools have already been described in section 4.3, but are briefly outlined here, for the sake of clarity:

(a) Labial consonants and round vowels [p b m f v ɔ o u] are Labial

(b) Coronal consonants and front vowels [t d n s z ʃ ʒ l ɾ i e ɛ] are Coronal

(c) Dorsal consonants and back vowels [k g ʀ u o ɔ] are Dorsal

(d) Low and central vowels [a ɐ ə ɨ] lack PoA feature specification

Taking the descriptive tools listed above into consideration, we analyzed the PoA feature composition of consonants and vowels in children's output forms, in the first sessions. This analysis covered all mono- and multisyllabic productions that contained at least one consonant. We found four types of consonant-vowel combinations, in children's productions. These combinations are briefly described in (140).

(140) Types of consonant-vowel combinations observed in EP children's productions

I.	[C+$V_{low/central}$]	The consonant belongs to any PoA; the vowels are low ([a]) or central ([ɐ ə ɨ])
II.	[C_{PoA}=V_{PoA}]	[C_{lab} V_{lab}]: Labial consonant + [ɔ o u] [C_{cor} V_{Cor}]: Coronal consonant + [i e ɛ] [C_{dor} V_{dor}]: Dorsal consonant + [u o ɔ]
III.	[C_i+$V_{low/central}$+G_j]	Words with diphthongs, where the PoA of the glide differs from the PoA of the consonant.
IV.	[C_{PoA}≠V_{PoA}]	[C_{lab} V_{Cor}]: Labial consonant + [i e ɛ] [C_{dor} V_{Cor}]: Dorsal consonants + [i e ɛ] [C_{cor} $V_{lab/dor}$]: Coronal consonants + [u o ɔ]

Some examples of the four types of combinations are provided in (141), based on the five children's data.

(141) Examples of [C_{PoA} V_{PoA}] combinations in children's output forms

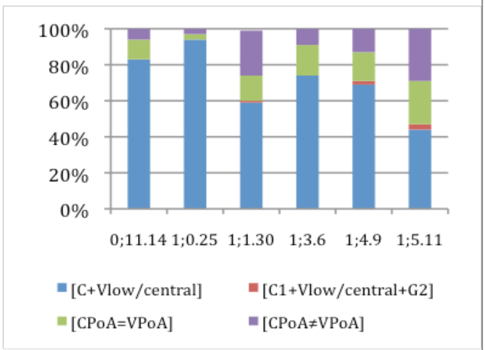
	Child	Age	Orthogr.	Gloss	Target	Output	Type of combination
(a)	Clara	1;1.3	bebé	baby	/bɛˈbɛ/	[bɐpɐ]	[C_{lab} + $V_{central}$]
(b)	Inês	1;0.25	dá	to give	/ˈda/	[ˈda]	[C_{cor} + V_{low}]
(c)	João	1;2.30	bolacha	cookie	/buˈlaʃɐ/	[ɐˈbɐ]	[C_{lab} + $V_{central}$]
(d)	Luma	1;1.10	Opla	Prop.noun	/ˈɔplɐ/	[ˈpapɐ]	[C_{lab} + $V_{low/central}$]
(e)	Inês	1;5.11	aqui	here	/ɐˈki/	[ˈtʲi]	[C_{PoA}=V_{PoA}]
(f)	João	1;4.17	bolo	cake	/ˈbolu/	[ˈbu]	[C_{PoA}=V_{PoA}]
(g)	Joana	1;10.22	não	no	/ˈnɐ̃w̃/	[ˈnɐ̃w̃]	[C_{cor}+$V_{central}$+$G_{lab/dor}$]
(h)	Clara	1;7.11	pai	father	/ˈpaj/	[paj]	[C_{lab}+V_{low}+G_{cor}]
(i)	Luma	1;10.18	vovô	grandfather	/voˈvo/	[toˈto]	[C_{PoA}≠V_{PoA}]
(j)	Clara	1;2.22	bebé	baby	/bɛˈbɛ/	[beˈbi]	[C_{PoA}≠V_{PoA}]
(k)	Inês	1;5.11	queijo	cheese	/ˈkɐjʒu/	[keˈkeː]	[C_{PoA}≠V_{PoA}]

As will be shown in the graphs provided below, type I ([C+$V_{low/central}$]) is the most frequent consonant-vowel combination in early output forms, while types III ([C_i+$V_{low/central}$+G_j]) and IV ([C_{PoA}≠V_{PoA}]) tend to appear only in later sessions. We will now turn to the distribution of each type of combination, per session, in each child's *corpus*.

A. Inês

The occurrence of each type of consonant-vowel combinations in Inês' first sessions (from 0;11 to 1;5) is given in graph (142). Raw numbers are provided in (142.a).

(142) *Distribution of $C_{PoA}V_{PoA}$ combinations – Inês*



(142.a) *Quantitative data (tokens)*

Inês	[C + $V_{low/central}$]		[C_i+ $V_{low/central}$+G_j]		[C_{PoA}=V_{PoA}]		[C_{PoA}≠V_{PoA}]	
	Nº	%	Nº	%	Nº	%	Nº	%
0;11.14	15	83%			2	11%	1	6%
1;0.25	65	94%			2	3%	2	3%
1;1.30	92	59%	2	1%	22	14%	39	25%
1;3.6	147	74%			34	17%	18	9%
1;4.9	87	69%	3	2%	20	16%	17	13%
1;5.11	149	44%	9	3%	82	24%	100	29%

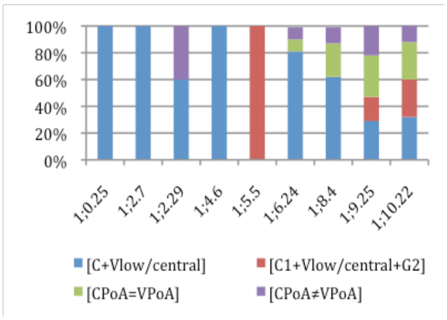
In Inês' data, words containing only low or central vowels are above 80% at 0;11 and 1;0. From 1;1 onwards, that type of combination decreases; the second most frequent combination becomes [C_{PoA}≠V_{PoA}] at 1;1 and 1;5 or [C_{PoA}=V_{PoA}] , at 1;3-1;4.

Although the majority of productions at 1;5 are either combinations of consonants with low or central vowels or [C_{PoA}=V_{PoA}], it is worth noticing that there are already 29% (100 occurrences, see 142.a) in that same session of cases where the words produced contain consonants and vowels of different PoA features.

B. Joana

The graph given in (143) provides the distribution of different types of [C_{PoA}-V_{PoA}] in Joana's productions, between the age of 1;0 and 1;10.

(143) *Distribution of $C_{PoA}V_{PoA}$ combinations – Joana*



(143.a) *Quantitative data*

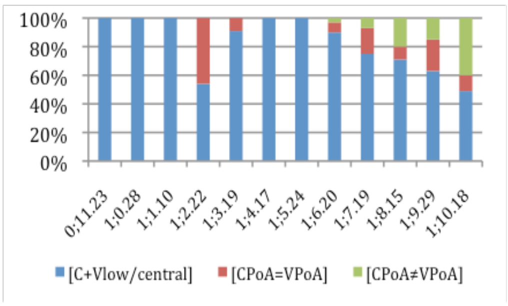
Joana	[C + $V_{low/central}$]		[C_i+$V_{low/central}$+ G_j]		[C_{PoA}=V_{PoA}]		[C_{PoA}≠V_{PoA}]	
	Nº	%	Nº	%	Nº	%	Nº	%
1;0.25	4	100%						
1;2.7	4	100%						
1;2.29	3	60%					2	40%
1;4.6	1	100%						
1;5.5			1	100%				
1;6.24	17	81%			2	9%	2	9%
1;8.4	5	62%			2	25%	1	12%
1;9.25	16	29%	10	18%	17	31%	12	22%
1;10.22	28	32%	24	28%	24	28%	11	13%

As shown above, the majority of Joana's productions until the age of 1;6 contain only low or central vowels. There are, however, three occurrences of [C_{PoA}≠V_{PoA}] at 1;2 and one occurrence of [C_i+$V_{low/central}$+G_j] at 1;5. Note that percentages correspond to very low tokens within this period (see 143.a). At 1;8 and onwards, [C_{PoA}≠V_{PoA}] combinations appear with relative frequency (around 25%). From 1;9 onwards, the frequency of words containing only low or central vowels decreases to around 30% and [C_i+$V_{low/central}$+G_j] increases to 28% (together with [C_{PoA}≠V_{PoA}] , they correspond to 41% of all productions, at 1;9).

C. Luma

The distribution of the different types of consonant-vowel combinations in Luma's data, from the age of 0;11 to 1;10, is presented in (144) .

(144) Distribution of $C_{PoA}V_{PoA}$ combinations – Luma



(144.a) *Quantitative data*

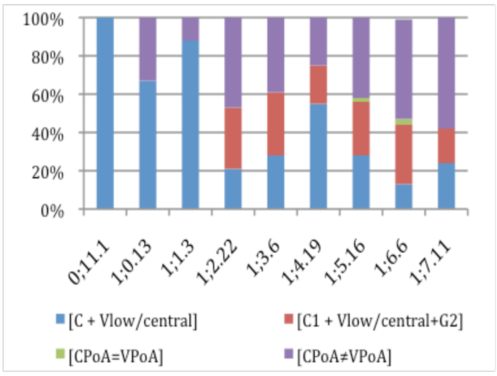
Luma	[C + $V_{low/central}$]		[C_{PoA}=V_{PoA}]		[C_{PoA}≠V_{PoA}]	
	Nº	%	Nº	%	Nº	%
0;11.23	2	100%				
1;0.28	10	100%				
1;1.10	38	100%				
1;2.22	13	54%	11	46%		
1;3.19	59	91%	5	9%		
1;4.17	5	100%				
1;5.24	21	100%				
1;6.20	26	90%	2	7%	1	3%
1;7.19	53	75%	13	18%	5	7%
1;8.15	32	71%	4	9%	9	20%
1;9.29	55	63%	19	22%	13	15%
1;10.18	42	49%	9	11%	34	40%

As shown above, more than 80% of Luma's productions between 0;11 and 1;6 contain only low or central vowels; within this period, there are also some occurrences of [C_{PoA}=V_{PoA}], particularly at 1;2. It is only at 1;8 that words containing consonants and vowels of different PoA features occur with relative frequency in this child's data (around 20%), with an increase at 1;10 (to 40% of the cases).

D. Clara

The graph given in (145) presents the frequency of occurrence of the four types of consonant-vowel combinations in the words produced by Clara from the age of 0;11 to 1;7.

(145) Distribution of $C_{PoA}V_{PoA}$ combinations - Clara	(145.a) *Quantitative data*



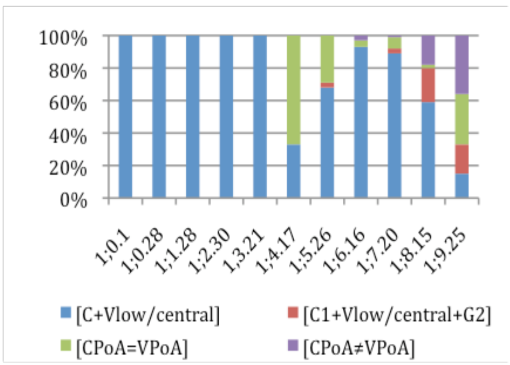
Clara	[C + $V_{low/central}$]		[C_i + $V_{low/central}$+G_j]		[C_{PoA}=V_{PoA}]		[C_{PoA}≠V_{PoA}]	
	Nº	%	Nº	%	Nº	%	Nº	%
0;11.1	3	100%						
1;0.13	2	67%					1	33%
1;1.3	15	88%					2	12%
1;2.22	4	21%	6	32%			9	47%
1;3.6	5	28%	6	33%			7	39%
1;4.19	11	55%	4	20%			5	25%
1;5.16	14	28%	14	28%	1	2%	21	42%
1;6.6	4	13%	9	31%	1	3%	15	52%
1;7.11	13	24%	10	18%			32	58%

In the first three sessions (from 0;11 to 1;1), the majority of the words (mono- and multisyllabic) contain low or central vowels. From 1;2 onwards, words containing combinations of consonants and vowels of different PoA features ([C_{PoA}≠V_{PoA}]) increase in Clara's output forms (to around 45%), as well as combinations where the consonants and glides differ in PoA (to around 25%).

E. João

The graph given in (146) presents the distribution of the different types consonant-vowel combinations in João's production, from 1;0 to 1;9.

(146) Distribution of $C_{PoA}V_{PoA}$ combinations – João	(146.a) *Quantitative data*



	[C + $V_{low/central}$]		[C_i + $V_{low/central}$+G_j]		[C_{PoA}=V_{PoA}]		[C_{PoA}≠V_{PoA}]	
	Nº	%	Nº	%	Nº	%	Nº	%
1;0.1	6	100%						
1;0.28	6	100%						
1;1.28	9	100%						
1;2.30	17	100%						
1,3.21	40	100%						
1;4.17	10	33%			20	67%		
1;5.26	45	68%	2	3%	19	29%		
1;6.16	69	93%			3	4%	2	3%
1;7.20	86	89%	3	3%	7	7%	1	1%
1;8.15	36	59%	13	21%	1	2%	11	18%
1;9.25	22	15%	26	18%	44	31%	51	36%

As shown above, all mono- and polysyllabic words produced by João between 1;0 and 1;3 contain only low or central vowels. This type of combination remains highly frequent until the age of 1;7 (most often above 60%), but another type of combination also appears with relative frequency, particularly at 1;4 and 1;5: [C_{PoA}=V_{PoA}] (mostly [C_{Lab} V_{Lab}] patterns). From 1;8 onwards, combinations containing different consonants and vowels or consonants and glides appear with increasing frequency (at 1;9, [C_{PoA}≠V_{PoA}] occurs in 36% of João's productions, and [C_i+$V_{low/central}$+G_j] occurs in 18% of the cases).

To sum up, the analysis of mono- and multisyllabic output forms showed that early productions most often contain combinations of consonants with low or central vowels. Combinations of the type [C_{PoA}=V_{PoA}] tend to appear later, as well as combinations that involve differences in PoA between consonants and vowels ([C_{PoA}≠V_{PoA}]) or between consonants and glides ([C_i+$V_{low/central}$+G_j]).

Children start producing non-homorganic combinations of consonants and vowels, i.e. [C_{PoA}≠V_{PoA}] or of consonants and glides -[C_i+$V_{low/central}$+G_j], with some frequency, at least above 20%, at the following ages:

(a) Clara: 1;2

(b) Inês: 1;5

(c) João: 1;8

(d) Joana: 1;9

(e) Luma: 1;10

It is worth emphasizing that EP and Dutch children differ at a very early stage: studies in Dutch have reported on an early predominant [C_{PoA}=V_{PoA}] stage (see section 4.1.1), while [$CV_{low/central}$] is the most frequent form in Portuguese children's early productions. This issue will be discussed in section 4.8.

4.6 Manner feature composition of early words in EP: Results

In this current section, we describe the consonantal feature composition of EP children's intake and output forms, focusing on manner features. This section is organized as follows. The frequency of harmonic ([C_{MoA}=C_{MoA}]) and non-harmonic ([C_{MoA}≠C_{MoA}]) patterns in intake and output forms is presented in subsections 4.6.1 and 4.6.2, respectively. Subsection 4.6.3 explores the frequency of manner features in harmonic productions.

4.6.1 Distribution of /C_{MoA}=C_{MoA}/ and /C_{MoA}≠C_{MoA}/ patterns in intake forms

The analysis of the set of multisyllabic words attempted by each child showed that all have an initial preference for /C_{MoA}=C_{MoA}/ target forms. This preference is illustrated in (147).

(147) Examples of /C_{MoA}=C_{MoA}/ target words selected in the first sessions

	Child	Age	Orthogr.	Gloss	Target	PoA pattern
(a)	Inês	0;11.14	bebé	baby	/bɛˈbɛ/	/Stop…Stop/
(b)	Joana	1;0.25	mamã	mommy	/mɐˈmɐ̃/	/Nas…Nas/
(c)	Luma	1;2.22	pato	duck	/ˈpatu/	/Stop…Stop/
(d)	Clara	0;11.1	papa	baby food	/ˈpapɐ/	/Stop…Stop/
(e)	João	1;3.21	panda	panda	/ˈpɐ̃dɐ /	/Stop…Stop/

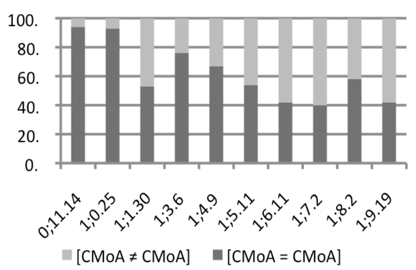
Two main sound classes appear in early /C_{MoA}=C_{MoA}/ target words: stops (see examples in (a) and from (c) to (e)) and nasals (example (b)).

As will be shown next, the duration of the /C_{MoA}=C_{MoA}/ period in intake forms varies across children.

A. Inês

In Inês' data, the preference for /C_{MoA}=C_{MoA}/ target words is more evident at the first two sessions. This pattern is shown in graph (148), which presents the distribution of /C_{MoA}=C_{MoA}/ and /C_{MoA}≠C_{MoA}/ multisyllabic target words in this child's *corpus*, from 0;11 to 1;9. The graph is complemented with quantitative data, in (148.a).

(148) Distribution of /C_{MoA}=C_{MoA}/ and /C_{MoA}≠C_{MoA}/ in the intake – Inês



(148.a) *Quantitative data (tokens)*

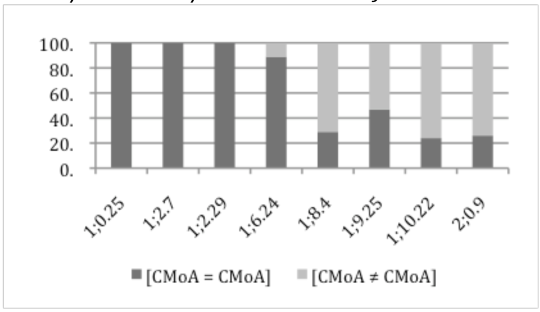
	/C_{MoA}=C_{MoA}/		/C_{MoA}≠C_{MoA}/	
	Nº	%	Nº	%
0;11.14	16	94%	1	6%
1;0.25	40	93%	3	7%
1;1.30	40	53%	35	47%
1;3.6	62	76%	20	24%
1;4.9	54	67%	27	33%
1;5.11	78	54%	66	46%
1;6.11	68	42%	93	58%
1;7.2	42	40%	63	60%
1;8.2	95	58%	69	42%
1;9.19	108	42%	151	58%

As shown above, there is an initial predominance of /C_{MoA}=C_{MoA}/ patterns in Inês' intake, above 80%, at 0;11 and 1;0. From 1;1 onwards, the frequency of harmonic patterns decreases below 60% in most sessions.

B. Joana

The predominance of harmonic manner patterns in Joana's intake occurs in a longer period of time than the one observed in Inês. The graph given in (149) provides the distribution of harmonic and non-harmonic manner patterns in Joana's intake, from 1;0 to 2;0.

(149) Distribution of $/C_{MoA}=C_{MoA}/$ and $/C_{MoA}\neq C_{MoA}/$ in the intake – Joana



(149.a) *Quantitative data (tokens)*

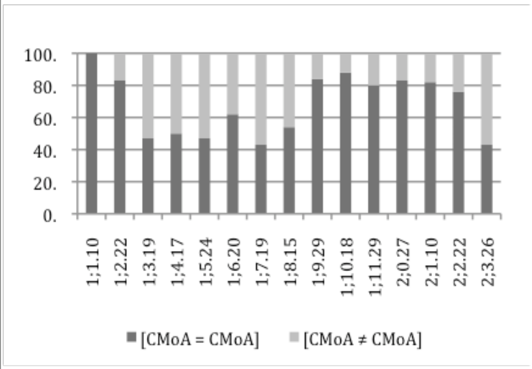
	$/C_{MoA}=C_{MoA}/$		$/C_{MoA}\neq C_{MoA}/$	
	Nº	%	Nº	%
1;0.25	4	100%		
1;2.7	2	100%		
1;2.29	2	100%		
1;6.24	17	89%	2	11%
1;8.4	2	29%	5	71%
1;9.25	20	47%	23	53%
1;10.22	10	24%	32	76%
2;0.9	29	26%	84	74%

Between 1;0 and 1;6 almost all multisyllabic target words attempted by Joana are of the type $/C_{MoA}=C_{MoA}/$ (100% between 1;0 and 2;2 and 89% at 1;6) From 1;8 onwards, non-harmonic patterns become predominant in this child's intake, i.e. above 60%, in most sessions. Note that there are few tokens before the age of 1;9 (see 149.a).

C. Luma

The graph provided in (150) shows the distribution of $/C_{MoA}=C_{MoA}/$ and $/C_{MoA}\neq C_{MoA}/$ patterns in the multisyllabic words attempted by Luma between the ages of 1;1 and 2;3. The graph is complemented with quantitative data in (150.a).

(150) Distribution of $/C_{MoA}=C_{MoA}/$ and $/C_{MoA}\neq C_{MoA}/$ in the intake – Luma



(150.a) *Quantitative data (tokens)*

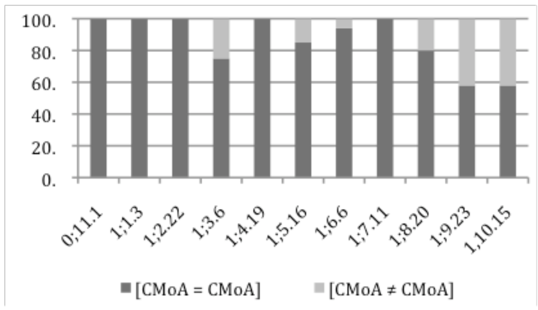
	$/C_{MoA}=C_{MoA}/$		$/C_{MoA}\neq C_{MoA}/$	
	Nº	%	Nº	%
1;1.10	67	100%	0	
1;2.22	10	83%	2	17%
1;3.19	14	47%	16	53%
1;4.17	2	50%	2	50%
1;5.24	7	47%	8	53%
1;6.20	16	62%	10	38%
1;7.19	33	43%	43	57%
1;8.15	21	54%	18	46%
1;9.29	53	84%	10	16%
1;10.18	58	88%	8	12%
1;11.29	57	80%	14	20%
2;0.27	43	83%	9	17%
2;1.10	64	82%	14	18%
2;2.22	64	76%	20	24%
2;3.26	35	43%	47	57%

In Luma's *corpus*, there is a predominance of $/C_{MoA}=C_{MoA}/$ patterns in the target words selected in the first two sessions, between 1;1 and 2;2, above 80%. From then onwards, much variation is found: between 1;3 and 1;8, the frequency of selection of harmonic and non-harmonic patterns is balanced, around 50%, for each type of pattern, then from 1;9 to 2;2, $/C_{MoA}=C_{MoA}/$ become predominant again, around 80%, followed by a decrease to 43% at 2;3.

D. Clara

Similarly to Joana, Clara presents a longer period of $/C_{MoA}=C_{MoA}/$ predominance in attempted target words. The distribution of harmonic and non-harmonic intake forms in this child's data is given in (151).

(151) *Distribution of /C_{MoA}=C_{MoA}/ and /C_{MoA}≠C_{MoA}/ in the intake – Clara*



(151.a) *Quantitative data (tokens)*

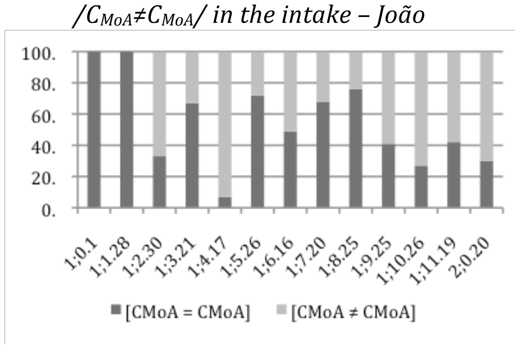
	/C_{MoA}=C_{MoA}/		/C_{MoA}≠C_{MoA}/	
	Nº	%	Nº	%
0;11.1	1	100%		
1;1.3	12	100%		
1;2.22	10	100%		
1;3.6	6	75%	2	25%
1;4.19	4	100%		
1;5.16	11	85%	2	15%
1;6.6	15	94%	1	6%
1;7.11	20	100%		
1;8.20	66	80%	17	20%
1;9.2	63	58%	47	42%
1,10.15	52	58%	37	42%

In Clara's *corpus*, the frequency of selection of /C_{MoA}=C_{MoA}/ patterns is above or around 80% of all multisyllabic intake forms, between the ages of 0;11 and 1;8. At 1;9 and 1;10, harmonic patterns decrease to 60% and non-harmonic target words are attempted more often, i.e. in about 40% of the cases.

E. João

Similarly to Inês and Luma, João shows a predominance of /C_{MoA}=C_{MoA}/ patterns in intake forms mostly at the first two sessions, as shown in the graph given in (152).

(152) *Distribution of /C_{MoA}=C_{MoA}/ and /C_{MoA}≠C_{MoA}/ in the intake – João*



(152.a) *Quantitative data*

	/C_{MoA}=C_{MoA}/		/C_{MoA}≠C_{MoA}/	
	Nº	%	Nº	%
1;0.1	6	100%	0	
1;1.28	3	100%	0	
1;2.30	5	33%	10	67%
1;3.21	24	67%	12	33%
1;4.17	2	7%	25	93%
1;5.26	38	72%	15	28%
1;6.16	23	49%	24	51%
1;7.20	53	68%	25	32%
1;8.25	25	76%	8	24%
1;9.25	51	41%	73	59%
1;10.26	42	27%	113	73%
1;11.19	72	42%	101	58%
2;0.20	49	30%	113	70%

As shown above, /C_{MoA}=C_{MoA}/ patterns are predominant, 100%, in João's intake forms mostly in the first two sessions, at 1;0 and 1;1. Between 1;2 and 1;8, there is much variation in the frequency of selection of harmonic and non-harmonic patterns. From 1;9 onwards, harmonic patterns represent only 40% of the intake forms selected by this child.

To sum up, all children show an initial predominance, above 80%, of /C_{MoA}=C_{MoA}/ patterns over /C_{MoA}≠C_{MoA}/ patterns, in intake forms. However, the duration of this harmonic period varies across children: Inês, Luma and João select /C_{MoA}=C_{MoA}/ more often in the first two sessions - Inês: 0;11-1;0; Luma: 1;1-1;2; João:1;0-1;1 - while in the data of Clara and Joana the predominance of /C_{MoA}=C_{MoA}/ takes place over a more extensive period of time: Joana from 1;0 to 1;6; Clara from 0;11 to 1;8.

4.6.2 Distribution of [C_{MoA}=C_{MoA}] and [C_{MoA}≠C_{MoA}] patterns in output forms

Similarly to what has been described for place feature patterns in section 4.5.2, the majority of the early multisyllabic words produced by all children display manner feature identity: [C_{MoA}=C_{MoA}]. Some examples of these productions are given in (153).

(153) Examples of [C_{MoA}=C_{MoA}] forms in children's productions

	Child	Age	Orthogr.	Gloss	Target	Output	MoA pattern
(a)	Inês	1;4.9	David	prop.noun	/dɐˈvid/	[diˈdi]	[Stop…Stop]
(b)	Inês	1;6.11	colher	spoon	/kuˈʎɛɾ/	[kɛˈkɛ]	[Stop…Stop]
(c)	Joana	1;0.25	mamã	mommy	/mɐˈmɐ̃/	[ɐmaˈmɐ̃]	[Nas…Nas]
(d)	Joana	1;9.25	Raquel	prop. noun	/ʀɐˈkɛɫ/	[kɐˈkɛ]	[Stop…Stop]
(e)	Luma	1;3.5	Frota	prop.noun	/ˈfɾɔtɐ/	[tɐtɐ]	[Stop…Stop]
(f)	Luma	1;7.5	Susana	prop.noun	/suˈzɐnɐ/	[ˈnɐnɐ]	[Nas…Nas]
(g)	Clara	1;5.16	mano	brother	/ˈmɐnu/	[ˈmɐnu]	[Nas…Nas]
(h)	Clara	1;10.15	Ruca	prop.noun	/ˈʀukɐ/	[ˈgukɐ]	[Stop…Stop]
(i)	João	1;3.21	papa	cereal	/ˈpapɐ/	[ˈpapɐ]	[Stop…Stop]
(j)	João	1;6.16	maçã	apple	/mɐˈsɐ̃/	[ˈmama]	[Nas…Nas]

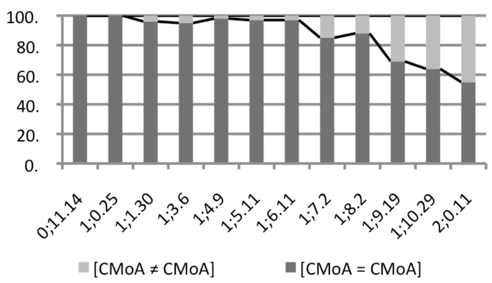
As illustrated above, two main MoA patterns appear in children's productions: [Stop…Stop] and [Nas…Nas] (see section 4.6.3). The harmonic output forms may sometimes correspond to harmonic targets (see examples in (c), (g), (i)) but often correspond to non-harmonic adult forms (see examples in (a) and (b), for instance).

The duration of this harmonic production stage varies across children, as will be shown below.

A. Inês

The graph provided in (154) shows the distribution of [C_{MoA}=C_{MoA}] and [C_{MoA}≠C_{MoA}] output forms, per session, in Inês' data; the graph is complemented with quantitative data (see 154.a).

(154) Distribution of $[C_{MoA}=C_{MoA}]$ and $[C_{MoA}≠C_{MoA}]$ in Inês' productions	(154.a) *Quantitative data*



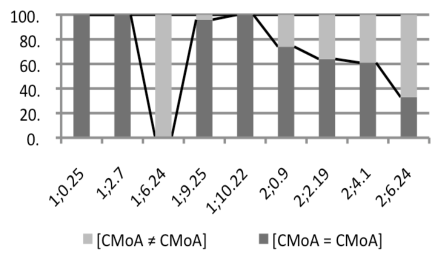
	$[C_{MoA}=C_{MoA}]$ Nº	%	$[C_{MoA}≠C_{MoA}]$ Nº	%
0;11.14	6	100%	0	0%
1;0.25	34	100%	0	0%
1;1.30	87	96%	4	4%
1;3.6	122	95%	7	5%
1;4.9	58	98%	1	2%
1;5.11	154	97%	5	3%
1;6.11	117	97%	4	3%
1;7.2	63	85%	11	15%
1;8.2	153	88%	20	12%
1;9.19	148	69%	67	31%
1;10.29	221	64%	126	36%
2;0.11	208	55%	172	45%

As shown above,$[C_{MoA}=C_{MoA}]$ forms constitute above 80% of the multisyllabic forms produced by Inês, from the age of 0;11 to 1;8. From 1;9 onwards, the frequency of occurrence of these harmonic forms starts decreasing gradually.

B. Joana

The distribution of harmonic and non-harmonic manner patterns in multisyllabic words produced by Joana is presented in graph (155).

(155) Distribution of $[C_{MoA}=C_{MoA}]$ and $[C_{MoA}≠C_{MoA}]$in Joana's productions	(155.a) *Quantitative data*



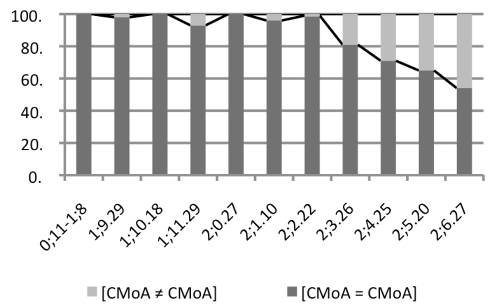
	$[C_{MoA}=C_{MoA}]$ Nº	%	$[C_{MoA}≠C_{MoA}]$ Nº	%
1;0.25	1	100%	0	0%
1;2.7	1	100%	0	0%
1;6.24	0	0%	2	100%
1;9.25	26	96%	1	4%
1;10.22	12	100%	0	0%
2;0.9	35	74%	12	26%
2;2.19	43	64%	24	36%
2;4.1	42	61%	27	39%
2;6.24	71	33%	143	67%

Except for 1;6, where the 100% corresponds to two occurrences, see (155.a), $[C_{MoA}=C_{MoA}]$ is produced above 80% from 1;0 to 1;10. At 2;0 and onwards, harmonic productions decrease and non-harmonic productions increase gradually. Note that, similarly to what has been observed for PoA, there are very few occurrences of multisyllabic forms in Joana's data before the age of 1;9.

C. Luma

Similarly to what was observed for PoA patterns (see section 4.5.2), the predominance of harmonic MoA sequences in Luma's productions is evident until the age of 2;3. The distribution of $[C_{MoA}=C_{MoA}]$ and $[C_{MoA}≠C_{MoA}]$ in this child's data is presented in (156).

(156) *Distribution of [C_{MoA}=C_{MoA}] and [C_{MoA}≠C_{MoA}]in Luma's productions*



(156.a) *Quantitative data*

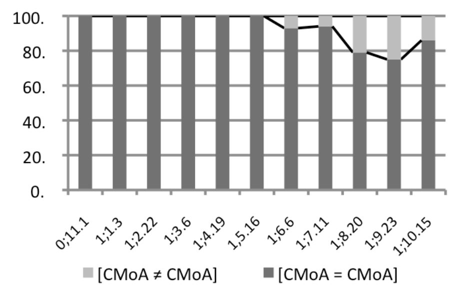
	[C_{MoA}=C_{MoA}]		[C_{MoA}≠C_{MoA}]	
	Nº	%	Nº	%
0;11.23	1	100%	0	0%
1;8.15	20	100%	0	0%
1;9.29	63	98%	1	2%
1;10.18	55	100%	0	0%
1;11.29	53	93%	4	7%
2;0.27	30	100%	0	0%
2;1.10	66	96%	3	4%
2;2.22	96	99%	1	1%
2;3.26	154	81%	36	19%
2;4.25	209	71%	86	29%
2;5.20	239	65%	131	35%
2;6.27	164	54%	141	46%

As shown above, more than 80% of Luma's multisyllabic productions are harmonic for MoA features, from the first session studied, at 0;11, to the age of 2;3. At 2;4 and onwards, non-harmonic productions increase and harmonic ones decrease, gradually.

D. Clara

Clara was studied until the age of 1;10. Throughout this period, the vast majority of her multisyllabic productions are harmonic for manner features. This pattern is shown in (157).

(157) *Distribution of [C_{MoA}=C_{MoA}] and [C_{MoA}≠C_{MoA}]in Clara's productions*



(157.a) *Quantitative data*

	[C_{MoA}=C_{MoA}]		[C_{MoA}≠C_{MoA}]	
	N.º	%	N.º	%
0;11.1	1	100%	0	0%
1;1.3	10	100%	0	0%
1;2.22	10	100%	0	0%
1;3.6	5	100%	0	0%
1;4.19	3	100%	0	0%
1;5.16	12	100%	0	0%
1;6.6	14	93%	1	7%
1;7.11	17	94%	1	6%
1;8.20	68	79%	18	21%
1;9.23	104	75%	34	25%
1;10.15	131	86%	22	14%

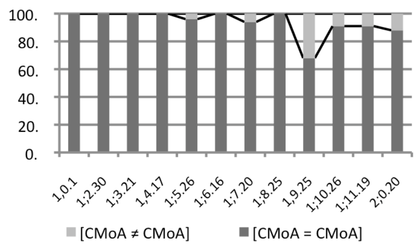
As shown above, although some decreases occur from 1;8 onwards, Clara's multisyllabic productions are overwhelmingly of the type [C_{MoA}=C_{MoA}], above or around 80%, in all sessions of the *corpus*.

Note that, although representing a low percentage, there is already a relatively large number of occurrences of non-harmonic forms at the last three sessions (see 157.a); in chapter 5, it will be shown that most of these occurrences correspond to a small set of MoA target [C≠C] combinations, that are already in the process of acquisition at this age (see chapter 5).

E. João

João was studied until the age of 2;0. Similarly to Clara, the majority of his productions are $[C_{MoA}=C_{MoA}]$, in the whole *corpus*. The distribution of harmonic and non-harmonic patterns in this child's multisyllabic output forms is given in (158).

(158) Distribution of $[C_{MoA}=C_{MoA}]$ and $[C_{MoA}\neq C_{MoA}]$ in João's productions



(158.a) *Quantitative data*

	$[C_{MoA}=C_{MoA}]$		$[C_{MoA}\neq C_{MoA}]$	
	Nº	%	Nº	%
1,0.1	5	100%	0	0%
1;2.30	1	100%	0	0%
1;3.21	3	100%	0	0%
1,4.17	3	100%	0	0%
1;5.26	26	96%	1	4%
1;6.16	40	100%	0	0%
1;7.20	49	94%	3	6%
1;8.25	20	100%	0	0%
1;9.25	69	68%	32	32%
1;10.26	132	91%	13	9%
1;11.19	145	91%	13	9%
2;0.20	134	88%	19	12%

Except of a slight decrease at 1;9, $[C_{MoA}=C_{MoA}]$ forms constitute above or around 90% of all multisyllabic productions in João's data, in the whole *corpus*.

Note that, although this child seems to be at the harmonic stage until the age of 2;0, he is already producing some $[C_{MoA}\neq C_{MoA}]$ forms (see 158.a), which will be explored in chapter 5.

In sum, all children studied go through an initial stage where the majority of multisyllabic productions (above 80%) are $[C_{MoA}=C_{MoA}]$. The time frame covered by $[C_{MoA}=C_{MoA}]$ predominance in intake and output forms, in each child's *corpus*, is summarized in (159).

(159) Time-frame covered by the predominance of $[C_{MoA}=C_{MoA}]$ patterns

$[C_{MoA}=C_{MoA}]$	Intake		Production	
Inês	0;11	1;0	0;11	1;8
Joana	1;0	1;6	1;0	1;10
Luma	1;1	1;2	0;11	2;3
Clara	0;11	1;8	0;11	1;10
João	1;0	1;1	1;0	2;0

Comparing intake and output patterns, we can see that the preference for $[C_{MoA}=C_{MoA}]$ occurs in a much more extended period of time in production than in the intake. Most children start attempting /C≠C/ targets until the age of 1;6, but those targets are rendered in alternative output forms for the following months, in most cases until 1;8 and 1;10 (see table above).

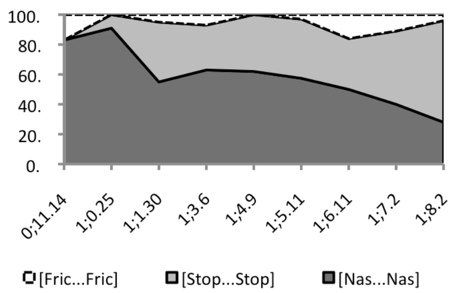
4.6.3 Distribution of manner features in $[C_{MoA}=C_{MoA}]$ productions

In the preceding section, it was shown that children go through an initial stage where the vast majority of the multisyllabic forms produced are harmonic for manner features: Inês until 1;8; Joana until 1;10, Luma until 2;3 and Clara and João until the last session studied, i.e. until 1;10 and 2;0, respectively. In the current section, we will describe the frequency of each MoA feature within those harmonic output forms.

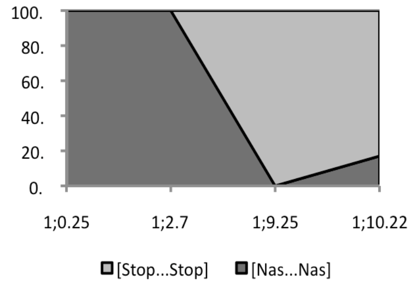
The graphs presented in (160) show the distribution of stops, nasals, fricatives, laterals and rhotics in the [C_{MoA}=C_{MoA}] output stage, for each child (from 160.a to 160.e).

(160) Frequency of MoA features in [C_{MoA}=C_{MoA}] productions (appendix F)

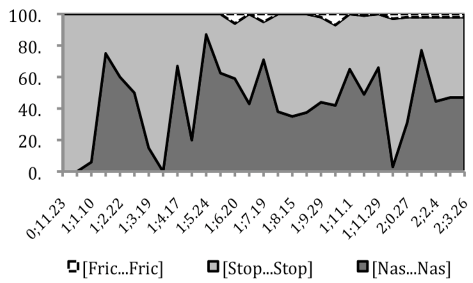
(160.a) *Inês*



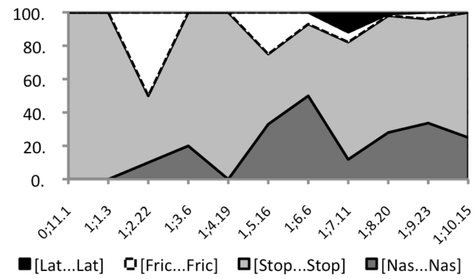
(160.b) *Joana*



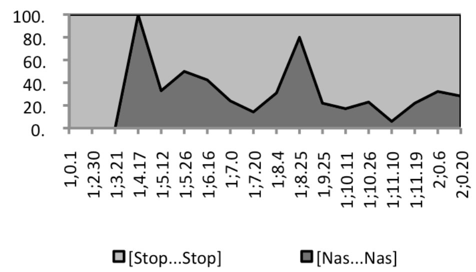
(160.c) *Luma*



(160.d) *Clara*



(160.e) *João*



As shown in the five graphs depicted above, nasals and stops are the two most frequently occurring manner features, within the [C_{MoA}=C_{MoA}] stage. There are some occurrences of fricatives, mostly in the speech of Inês and Clara, but most often below 20%. There are also some occurrences of laterals (see graphs (160.d) and (160.e)) but their occurrence is quite marginal in these first sessions, below 10% (see appendix F). Some examples are given in (161).

(161) Examples of [C_{MoA}=C_{MoA}] output patterns

	Child	Age	Orthogr.	Gloss	Target	Output	MoA pattern
(a)	Clara	1;7.11	mana	sister	/ˈmɐnɐ/	[mɐˈnɐ]	[Nas…Nas]
(b)	Inês	1;1.30	papá	daddy	/pɐˈpa/	[baba]	[Stop…Stop]
(c)	Clara	1;2.22	bebé	baby	/bɛˈbɛ/	[βɨˈβe]	[Fric…Fric]
(d)	Inês	1;5.11	Inês	prop.noun	/iˈneʃ/	[neˈɲe]	[Nas…Nas]
(e)	Inês	1;8.2	chapéu	hat	/ʃɐˈpɛw/	[paˈbɛw]	[Stop…Stop]
(f)	Joana	1;9.25	Raquel	prop.noun	/ʀɐˈkɛɫ/	[kɐkɛ]	[Stop…Stop]
(g)	Luma	2;2.22	bola	ball	/ˈbɔlɐ/	[poˈpɐ]	[Stop…Stop]
(h)	João	1;10.26	limão	lemon	/liˈmɐ̃w̃/	[miˈmɐ̃w̃]	[Nas…Nas]
(i)	Inês	1;8.2	limpar	to clean	/lĩˈpaɾ/	[ɐgeˈpa]	[Stop…Stop]
(j)	João	1;10.26	vida	life	/ˈvidɐ/	[ˈdidɐ]	[Stop…Stop]
(k)	João	1;9.25	café	coffee	/kɐˈfɛ/	[tɐˈtɛ]	[Stop…Stop]
(l)	Luma	2;3.26	sujo	dirty	/ˈsuʒu/	[ˈtuduː]	[Stop…Stop]

As shown above, [C_{MoA}=C_{MoA}] output forms can correspond to target words that are already harmonic in manner (see examples in (a) and (b)). However, there are also cases where the harmonic output corresponds to [C_{MoA}≠C_{MoA}] targets. Within this group, a pattern that is commonly observed is that the MoA produced is the same as the MoA of the consonant in the target stressed syllable, independently of the word position: C2 (see examples (d) to (f), (h) and (i)) and C1 (see example in (g)). In other cases, particularly at later sessions, the manner feature produced does not match the consonant in the target stressed syllable, when that consonant is not mastered yet. This applies most often to fricatives (see examples from (j) to (l)). In these cases, the produced consonant is a stop, even if there is no stop at the target word (example (l)).

4.7 Summary of the main findings

The current section presents a summary of the main findings described in this chapter.

A. PLACE FEATURE COMPOSITION OF EARLY WORDS

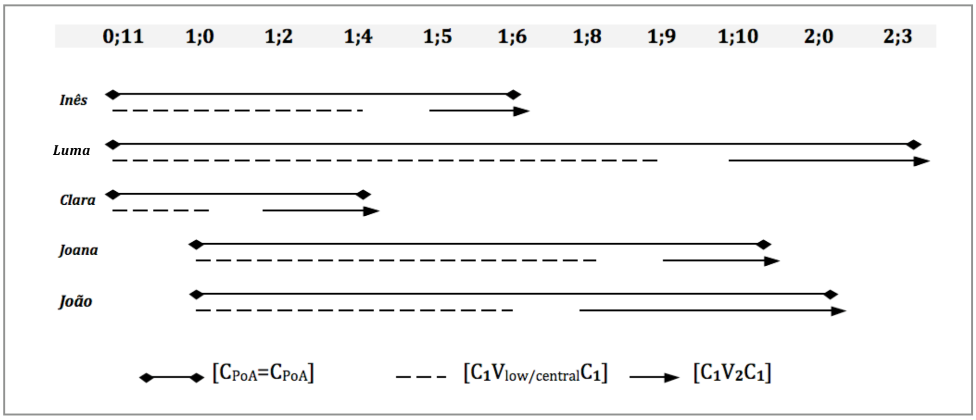
Except for Luma, the Portuguese children show an initial preference for [C_{PoA}=C_{PoA}] forms, both in the intake and in output forms. The duration of this homorganic stage varies across children; in general, it is longer in production than in the intake, except for Clara, where [C_{PoA}=C_{PoA}] are predominant until 1;4, both in intake and output forms.

During the [C_{PoA}=C_{PoA}] stage, two place features are predominant: Labial and Coronal. Labials tend to be more frequent than coronals in early sessions. This preference (Labial>>Coronal) reflects the children's early set of attempted words, where labials predominate.

The analysis of the place feature composition of both consonants and vowels in children's output forms showed that the majority of the words produced in the first sessions contain only low or central vowels and that words containing combinations where consonants and vowels (or glides) differ in place specification appear only in later sessions: Clara from 1;2, Inês, from 1;5, João from 1;8, Joana from 1;9 and Luma from 1;10.

In summary, children go through an initial output stage in which they produce mostly [C_{PoA}=C_{PoA}] words; in the first sessions, the vowels in those [C_{PoA}=C_{PoA}] forms are usually low or central [$C_iV_{low/central}C_i$]. In later sessions, [C_{PoA}=C_{PoA}] forms can already contain vowels of different place features ([C_i V_jC_i]). The chronological order of development of place feature patterns for consonants and vowels in output forms is summarized in (162).

(162) General order of development of [$C_{PoA}V_{PoA}C_{PoA}$] patterns



As depicted above, the majority of the forms in the [C_{PoA}=C_{PoA}] output stage in all children's *corpora* is characterized by the combination of consonants with low or central vowels. The production of words where vowels display a different PoA from the consonants of the word appear in the second half of the [C_{PoA}=C_{PoA}] stage. For instance, in Inês' data, the [C_{PoA}=C_{PoA}] stage covers the period from 0;11 to 1;6; until 1;4 those homorganic productions are mostly of the type [$C_iV_{low/central}C_j$] and it is only from 1;5 onwards that [$C_iV_jC_i$] appear more frequently in this child's productions. Another finding was that, contrary to Dutch learners, where [C_{PoA}=V_{PoA}] is predominant in early age, EP children produce mostly [C $V_{low/central}$]. This issue will be discussed in section 4.8 (see subsection A).

B. MANNER FEATURE COMPOSITION OF EARLY WORDS

Just as observed for place word-patterns, children show an initial preference for [C_{MoA}=C_{MoA}] sequences, both in the intake and in output forms. The duration of the

$[C_{MoA}=C_{MoA}]$ stage varies across children; in general, it is longer in output forms than in the intake.

During the $[C_{MoA}=C_{MoA}]$ output stage, stops and nasals are the predominant sound classes produced. Children's early intake reflects their initial production abilities: the first set of words attempted predominantly contains stops and nasals and rarely include fricatives or liquids.

C. Development of place and manner patterns

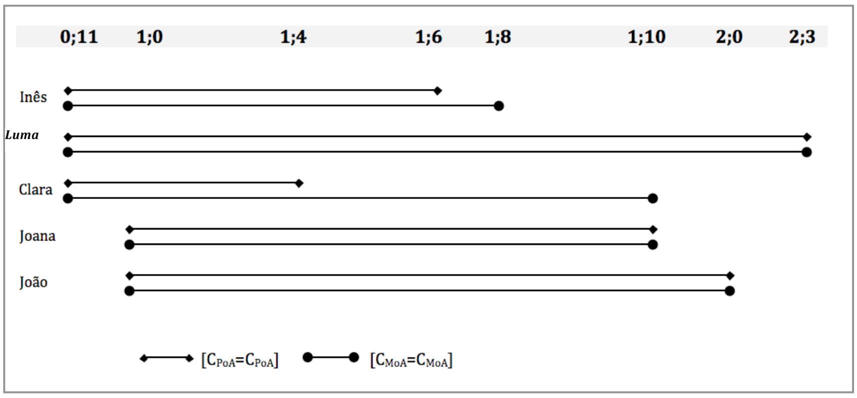
In the overall picture, children go through an initial harmonic stage for both place and manner features. This stage was observed in intake and output forms and has a variable duration across children. The table given in (163) summarizes the periods covered by the [C=C] stage, in intake and output forms, per child.

(163) $[C_{PoA}=C_{PoA}]$ and $[C_{MoA}=C_{MoA}]$ stages in intake and output forms - summary

	$[C_{PoA}=C_{PoA}]$				$[C_{MoA}=C_{MoA}]$			
[C=C] stage	Intake		Output		Intake		Output	
Inês	0;11	1;4	0;11	1;6	0;11	1;0	0;11	1;8
Joana	1;0	1;6	1;0	1;10	1;0	1;6	1;0	1;10
Luma	----	----	0;11	2;3	1;1	1;2	0;11	2;3
Clara	0;11	1;4	0;11	1;4	0;11	1;8	0;11	1;10
João	1;0	1;1	1;0	2;0	1;0	1;1	1;0	2;0

For three of the children (Luma, Joana, João) the duration of the [C=C] stage is the same for place and for manner feature patterns. For the other two children (Inês and Clara), the $[C_{MoA}=C_{MoA}]$ stage is longer than the $[C_{PoA}=C_{PoA}]$ stage. This chronology is summarized in (164).

(164) Duration of the $[C_{PoA}=C_{PoA}]$ and $[C_{MoA}=C_{MoA}]$ stage



4.8 Discussion

The current section presents a discussion of the acquisition patterns observed in this chapter, in the light of the theoretical issues referred to in section 4.1.

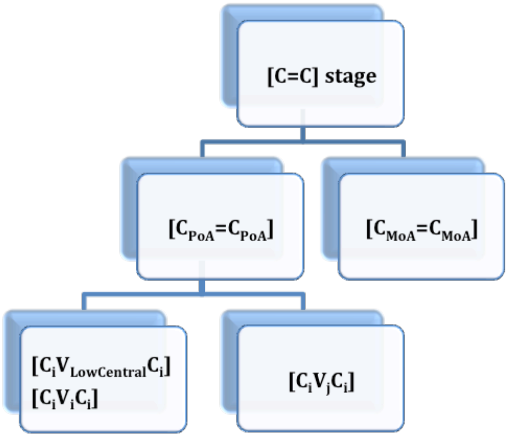
A. An initial [C=C] output stage in EP

The data of the five Portuguese children provided evidence for the existence of an initial harmonic output stage, affecting both place and manner features. This stage starts at the first productions and presents a variable duration, depending on the child and on the feature involved. In the data of three of the children (Luma, Joana and João), the [C_{PoA}=C_{PoA}] and the [C_{MoA}=C_{MoA}] stages have an identical duration: until 2;3 in Luma's data, until 2;0 in João and until 1;10 in Joana (but note that 2;0 corresponds to the last session studied in João's *corpus*, thus, we do not know if one of the stages ends before the other). In the data of Inês and Clara, the [C_{PoA}=C_{PoA}] stage is shorter than the [C_{MoA}=C_{MoA}] stage (see section 4.7).

The [C=C] stage observed, both for place and for manner features, resembles the findings reported in other languages, namely English (Stoel-Gammon, 2002); Dutch (Levelt, 1994; Langeslag, 2007; Fikkert & Levelt, 2008), Spanish (Macken, 1979); German and French (Altvater-Mackensen, Dos Santos & Fikkert, 2008; Altvater-Mackensen & Fikkert, 2009).

Additionally, the analysis of the feature composition of consonants and vowels within the [C_{PoA}=C_{PoA}] output forms showed that Portuguese children have an initial preference for combinations of homorganic consonants with low or central vowels. It is only in later sessions that combinations of the type [$C_iV_jC_i$] (where vowels differ from consonants in place specification) appear in children's productions, with relative frequency (see diagram in (162), section 4.7). Therefore, there are two periods, within the [C_{PoA}=C_{PoA}] stage: one where all consonants share place specification and vowels are placeless (or share the PoA of the consonant, less frequently) and another where consonants still share place specification but vowels can already be independently specified. The representation of the [C=C] stage, subdivided into the [C_{PoA}=C_{PoA}] and the [C_{MoA}=C_{MoA}] substages is provided in (165).

(165) The initial stage in the development of place and manner feature patterns



According to Levelt (1994) and Fikkert & Levelt (2008), the initial stage of development in place feature patterns in Dutch is characterized by (i) combinations of homorganic consonants with low vowels [$C_iV_{low}C_i$]; (ii) combinations of consonants and vowels that share PoA features [$C_iV_iC_i$]. According to these authors, there is one single unit for feature specification at this point of development: the WORD. Children map a single feature specification to the whole WORD, resulting into two possible output forms: consonant and vowels share the place specification, or only the consonants are homorganic and vowels are placeless ([low]).

In general, the Portuguese data shows evidence for the model proposed by Fikkert & Levelt: if we assume that low and central vowels are placeless, then Portuguese children go through an initial period within the [C_{PoA}=C_{PoA}] stage, where consonants are homorganic and vowels are placeless. In this perspective, Portuguese children seem to go through an initial 'whole word stage', where one single PoA specification is assigned to an incomplete lexical representation. Similar results were found for manner, since early output forms are mostly of the type [C_{MoA}=C_{MoA}]. A question that arises now is how specification occurs; if children are dealing with incomplete lexical representations, where does the place or manner feature produced come from? This issue will be discussed in the next subsection.

B. **Feature assignment to early lexical representations**

As far as place features are concerned, Fikkert & Levelt (2008) and Levelt (to appear) argue that children extract place specification from target stressed vowels, if they are non-low (or non-central, according to Levelt, p.c); otherwise, place features are provided by one of the target consonants (Levelt, to appear) (see section 4.1.1). The selected place specification is then mapped to children's unsegmentalized representation, resulting in a form harmonized for place, most often [Lab…Lab] and [Cor…Cor].

Regarding manner features, Langeslag (2007) suggests that it is the target consonant in word-initial position (in <u>C</u>VCV forms) that provides the manner specification. The feature is assigned to C1 in the child's lexical representation and then copied to the other positions, which are unspecified. If the target C1 is still not mastered yet, children assign a stop (default) or a fricative to word initial position and then copy it to the rest of the word, resulting in [Stop…Stop] or [Fric…Fric] patterns (see section 4.1.2).

We will now analyze Portuguese children's data in the light of these two approaches.

Place feature specification

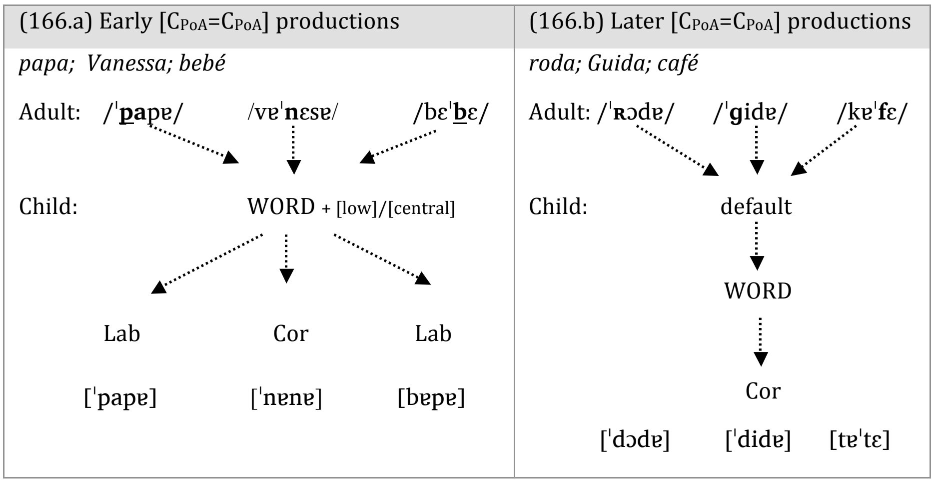
As far as place features are concerned, it was shown that the five children studied have a clear preference for combinations of labial or coronal consonants and low or central vowels, in early productions (see section 4.5.4). Most often, these combinations correspond to target words where the stressed syllable is constituted by a [C $V_{low/central}$] combination: *papa, pap<u>á</u>, M<u>á</u>rio, p<u>a</u>to, mam<u>ã</u>, p<u>an</u>da, ba<u>na</u>na)*. Children tend to be faithful to these target combinations, reproducing the target stressed syllable accurately, as far as PoA or height features are concerned: /ˈpapɐ/->[ˈpapɐ]; /bɐˈnɐnɐ/->[ˈɲɐɲɐ]. Thus, in these cases, children seem to be taking into account the entire target stressed syllable. However, assuming that low and central vowels lack place specification, only the consonant in onset of the target stressed syllable can provide the Labial or Coronal specification.

Additional support for the idea that it is the consonant in the target stressed syllable and not the vowel that provides the place specification comes from early productions like /bɛˈbɛ/, produced as [pəbə]/[bɐpɐ] (see section 4.5.4), where children preserve the PoA of the consonant in their productions (Labial, in this case) but change the quality of the vowel, rendering, for instance, a target coronal vowel [ɛ] as central vowels [ə ɐ]. Note that, if children were more likely to select place specification from the target stressed vowel than from the consonant, we might expect production patterns of the type */bɛˈbɛ/->[tete], where the coronality of the target vowel would be mapped to children's representations, resulting in a [Cor…Cor] output. Outputs like these were found in Dutch child language (Levelt, 1994). However, these types of productions are not common in the Portuguese data. In this respect, EP learners differ from Dutch children. It might be the case that Portuguese children are provided with less evidence for the vowel specification than the Dutch children, since vowels in EP adult speech are often submitted to different types of phonological and morphological processes both in nouns and in verbal forms, namely vowel reduction or deletion (for a review of those processes, see Mateus & d' Andrade, 2000).

There are, however, some cases, specifically in later sessions within the [C_{PoA}=C_{PoA}] stage, where [$C_iV_jC_i$] already occur, where the place feature produced does not match the consonant in the target stressed syllable; for instance, words like /ˈ**v**idɐ/ are produced as [ˈdidɐ]; /ˈʀɔdɐ/ as [ˈdɔdɐ] or /kɐˈ**f**ɛ/ as [tɐˈtɛ] (see section 4.5.3). In general, these outputs correspond to target words where the consonant in onset of the stressed syllable has not yet been mastered (dorsals in João's data and fricatives and liquids in the data of all children). In these cases, the most common PoA produced is Coronal.

Based on the patterns observed, we can hypothesize that, in early forms, children extract the place specification from the consonant in onset of the target stressed syllable and assign it to their early unsegmentalized representations (see (166.a), below). When target words containing non-acquired consonants in the stressed syllable start being attempted (dorsals or labial fricatives, for instance), a coronal consonant is inserted by default (see (166.b)).

(166) Place feature specification in children's representations



According to our proposal, vowels are specified, as default, as low or central in early productions (see (166.a)) thus lacking PoA specification. In later productions, vowels can already be independently specified for place, resulting in [$C_iV_jC_i$] patterns (166.b).

Manner feature specification

Regarding manner feature specification, it was shown that the MoA feature produced in [C=C] output forms frequently coincides with the MoA of the consonant in the onset of the target stressed syllable, for instance, words like /ˈb̠ɔlɐ/ are produced as [poˈpɐ], /ʃɐˈp̠ɛw/ as [paˈbɛw] or /liˈm̠ɐ̃w̃/ as [miˈmɐ̃w̃] (see section 4.6.3). The onset of the target stressed syllable can be in word-initial position, i.e. in trochees like *bola*, for instance, or in intervocalic position, i.e. in iambs like *chapéu*.

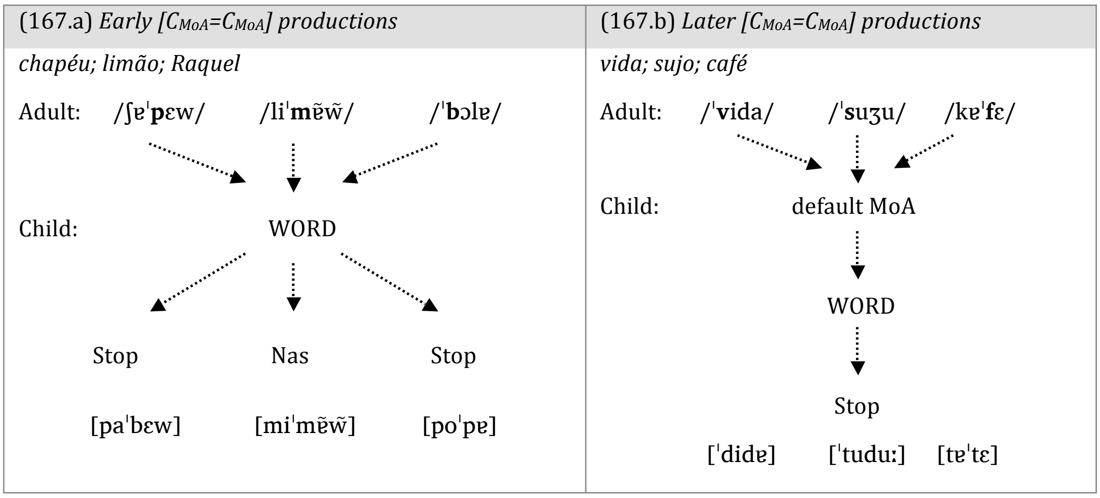
The patterns given above are hard to account for in the approach proposed by Langeslag (2007); according to this author, the manner specification is provided by target C1. Within this perspective, productions such as /liˈmɐ̃w̃/->[miˈmɐ̃w̃] or /ʃɐˈpɛw/->[paˈbɛw] would have to be described as resulting from (i) default insertion of Nasal or Stop in C1; (ii) spreading of Nasal or Stop, to C2. However, why would children insert Nasal in one case and Stop in the other?

According to our proposal, the two production patterns illustrated above do not result from a default insertion of Nasal or Stop. Instead, they result from the association of the MoA of the consonant in the target stressed syllable to the children's lexical representations (see (167.a), below).

There are, however, [C=C] output forms where the MoA produced does not match the MoA of the consonant in the target stressed syllable; for instance words like /ˈvidɐ/ are produced as [ˈdidɐ], /kɐˈfɛ/ is rendered as [tɐˈtɛ] or /ˈsuʒu/ as [ˈtuduː] (see section 4.6.3). These cases tend to occur in later sessions and correspond to target words where the consonant in the target stressed syllable is still not acquired (most often fricatives, but also liquids). The consonant produced for these problematic target forms is most often a stop. Similarly to coronals, stops show a default status in children's system, emerging whenever the learner has to cope with a non-acquired consonant.

To sum up, the analysis proposed here is that the same general pattern attested for place applies to manner specification in early words. Children start by selecting the manner specification of the consonant in the target stressed syllable. If the target stressed consonant is not mastered yet, a default insertion takes place, resulting in [Stop…Stop] output forms. This specification procedure is formalized in (167).

(167) Manner feature specification in children's representations



C. Distribution of [C=C] patterns in children and adult speech

In sections 4.5.3, we observed that there are two predominant place feature patterns in children's [C=C] output forms: [Lab…Lab] and [Cor…Cor]; the pattern [Dor…Dor] is infrequent, in the overall set of homorganic productions. It was also shown in section 4.5.3 that [Lab…Lab] forms tend to predominate in early sessions, while the occurrence of [Cor…Cor] outputs tends to increase throughout the [C=C] stage. This distribution of [C=C] patterns in children's speech does not resemble the distribution of homorganic feature patterns in the sample of EP adult speech presented in section 4.2: in this sample, [Cor…Cor] is the most frequent [C=C] pattern (23%), while [Lab…Lab] and [Dor…Dor] are quite infrequent (3% and 1%, respectively).

It is worth noticing that, although children's productions often do not resemble adult speech, the feature patterns of their early productions do not deviate from those of the adult targets: the first set of words appear to be selected to accommodate the child's initial abilities, and are mostly composed of labial consonants: *mamã, papá, bebé, papa, popó* (see section 4.5.1); this is a good illustration of the fact that intake can provide information about the phonological knowledge of the child.

As for manner [C=C] output forms, it was shown, in section 4.6.3, that two patterns predominate in children's early forms: [Stop…Stop] and [Nas…Nas]. If we compare the distribution of children's [C_{MoA}=C_{MoA}] patterns to the distribution of [C_{MoA}=C_{MoA}] patterns in EP adult speech, we can see that in both sets of data [Stop…Stop] is highly frequent. However, [Nas…Nas] is also frequent in children's speech, particularly in the first sessions (see section 4.6.3), while [Nas…Nas] corresponds to only 5% of the patterns in EP adult speech (see 4.2).

In sum, children's [C=C] output forms resemble the sample of EP adult speech in the high frequency of [Lab…Lab] and [Cor…Cor] over [Dor…Dor] and of [Stop…Stop] and [Nas…Nas] over [Fric…Fric] and [Liq…Liq]. However, there are also salient differences between the sets of *corpora*, namely with respect to both the frequency of [Lab…Lab] relative to [Cor…Cor], and the frequency of [Nas…Nas] relative to [Stop…Stop]. These differences seem to be related to the children's early intake, which appears to be selected to accommodate their early phonological abilities. Thus, similarly to what has been observed in chapter 3, no straightforward relation was found between children's early forms and distributional patterns in EP adult speech.

d. Intake patterns

In general, all children showed an initial preference for the selection of /C=C/ target words. The duration of this preference, however, is shorter in the intake than in production, particularly in the data of João and Luma.

The early preference for /C=C/ targets results in a high degree of correctly produced forms in children's early output patterns. However, with the expansion of children's active vocabulary, selection strategies loose their strength and more and more /C≠C/ words are attempted. Throughout a certain period of time (with variable duration, see section 4.7), those non-harmonic patterns are rendered as harmonic, originating deviant productions. A detailed analysis of the alternative output forms for /C≠C/ targets will be presented in chapter 6.

4.9 Concluding remarks

The analysis presented in the current chapter showed that children's early words obey to severe constraints, as far as place and manner features are concerned. Children start by producing harmonic consonantal sequences, where all consonants produced in the word share place and manner features. Several questions arise now: when and how do children start producing [C≠C] patterns? Do all non-harmonic sequences ([C≠C]) appear at the same time or is their acquisition further constrained? These questions will be addressed in chapter 5, where we will focus on the development of [C≠C] patterns of place and manner features.

Chapter 5 – The development of [C≠C] forms

Introduction

The findings observed in the previous chapter showed that the Portuguese children studied in this project go through an initial harmonic stage, both in place and for manner feature specification. Throughout this period, the overwhelming majority of these children's productions (around or above 80%) are of the type [C=C], in which all consonants (in onset) in the word share place and/or manner features. As mentioned at the end of chapter 4 (see section 4.9), several questions arise now, namely: (i) when do [C≠C] forms appear in children's speech and (ii) do all [C≠C] forms become available simultaneously or is development further constrained?

The questions presented above will constitute the focus of the current chapter. Among other aspects, it will be shown that non-harmonic consonantal sequences tend to appear in a gradual order in children's speech and that the acquisition of features is often determined by their position in the word, as well as by some combinatorial restrictions.

This chapter is organized as follows. In section 5.1, we present a review of the literature on the acquisition of non-harmonic ([C≠C]) combinations, focusing both on place and on manner features. Section 5.2 provides information on the consonantal inventory of the target system and explores the distributional properties of features and patterns in a sample of EP adult speech. Section 5.3 presents a summary of the theoretical issues and lists the research questions and aims of the current chapter. The methodological issues are discussed in 5.4. The results of the data analysis are described in section 5.5, for the acquisition of [C_{PoA}≠C_{PoA}] patterns and in section 5.6, for the acquisition of [C_{MoA}≠C_{MoA}] forms. A summary of the main findings is provided in 5.7, followed by a general discussion in section 5.8. Finally, the concluding remarks are presented in section 5.9

5.1 The acquisition of [C≠C] combinations

Part of the research on the acquisition of consonantal systems has shown that combinations of different place and/or manner features within the word are not available at the onset of speech (Levelt, 1994; Langeslag, 2007). Those non-harmonic sequences tend to appear later and are introduced gradually in children's output forms. Additionally, positional effects seem to come into play throughout the process of development of [C≠C] patterns, since some features tend not to be acquired simultaneously across word-positions: they first appear in one position and only later in the other. Stoel-Gammon (1996), for instance, reports on the fact that English children tend to acquire velar segments in non-initial position first and only afterwards in C1. Lamprecht *et al*. (2004) show that Brazilian children tend to acquire (i) coronal fricatives [s] and [ʃ] first in medial onset and later in C1 position; (ii) coronal fricative [ʒ] and the lateral [l] are first acquired in word-initial position and only later in medial onset. Asymmetries are also referred to in Bernhardt & Stemberger (1998), who state that fricatives tend to be acquired in C1 only after they are already established in non-initial position (see also Edwards, 1996, for similar findings). Stoel-Gammon (2002) and Kehoe & Lléo (2002) also report on a general tendency for fricatives and liquids to be acquired first in non-initial context and later in word-initial position.

These findings and their theoretical interpretations will be described in the current section. We will start by an outline of the studies with focus on the acquisition of place feature patterns, in subsection 5.1.1; then, in subsection 5.1.2, we describe the reports on the acquisition of manner combinations. In subsection 5.1.3, we discuss some theoretical issues concerning the development of [C≠C] forms, namely their relation to children's developing lexicon and to the distributional properties of consonants in the input language.

5.1.1 Reports on the acquisition of place feature patterns

Few studies have focused on the development of place patterns, from early productions to later stages of acquisition. As discussed in chapter 4 (section 4.1), this line of investigation has mostly been developed in Dutch (Levelt, 1994; Fikkert & Levelt, 2008), to which we turn to next.

Based on the acquisition data of five Dutch children, aged between 1;0 and 2;11,[28] Levelt (1994) and Fikkert & Levelt (2008) argue that the development of place patterns is inherently related to the phonological unit WORD,[29] first as a whole and later related to particular word-positions. Based on their findings, Fikkert & Levelt propose a model for the acquisition of PoA features.[30] The first two stages of this model were already discussed in chapter 4; they refer to the beginning of phonological organization, in which all consonants within the words produced share the place specification on the surface ([C_{PoA}=C_{PoA}]). In the current chapter, we will focus on the three last

[28] Data integrated in the CLPF database, available in CHILDES (MacWhinney, 2000).
[29] The term WORD is used by Levelt (1994) and Fikkert & Levelt (2008) as an abstract category; it can be constituted by <u>CVC</u> in monosyllables or by <u>CVC</u>V in disyllables (Levelt, 1994: 84-85).
[30] This model was first proposed by Levelt (1994); further developments are added in the subsequent work of Fikkert & Levelt (2008).

developmental stages of the model proposed by Fikkert & Levelt, which refer to period where non-identical consonants can occur within the same word.

According to Fikkert & Levelt, the emergence of [C_{PoA}≠C_{PoA}] patterns forms stage III of the general development of place specifications. At this stage, children start producing non-homorganic combinations. The first pattern acquired is [Lab…Cor].[31] For some time, [Lab…Cor] is the only non-homorganic pattern produced, while all other target [C_{PoA}≠C_{PoA}] patterns are still not rendered in a target-like fashion. For instance, although [Lab…Cor] is already available, the reverse target combination, where Labial is at the non-initial position, [Cor…Lab], is almost exclusively rendered in a [Lab…Lab] format. Some examples of Dutch children's productions at stage III are provided in (168).

(168) Stage III in the development of place feature patterns in Dutch: examples (Levelt, 1994)

	Gloss	Orthogr.	Target	Output	Target PoA	Output PoA	Child/Age
(a)	boat	boot	/ˈbot/	[ˈbɔit]	/Lab…Cor/	[Lab…Cor]	Robin, 1;7.13
(b)	sleep	slapen	/ˈslapə/	[ˈpapə]	/Cor…Lab/	[Lab…Lab]	Robin, 1;8.24
(c)	table	tafel	/ˈtafəl/	[ˈpafy]	/Cor…Lab/	[Lab…Lab]	Robin, 1;10.7

Note that the early preference for [Lab…Cor] patterns has also been reported in other studies, on a variety of languages (Ingram, 1974; Macken, 1979; MacNeilage & Davis, 2000). According to Ingram (1974), the fronting phenomena results from children's preference for an organization of place features from front to back, across the word. According to MacNeilage & Davis (2000), word-initial labials reflect children's preference for easy articulations at the beginning of the word, since labials involve no tongue movements.

Back to Fikkert & Levelt's model, at stage IV, the [C_{PoA}≠C_{PoA}] combinations that contain Dorsal in non-initial position are acquired: [Lab…Dor] and [Cor…Dor]. However, target PoA combinations where Dorsal is in C1 position are still not rendered in a target-like fashion. Some examples are given in (169).

(169) Stage IV in the development of place feature patterns in Dutch: examples (Levelt, 1994)

	Gloss	Orthogr.	Target	Output	Target PoA	Output PoA	Child/Age
(a)	drink	drinken	/ˈdrɪŋkə/	[ˈtɪŋkə]	/Cor…Dor/	[Cor…Dor]	Robin, 1;9.24
(b)	lekker	good	/ˈlɛkəɹ/	[ˈtɛkə]	/Cor…Dor/	[Cor…Dor]	Robin, 1;9.24
(c)	koud	cold	/ˈkɑut/	[ˈtɑut]	/Dor…Cor/	[Cor…Cor]	Robin, 2;0.4
(d)	coffee	koffie	/ˈkɔfi/	[ˈpofi]	/Dor…Lab/	[Lab…Lab]	Robin 1;11.7

[31] The coding used by Fikkert & Levelt for this combination is PvT, where P represents Labial and T stands for Coronal. In the current dissertation, the P will be coded as Lab, the T as Cor and the K as Dor.

According to Fikkert & Levelt, the limitations on place feature assignment to particular word positions result from the emergence of two markedness constraints in Dutch children's grammar**:** [Labial, which requires the feature Labial to be aligned with the word-initial position and *[Dorsal, which prohibits Dorsal consonants to surface at the leftmost position within the word. During stages III and IV, the attempted target words that do not comply with these two structural requirements are submitted to alternative production strategies in children's output forms.

Fikkert & Levelt argue that the two markedness constraints referred to above emerged as an outcome of generalizations of the child over his or her own lexicon. This generalization is assumed to take place in the following way. The first two [$C_{PoA} \neq C_{PoA}$] combinations selected and produced correctly by Dutch children are [Lab…Cor], first, and [Cor…Dor]/[Lab…Dor] later. Children analyze their own lexicon and extract two generalizations: (i) Labial is assigned to C1 and (ii) Dorsal is *not* assigned to C1. These generalizations are grammaticized and captured by the two constraints [Labial and *[Dorsal, summarized in (170).

(170) Dutch children's generalization over their own lexicon

a) [Labial – Labial features must be aligned with the word-initial position

b) *[Dorsal – Dorsal features must not be aligned with the word-initial position

Coronal is the only place feature that is not restricted to a specific word position throughout stages III and IV. Fikkert and Levelt argue that this unrestricted behavior of coronals derives from their unspecified nature in the lexical representation (in this sense, their work is in line with the underspecification of Coronal, proposed by Paradis & Prunet, 1991).

It is only at stage V that positional restrictions to place specification loose their strength, and non-homorganic combinations displaying either non-initial Labial consonants and word-initial Dorsals start being produced in a target-like fashion: [Cor…Lab], [Dor…Cor] and [Dor…Lab]. For three of the six children studied by Levelt (1994), stage V occurs around the age of 2;0 (Tom, Eva, Jarmo), while for the other subjects this final stage occurs after 2;0 (Robin and Elke at 2;3; Noortje, at 2;7).

The three last stages of the model proposed by Fikkert & Levelt (2008) are summarized in (171).

(171) The development of place feature patterns in Dutch: Stages III, IV and V

Stage	Development	Production Patterns (cumulative)
III	Word-initial: Labial Non-initial: Coronal	[Lab…Cor]
IV	Word-initial: Coronal Non-initial: Dorsal	[Lab…Dor]; [Cor…Dor]
V	Word-initial: Dorsal Non-initial: Labial	[Cor…Lab]; [Dor…Cor]; [Dor…Lab]

Another interesting finding in Fikkert & Levelt's study is that final codas in monosyllables (CV<u>C</u>) and intervocalic onsets in disyllables (CV<u>C</u>V) pattern in a similar way,[32] as far as the development of place word-patterns is concerned. Similar results were also observed in the development of manner, to which we turn in the next section.

5.1.2 Reports on the acquisition of manner feature patterns

The development of manner feature patterns has been the focus of research conducted in Dutch (Langeslag, 2007) and in Dutch, German and French (Altvater-Mackensen, Dos Santos & Fikkert, 2008; Altvater-Mackensen & Fikkert, 2009). The main findings of these studies will be outlined in the current subsection.

The work of Langeslag (2007) is based on the data of six Dutch children, between the ages of 1;0 and 2;11.[33] Similarly to what has been reported for the development of place patterns, Langeslag observed that, as far as manner is concerned, intervocalic onsets (C2) and final consonants present a similar development. This same pattern has been observed in German: disyllables emerge later, but show the same developmental patterns that occur in CVC forms (Altvater-Mackensen & Fikkert, 2009).

According to Langeslag, the analysis of the development of manner features must focus both on word position and on the relation between both positions. This author proposes a model for the acquisition of manner word-patterns in Dutch. The first stage of this model is constituted by the early productions in the children's data, in which manner harmony prevails (pattern attested also in German and French); this first stage has already been discussed in chapter 4 and will not be addressed here. In the

[32] However, the status of intervocalic consonants (C2) in acquisition patterns is controversial in the literature: in some cases, C2 behave similarly to codas (Kehoe & Lléo, 2002, for fricatives), in other cases, C2 resemble word-initial onsets (Kehoe & Lléo, 2002, for segment /k/) and, finally, some studies claim that C2 pattern in a unique way, throughout the process of acquisition (Kehoe & Lléo, 2002, for segments /ts/ and /l/).
[33] Data integrated in the CLPF database.

current chapter, we will focus on the stages that involve the production of non-identical manner patterns: [$C_{MoA}≠C_{MoA}$].

In the model proposed by Langeslag, the second stage in the development of manner patterns in Dutch is characterized by the acquisition of the first non-harmonic combinations, most often [Stop…Fric]: /kofɪ/->[kɔfɪ] (*coffee*); Noortje, 2;6 (Langeslag, 2007).

According to Langeslag, the appearance of [Stop…Fric] in CVCV patterns marks the moment when the distinction between C1 and C2 is acquired. At this step of the development, the unit word has become segmentalized and consonants can be specified separately for place and for manner features.

In Langeslag's model, the acquisition of most manner word-patterns takes place in stage III. Two main templates emerge in this period: [x…Obstr] and [Stop…x] (where x stands for any MoA feature). The first templatic pattern regulates the appearance of new manner features in initial position: every newly-acquired manner in C1 must first combine with an Obstruent in C2. The second templatic pattern regulates the acquisition of manner in non-initial position: any newly-acquired manner in non-initial position must first combine with a Stop in C1. These templates are summarized in (172).

(172) Templatic patterns in the acquisition of [$C_{MoA}≠C_{MoA}$] patterns: stage III
(Langeslag, 2007)

a) [x…Obstr], for instance: [<u>Nas</u>…Obstr]>> [<u>Fric</u>…Obstr]>> [<u>Liq</u>…Obstr]
b) [Stop…x], for instance: [Stop…<u>Fric</u>]>> [Stop…<u>Nas</u>]>>[Stop…<u>Glide</u>] [Stop…<u>Liq</u>]

According to Langeslag, the emergence of the templates given above shows that the development of manner features in initial and non-initial position is, at least to a certain degree, interdependent.

It is only at stage IV (which overlaps with stage III, for some of the children) in Langeslag's model that combinations that do not include Stops in C1 or Obstruents in non-initial position (in other words, combinations of nondefault manner features) start surfacing in Dutch children's productions. Some examples of these 'late acquired' MoA patterns are listed in (173).

(173) Examples of manner patterns acquired later by Dutch children (Langeslag, 2007)
[Nas…Liq]; [Fric…Liq]; Fric…Nas]; [Fric…Glide]

Regarding the general order of acquisition of manner features in [C≠C] patterns, the majority of children in Langeslag's study acquired stops and nasals in word-initial position first. More variation was found in the acquisition of fricatives: three children acquired them in the order C2>>C1, while the other three acquired fricatives first in C1 (order C1>>C2) or in both positions simultaneously (C1/C2). No data is available in Langeslag's study on the acquisition of liquids.

THE ACQUISITION OF MANNER CONTRASTS

Langeslag (2007) establishes a distinction between the acquisition of manner features and the acquisition of manner contrasts. The idea is that a manner feature may already be available in a particular position in [C_{MoA}≠C_{MoA}] forms, but still not be used contrastively in that position. For instance, if, at an early stage, a child produces only [Stop…Stop] and [Stop…Fric] patterns, it is assumed that stops and fricatives are acquired but they are only contrastive in C2, since only stops are available in C1 position at this point.

According to Langeslag, the first contrasts acquired tend to be between stops and fricatives and between obstruents and sonorants (nasals). Most children acquire the earliest manner contrasts in non-initial position, while later contrasts appear in initial position first. This pattern is illustrated with data of Jarmo, in (174).

(174) Acquisition of early and late manner contrasts: non-initial position vs initial position (Langeslag, 2007)

Child/Age	Patterns acquired	Contrasts acquired	Word-position
Jarmo, 1;8	[Stop…Fric]; [Stop…Stop]	Stop/Fricative	Non-initial
Jarmo, 1;9	[Stop…Nas]	Obstruent/Sonorant	Non-initial
Jarmo, 2;1	[Nas..Fric]; [Liq…Fric]	Nasal/Approximant	Initial
Jarmo, 2;2	[Glide…Fric]	Liquid/Glide	Initial

As shown above, the first contrasts acquired by Jarmo are between stops and fricatives and between obstruents and sonorants. These two contrasts are acquired in non-initial position, at the ages of 1;8 and 1;9. Amongst the latest acquired contrasts, are the ones that involve sonorants, which appear in initial position first, at the ages of 2;1 and 2;2. It is worth noticing, however, there is some variation among Dutch children, as far as the order of introduction of manner contrasts is concerned: some children acquire the first manner contrasts in word-initial position (see the data of Tom, in Langeslag, 2007; see also Alvater-Mackensen & Fikkert, 2009).

In German, children tend to introduce contrasts in non-initial position first, in combinations where the first consonant is a stop (templatic pattern [Stop…x]; see Altvater-Mackensen & Fikkert, 2009). In French (Altvater-Mackensen, Dos Santos & Fikkert, 2008), the two children studied varied as to the position in which they first introduced contrasts in CVCV forms: one child (Marilyn) acquired manner contrasts first in C2 (combinations such as [Stop…Fric], [Stop…Nas], [Stop…Liq] surface first); the other child (Marie) introduced contrasts in word-initial position first (combinations such as [Nas…Stop] and [Liq…Stop] tend to emerge earlier than [Stop…Nas], [Stop…Liq]).[34]

Both Langeslag (2007) and Fikkert & Levelt (2008) suggest that there is a triangular relation between acquisition patterns, children's developing vocabulary and distributional frequency in the input. These issues will be discussed in the following sections.

5.1.3 Acquisition patterns and the developing lexicon

The studies performed in Dutch, both on place and manner acquisition (see sections 5.1.1 and 5.1.2) establish a relationship between developmental patterns and children's expanding vocabulary.

Langeslag (2007) argues that the main driving force behind the several stages in manner development is the child's developing lexicon. As the vocabulary of the young learner increases, the holistic representations are no longer able to differentiate between all the words.[35] A similar approach is presented in Levelt (1994; to appear) and Fikkert & Levelt (2008), for the acquisition of place word-patterns. The constraints [Lab and *[Dor (see section 5.1.1) are interpreted by these authors as the outcome of children's generalizations over their early vocabulary, which at some point almost exclusively contains words with Labial in C1. Non-homorganic target words with initial dorsals are not part of these children's early lexicon. As a result, two main generalizations appear: Labial must be assigned to C1; Dorsal must *not* be assigned to C1.

Fikkert, Levelt & van de Weijer (2002) and Fikkert & Levelt (2008) further propose that the feature patterns of words in children's developing lexicons reflect the frequency of these patterns in the input language. In this sense, developmental patterns can, ultimately, be traced back to frequency properties of the input. We will explore this issue in the next section.

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[34] Altvater-Mackensen, Dos Santos & Fikkert (2008) hypothesize that the cross-linguistic variation (in Dutch, German and French) in the position in which children acquire manner contrasts first might be related to stress: some children introduce contrasts in stressed position; others choose the unstressed position first.

[35] On holistic representations and the 'whole word' stage, see chapter 4.

5.1.4 The role of input frequency in the acquisition of [C≠C] patterns

As already discussed in the previous chapters, a relatively large body of research has shown that input frequency may influence phonological developmental, both in perception and production (Jusczyk *et al.* (1994) Storkel, 2001; Vodopivec, 2004; Edwards, Beckman, & Munson, 2004; Zamuner, Gerken, & Hammond, 2004; Monnin, Lœvenbruck & Beckman, 2007). A common notion within this line of investigation is phonotactic probability, which refers to the likelihood that sounds or sequences of sounds are acquired based on their distributional properties in the input. For instance, a sound that occurs more frequently in C1 position than in C2 is expected to be acquired in the order C1>>C2.

In their study of the acquisition of Dutch [C_{PoA}≠C_{PoA}] forms, Fikkert, Levelt & Van de Weijer (2002) argue that the early preference for [Lab…Cor] combinations and the initial constraint on word-initial dorsals correlates positively with the distribution of these patterns in adult speech. The authors analyzed a list of 914 words Dutch children are supposed to know by the age of six and verified that [Lab…Cor] is the most frequent PoA pattern in that list, constituting about 25% of the cases. On the contrary, patterns with Dorsal in C1 are less frequent: [Dor…Cor] appears in about 10% and [Dor…Lab] in 5% of the cases. This frequency hierarchy is reflected, according to the authors, in the order of acquisition of PoA patterns in Dutch: [Lab…Cor] forms are mastered before patterns with word-initial dorsals. The frequency hierarchy of PoA patterns in Dutch input and their corresponding order of acquisition are summarized in (175).

(175) Frequency of PoA patterns in the input and order of acquisition – Dutch

Frequency hierarchy in the input (descending) (Fikkert, Levelt & Van de Weijer, 2002)	Order of acquisition (descending) (Fikkert & Levelt, 2008)
[Lab…Cor] (25.49%)	[Lab…Cor]
[Cor…Dor] (13.24%)	[Cor…Dor]/[Lab…Dor]
[Lab…Dor](11.27%)	
[Dor…Cor] (10.83%)	[Dor…Cor]
[Cor…Lab](10.5%)	[Cor…Lab]/[Dor…Lab]
[Dor…Lab] (5.14%)	

Fikkert, Levelt & Van de Weijer further suggest that cross-linguistic differences in the acquisition of [C_{PoA}≠C_{PoA}] patterns might be traced back to different distributions of features in particular word-positions. Aiming to account for the fact that, as far as Consonant Harmony is concerned, Dutch children have almost exclusively (regressive)

Labial Harmony patterns,[36] while in the acquisition of English both Labial and Dorsal harmony have been attested, Fikkert, Levelt & Van de Weijer compared *corpora* of Child Directed Speech (CDS) in both languages.[37] They observed that, in English CDS, the distribution of Labial, Coronal and Dorsal in word-initial position is more or less even, while in C2 position, coronals are far more frequent than labials and dorsals. As for Dutch CDS, Coronal is the most frequent PoA in both word-positions. The authors hypothesize that, due to the high frequency of non-initial coronals in the input, English children associate C2 position with the unmarked place feature and, consequently, assume that C1 is the preferred position for the occurrence of marked PoA (Labial, Dorsal). At a given point in development, English children may overgeneralize this assumption, inferring that Labial and Dorsal should always be aligned with the left edge of the word, resulting in cases of 'apparent' Labial or Dorsal harmony (for instance, (table) /ˈteɪbəl/->[beːbu]; (duck) /dʌk/->[gʌk] (Smith, 1973)).

As for the Dutch children, they do not have evidence for an unmarked position, since coronals are equally frequent in C1 and C2, in CDS. According to Fikkert, Levelt & Van de Weijer this lack of evidence for a preferred position for the unmarked PoA (and, consequently, for the marked features) turns the distribution of Labial and Dorsal into a very important factor for Dutch learners. Since, in Dutch CDS (Van de Weijer, 1998), labials are more frequent in C1 - in the Van de Weijer *corpus*, around 78% of all labial segments occur in word initial position - and dorsals occur more often in C2, around 57%, children infer that Labial must be aligned with C1. The overgeneralization of this inference is the cause, according to Fikkert, Levelt & Van de Weijer, for the 'apparent' regressive Labial harmony patterns observed in Dutch (for instance /slɔfə/->[bɔfə]; Levelt, 1994).

The consonant harmony phenomenon will be explored in chapter 6, where we present an analysis of the alternative strategies children use when coping with problematic [C≠C] patterns. For the current chapter, the most relevant finding in the study of Fikkert, Levelt & Van de Weijer (2002) is the correlation between the distribution of place feature patterns in the input and the order of acquisition of those combinations, both within and across languages (Dutch and English).

One of the aims of the current dissertation is to contribute to the discussion of the potential role of the input distributional properties in the acquisition patterns observed

[36] See chapter 6 for an alternative designation for 'apparent' consonant harmony cases in Dutch, according to Levelt (to appear).
[37] Taking into consideration only the PoA of stops and nasals, for word-initial position, and of stops and fricatives, in C2.

in the data of the five Portuguese children. Since there is no extensive *corpus* on CDS in EP, this discussion will be based on the frequency rates extracted from a sample of EP adult speech. More details on this topic are provided below.

5.2 Distributional properties in adult speech

In chapter 4, we compared children's acquisition patterns to the distribution of place and manner feature patterns in a sample of adult speech, focusing on [C=C] patterns. A similar study will be performed in the current chapter, but now the comparison will focus on [C≠C] sequences. In order to establish this comparison, we extracted the 100 most frequent CVCV words from of the *corpus Spoken Portuguese* (see section 5.3) and identified the distribution of consonantal place and manner feature [C≠C] patterns in those words. For instance, a word like *muito* (plenty) was classified as [Lab…Cor], for place and as [Nas…Stop], for manner. The results are given in graphs (176) and (177).

(176) Distribution of place [C≠C] patterns in EP adult speech (appendix B)

	Nº	%
[Lab…Cor]	689	36%
[Dor…Cor]	436	23%
[Cor…Lab]	428	22%
[Lab…Dor]	142	7%
[Cor…Dor]	136	7%
[Dor…Lab]	93	5%

(177) Distribution of manner [C≠C] patterns in EP adult speech (appendix B)

	Nº	%
[Nas…Stop]	354	23%
[Stop…Fric]	321	21%
[Stop…Nas]	240	15%
[Stop…Lat]	125	8%
[Fric…Stop]	120	8%
[Stop…Rhot]	92	6%
[Fric…Nas]	79	5%
[Lat…Stop]	57	4%
[Nas….Lat]	51	3%
[Fric…Rhot]	31	2%
[Lat…Nas]	25	2%
[Nas…Fric]	24	2%
[Fric…Lat]	22	1%

As depicted in (176), [Lab…Cor] is the most frequently produced place feature pattern in the sample of the 100 most frequent CVCV words in EP adult speech; it corresponds to 36%, followed by [Dor…Cor], 23%, and [Cor…Lab], 22%. The patterns [Lab…Dor], [Cor…Dor] and [Dor…Lab] are the least frequent, occurring below 8% of the cases (see appendix B).

As for manner word-patterns (see (177)) the most frequent [C≠C] pattern is [Nas…Stop] in 23% of the cases, immediately followed by [Stop…Fric] (21%). The manner sequence [Stop…Nas] occurs relatively often, in 16% of the cases. The other combinations are less frequent, corresponding to percentages below 10%.

In section 5.8, the properties of EP adult speech described above will be compared with the patterns of acquisition of [C≠C] forms.

5.3 Summary and research questions

Research on segmental acquisition across languages (namely Dutch, German and French) shows that [C≠C] patterns are not available from the onset of speech production. Similar results were observed in EP (see chapter 4).

Research in the field has shown that the development of [C_{PoA}≠C_{PoA}] patterns takes place in a gradual fashion and is influenced by positional constraints (Levelt, 1994; Fikkert & Levelt, 2008). As far as PoA is concerned, studies developed in Dutch have shown that [Lab…Cor] is amongst the first [C_{PoA}≠C_{PoA}] combinations acquired. Then, two constraints emerge in children's output representations: [Labial, that aligns Labial consonants with the left edge of the word and *[Dorsal, which bans dorsals from C1. Due to the latter constraint, Dorsals are first acquired in non-initial position ([Cor…Dor], [Lab…Dor]) and only afterwards in word-initial ([Dor…Cor], [Dor…Lab]).

As for the development of [C_{MoA}≠C_{MoA}] patterns, studies performed in Dutch and in German (Langeslag, 2007; Altvater-Mackensen & Fikkert, 2009) report that [Stop…Fric] is the first combination that appears in CVCV forms. Then, two templatic patterns emerge in Dutch children's output representations: one that contains a stop in C1 ([Stop…x]) and another that contains an obstruent in C2 ([x…Obstr]). Combinations of manner features that do not fit these templates are the last to be acquired (for instance, [Liq…Nas] or [Fric…Liq]). Children vary as to the position in which features and contrasts are first acquired: some acquire the first features or contrasts in non-initial position, while others acquire them in word-initial position first.

In sections 5.1.3 and 5.1.4, it was pointed out that researchers have established a triangular relation between (i) the acquisition of [C≠C] forms, (ii) children's developing lexicon and (iii) input frequency (Fikkert, Levelt & van de Weijer, 2002). The main idea is that highly frequent structures in the input language are reflected in children's early lexicons and learners generalize over their own lexicon in order to organize their word productions. Within this view, constraints such as [Lab or *[Dor and templatic patterns such as [Stop…x] or [x…Obstr] are the outcome of generalizations children make over the most frequent structures in their own vocabulary. If children's vocabularies reflect the frequency rates in the input, frequent patterns in the input are expected to appear early in their productions.

In chapter 3 of the dissertation, a relation between the expansion of Portuguese children's active vocabulary and developmental patterns has already been observed. It was shown that the frequency of consonants, independently of word position, in the children's intake became closer to the frequency of occurrence of those consonants in a sample of adult speech, only after a certain point in the development (see chapter 3, section 3.5.6). The analysis of the number of different target-words (types) each child selected per session showed that the increase in similarity between children's intake and adult speech coincides with an increase in the number of types in the children's vocabulary. The number of types attempted by each child, per session is repeated in (178).

(178) Number of target-words (types) attempted per session (chapter 3)

	0;11	**1;0**	**1;1**	**1;2**	**1;3**	**1;4**	**1;5**	**1;6**	**1;7**	**1;8**	**1;9**	**1;10**	**2;0**	**2;2**	**2;3**
Inês	6	8	25		36	31	53	48	56	95	118				
Clara	2	2	5	5	7	6	14	9	13	26	55	51			
João		2	4	5	9	13	18	17	16	24	62	81			
Joana	2	1		4		2	2	10		10	33	50	102		
Luma	2	2	4	7	7	3	6	8	7	11	17	17	25	31	70

Assuming, in line with Langeslag (2007) and Fikkert & Levelt (2008), that developmental patterns result from the pressure of an expanding lexicon, one of the questions that will be addressed in the current chapter is if the increase in the number of types in children's active vocabulary coincides with the appearance of target-like [C≠C] patterns in their output forms.

As for the potential influence of the language addressed to children in developmental patterns, no extensive *corpus* is available for CDS in EP. For this reason, the only available possibility to compare developmental patterns with the input is by analyzing adult speech. In section 5.2, we saw that some feature sequences, namely [Lab…Cor] and [Nas…Stop] occur more often in adult speech than others ([Dor…Lab] or [Fric…Stop], for instance). One of the aims of the current chapter is to discuss if Portuguese children's developmental paths in the acquisition of [C≠C] patterns reflect the adult speech properties described above.

Two major research questions underlie the current chapter; they are summarized below.

(179) Research questions underlying the current chapter

a). How does the acquisition of [C_{PoA}≠C_{PoA}] and [C_{MoA}≠C_{MoA}] word-patterns develop in EP?
b). Which insights can those developmental patterns give us into Portuguese children's representations?

In order to discuss these two questions, several specific aims were formulated; they are listed in (180).

(180) Specific aims of the current chapter

1. Identify the order of acquisition of [C_{PoA}≠C_{PoA}] and [C_{MoA}≠C_{MoA}] patterns.
2. Study the impact of word position (C1 and C2) in the order of acquisition of PoA and MoA. 3. Report on the order of acquisition of PoA and MoA feature contrasts.
4. Analyze the relation between C1 and C2, during the acquisition of [C≠C] forms.
5. Discuss the potential influence of distributional properties of adult speech on the order of acquisition of [C≠C] patterns.

In order to achieve these goals, some methodological choices had to be made. They are described in the next section.

5.4 Method

The analysis presented in the current chapter is based on spontaneous longitudinal data of 5 Portuguese children (see chapter 2, for information on the database). The age period covered in this investigation and the corresponding number of recording sessions are presented in (181).

(181) Number of sessions and age period studied, in each child's corpus

Child	Age-period		N.º of sessions
Inês	0;11.14	4;2.18	30
Joana	0;11.24	4;0.13	26
Luma	0;11.23	2;6.27	39
João	1;10	2;0	22

As for methodological choices, the analysis was restricted to productions for disyllabic targets with two non-branching onsets: [CV(c)CV(c)].

Taking into consideration the primary features for PoA (Labial, Coronal, Dorsal) and for MoA (Stop, Nasal, Fricative, Lateral and Rhotic), six disyllabic place patterns and 20 disyllabic manner patterns could be expected; they are listed below.

(182) Disyllabic [C≠C] place word-patterns

[Lab…Cor]	[Dor…Lab]	[Cor…Lab]
[Lab…Dor]	[Dor…Cor]	[Cor…Dor]

(183) Disyllabic [C≠C] manner word-patterns

[Stop...Nas]	[Stop...Fric]	[Stop...Lat]	[Stop... Rhot]
[Nas... Stop]	[Nas...Fric]	[Nas...Lat]	[Nas... Rhot]
[Fric...Nas]	[Fric... Stop]	[Fric... Lat]	[Fric... Rhot]
[Lat...Nas]	[Lat... Stop]	[Lat...Fric]	[Lat... Rhot]
[Rhot...Nas]	[Rhot... Stop]	[Rhot...Fric]	[Rhot...Lat]

We searched for each of the PoA and MoA combinations listed above in the targets selected by each child, per session. Then, the child's renditions of each of the targets selected were analyzed; we identified the number of target-like productions and the number and type of alternative output forms (see appendixes G and H).

In order to make comparison feasible, we adopted the acquisition criteria used in Langeslag (2007): a given feature pattern is considered to be already in the process of acquisition if it is produced in a target-like fashion no less than twice in a given session/month, and at least once in the two following months. Note that we do not assume, in the current dissertation, that if these criteria are met that the structure is mastered; we only assume that the acquisition of that particular structure is already on the way. Moreover, the tables presented in appendix G provide a full quantitative account of target-like productions, for each [C≠C] pattern, per child, per session.

Similarly to what has been done in chapter 3, we will compare children's acquisition patterns to data of EP adult speech (sample constituted by 22842 words, taken from the *corpus Spoken Portuguese* - *Português Falado*; TA90PE; CLUL/Instituto Camões). For the current chapter, we extracted, using *FreP*,[38] the 100 most frequently produced CVCV words from the sample referred to above and, based on that subsample, coded the words for its place and manner feature composition (a word like *vida* was coded as [Lab...Cor] and [Fric...Stop], for instance). The results of this analysis were presented in section 5.2 (see also appendix B) and will be discussed in section 5.8.

According to the analysis presented in chapter 4 above, 80% of children's output forms in the first sessions are of the type [C=C]. When the occurrence of harmonic patterns decreased below 80%, we assumed, in this chapter, that children would be entering the [C≠C] stage. The threshold of the non-harmonic stage, based on the analysis of all output forms performed in chapter 4, is provided in (184).

(184) Threshold of the [C≠C] stage – overall output forms (chapter 4)

		Inês	Joana	Luma	Clara	João
PoA	Overall outputs	1;7	2;0	2;4	1;5	___
MoA	Overall outputs	1;9	2;0	2;4	___	___

In the data of the two children studied for a shorter period of time (Clara until 1;10 and João until 2;0), the threshold of [C_{MoA}≠C_{MoA}] stage was not identified (productions were still above 80% at the last sessions analyzed); note that, in João's data, it was also not possible to identify the beginning of the [C_{PoA}≠C_{PoA}] stage. A methodological goal in the current chapter is to verify if the age of acquisition of the first

[38] More information on this tool can be found at http://www.fl.ul.pt/LaboratorioFonetica/FreP.

[C≠C] disyllabic patterns coincides the general threshold of the [C≠C] stage defined in chapter 4. The results of this comparison will allow a discussion on the adequacy of the two approaches (analysis of the overall set of output forms *vs* analysis of the relation target/production of specific patterns) to the description of developmental patterns (see section 5.8).

5.5 The acquisition of place feature patterns in EP

In this section, we will describe the acquisition of the six PoA disyllabic word-patterns listed in (19), based on Portuguese acquisition data. This section is organized as follows. In 5.5.1, we describe the order of acquisition of [C_{PoA}≠C_{PoA}] forms. Subsection 5.5.2 presents the order of acquisition of place features per word position. In 5.5.3, the order of acquisition of place contrasts is discussed. The relation between C1 and C2 throughout the process of development is described in 5.5.4.

5.5.1 General order of acquisition of [C_{PoA}≠C_{PoA}] forms

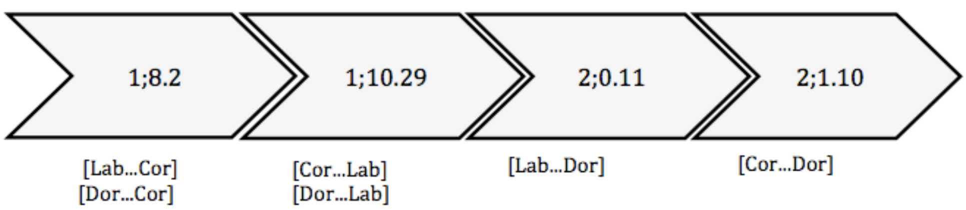
In this section, we present the order in which the six disyllabic [C_{PoA}≠C_{PoA}] combinations are acquired, in each child's *corpus*.

It is worth emphasizing that most word-combinations are not produced in a target-like fashion from the moment they are first attempted. There is a period in which those target patterns are submitted to alternative strategies in children's productions. This issue will be explored in chapter 6, where an analysis of the most frequent alternative output forms will be presented.

A. Inês

In Inês' data, the six disyllabic [C_{PoA}≠C_{PoA}] patterns emerge as target-like between the ages of 1;8 and 2;1. The first patterns to be acquired are the ones that contain Labial and Dorsal in C1 and Coronal in C2: [Lab…Cor] and [Dor…Cor]. The last pattern to surface systematically is [Cor…Dor]. The order of acquisition of the six PoA combinations is depicted in (185). See appendix G, for a list of the number of targets attempted and the corresponding number and percentage of target-like productions, per session.

(185) General order of acquisition of [C_{PoA}≠C_{PoA}] patterns – Inês (appendix G)



Some examples of the first target-like productions for each PoA pattern are provided next.

(186) First target-like productions for each [C_{PoA}≠C_{PoA}] pattern - Inês

	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	1;8.2	pato	duck	/ˈpatu/	[ˈpatʲu]	[Lab...Cor]
(b)	1;8.2	queijo	cheese	/ˈkɐjʒu/	[ˈgɛtu]	[Dor…Cor]
(c)	1;10.29	sumo	juice	/ˈsumu/	[ˈtumə]	[Cor…Lab]
(d)	1;10.29	garfo	fork	/ˈgaɾfu/	[ˈgapu]	[Dor…Lab]
(e)	2;0.11	boca	mouth	/ˈbokɐ/	[ˈbukɐ]	[Lab…Dor]
(f)	2;1.10	quero	(I) want	/ˈkɛɾu/	[ˈkɛɾu]	[Dor…Cor]

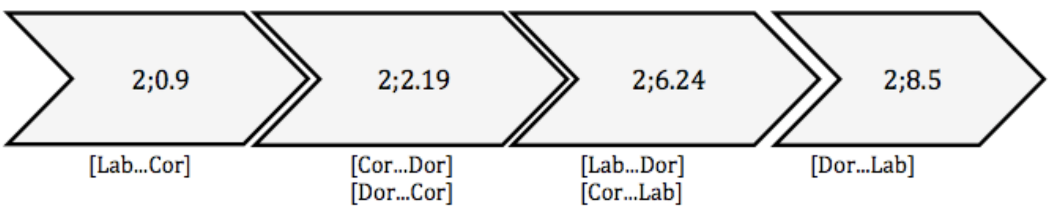
Some of the [C_{PoA}≠C_{PoA}] targets are submitted to alternative production strategies, before they are acquired/stabilized in Inês' system. Others are simply avoided, and are only selected at the time the child is already able to produce them accurately. This issue will be further explored in chapter 6.

In chapter 4, we observed that homorganic output forms constituted above 80% of all productions in Inês' *corpus* until the age of 1;6. It was only from 1;7 onwards that the frequency of non-homorganic forms started to increase. Based on that finding, we hypothesized that Inês entered the [C_{PoA}≠C_{PoA}] stage at 1;7. However, it is only at 1;8 that target-like productions for disyllabic forms appear. We analyzed the non-homorganic productions that occurred at 1;7 and verified that they were either target-like productions for adult polysyllables (for instance, /ipɔˈpɔtɐmu/->[pɔˈpɔtʲo] and /sɐˈpatu/->[paˈpata]) or resulted from alternative production strategies (/ˈkɔpu/->[p̺a̺ˈkɔː]/[ˈkotʲɔ]).

B. Joana

In Joana's *corpus*, the six disyllabic [C_{PoA}≠C_{PoA}] patterns emerge in a target-like fashion between 2;0 and 2;8. The first pattern acquired is [Lab…Cor] and the last is [Dor…Lab]. The global acquisition order is presented in (187); see appendix G for a quantitative account of targets and corresponding accurate productions.

(187) General order of acquisition of [C_{PoA}≠C_{PoA}] patterns – Joana (appendix G)



Some examples of the first target-like renditions of each non-homorganic place pattern are given in (188).

(188) First target-like productions for each $[C_{PoA}\neq C_{PoA}]$ pattern - Joana

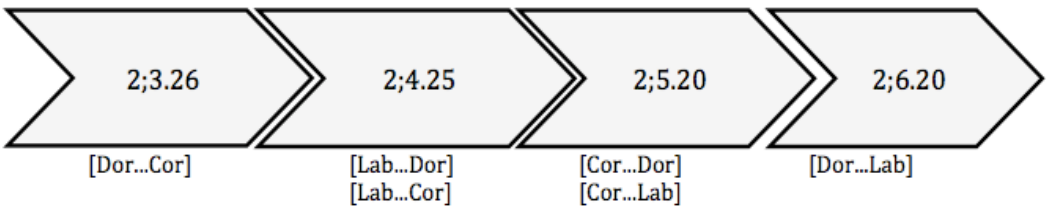
	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	2;0.9	pastor	shepherd	/pɐʃˈtoɾ/	[pɐˈtʲo]	[Lab…Cor]
(b)	2;2.19	saco	bag	/ˈsaku/	[ˈʃaku]	[Cor…Dor]
(c)	2;2.19	Guito	prop.noun	/ˈgitu/	[ˈgitʲu]	[Dor…Cor]
(d)	2;6.24	porco	pig	/ˈpoɾku/	[ˈpuku]	[Lab…Dor]
(e)	2;6.24	chapéu	hat	/ʃɐˈpɛw/	[ʒəˈpɛw]	[Cor…Lab]
(f)	2;8.5	comer	to eat	/kuˈmeɾ/	[kuˈmej]	[Dor…Lab]

In chapter 4, the analysis of Joana's output forms showed that this child was at the $[C_{PoA}=C_{PoA}]$ stage until the age of 1;10 and that it was only from 2;0 onwards that $[C_{PoA}\neq C_{PoA}]$ output forms increased in production. The target/production analysis presented here shows that 2;0 is in fact the age at which non-homorganic combinations start emerging in a target-like fashion. However, at 2;0, only [Lab…Cor] can be considered being in the process of acquisition; the other patterns emerge later, within an interval of 8 months. During the period in which each combination is still not acquired, the most frequent strategy used by Joana is syllable (or segment) deletion. This issue will be further explored in chapter 6.

C. Luma

In Luma's *corpus*, the acquisition of $[C_{PoA}\neq C_{PoA}]$ patterns takes place between 2;3 and 2;6. The first combination that emerges is [Dor…Cor] and the last is, as in Joana, [Dor…Lab].[39] This order of acquisition is shown in (189).

(189) General order of acquisition of $[C_{PoA}\neq C_{PoA}]$ patterns – Luma (appendix G)



The first faithful renditions of each PoA pattern are illustrated next.

[39] In fact, this combination emerges at the last session, thus it does not fully match the criteria adopted here (there is no data available on the two following months); however, it still gives us the order of acquisition in relation to the other patterns: it is the last to emerge.

(190) First target-like productions for each $[C_{PoA}\neq C_{PoA}]$ pattern – Luma

	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	2;3:26	casa	house	/ˈkazɐ/	[kaʒɐː]	[Dor…Cor]
(b)	2;4.25	mocho	owl	/ˈmoʃu/	[ˈboʒuː]	[Lab…Cor]
(c)	2;4.25	pega	take (it)	/ˈpɛgɐ/	[ˈpɛgɐ]	[Lab…Dor]
(d)	2;5.20	larga	let (it) go	/ˈlaɾgɐ/	[ˈnagɐ]	[Cor…Dor]
(e)	2;6.20	leva	take (it)	/ˈlɛvɐ/	[ˈnɛvɐ]	[Cor…Lab]
(f)	2;6.20	comer	to eat	/kuˈmeɾ/	[kuˈme]	[Dor…Lab]

Compared to the other children, the first $[C_{PoA}\neq C_{PoA}]$ patterns emerge quite late in Luma's *corpus*. However, as soon as the first [C≠C] pattern is being acquired, the other five combinations emerge within a short time frame (2;3 to 2;6).

In the analysis of output forms, presented in chapter 4, it was suggested that Luma entered the $[C_{PoA}\neq C_{PoA}]$ stage at the age of 2;4, since until 2;3 above 80% of her productions were of the type $[C_{PoA}=C_{PoA}]$. However, the comparison between target and production forms presented here shows that the production of disyllabic $[C_{PoA}\neq C_{PoA}]$ patterns has already started in a systematic way at 2;3, for the combination [Dor…Cor]. At this age, 8 out of 15 attempted [Dor…Cor] forms are already rendered in a target-like fashion (53% - see appendix G).

D. Clara

At the last session analyzed in Clara's *corpus*, at 1;10, three $[C_{PoA}\neq C_{PoA}]$ patterns are already being acquired. The first combination that appears is [Lab…Cor] at 1;5, followed by [Dor…Cor] at 1;8 and [Cor…Lab] at 1;9. This order of development is summarized in (191).

(191) General order of acquisition of $[C_{PoA}\neq C_{PoA}]$ patterns – Clara (appendix G)

The first target-like renditions of the three $[C_{PoA}\neq C_{PoA}]$ patterns are given in (192).

(192) First target-like productions for [C_{PoA}≠C_{PoA}] patterns – Clara

	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	1;5.16	mano	brother	/ˈmɐnu/	[ˈmɐnu]	[Lab...Cor]
(b)	1;8.20	gato	cat	/ˈgatu/	[ˈgatu]	[Dor...Cor]
(c)	1;9.23	tampa	cover	/ˈtɐ̃pɐ/	[ˈtɐmɐ]	[Cor...Lab]

It is important to emphasize that, except for [Lab…Cor] and [Dor…Cor], Clara selects very few non-homorganic patterns, as shown in appendix G.

In chapter 4, Clara was considered to be at the [C_{PoA}=C_{PoA}] stage until the age of 1;4. The comparison target/production performed in the present chapter confirms the findings in chapter 4: it is only at 1;5 that the first [C_{PoA}≠C_{PoA}] combination is acquired.

E. João

João was studied until the age of 2;0. Until that age, only one non-homorganic combination is acquired: [Lab…Cor], at the age of 1;7. The target-like productions for [Lab…Cor] forms at this age correspond to one single target-word, as illustrated in (193).

(193) First target-like production for [C_{PoA}≠C_{PoA}] patterns – João (appendix G)

Age	Orthogr.	Gloss	Target	Output	PoA pattern
1;7.0	bola	ball	/ˈbɔlɐ/	[bɔˈʎa]	[Lab...Cor]

In chapter 4, we hypothesized that João was still at the [C_{PoA}=C_{PoA}] output stage at the age of 2;0, since the majority of his output forms, above 80%, was homorganic. However, we can see that one disyllabic pattern ([Lab…Cor]) was already systematically produced according to the target from 1;7 onwards. This discrepancy between the results of the analysis of output forms only (as provided in chapter 4) and the analysis of target/production presented in the current chapter results from the fact that very few non-homorganic targets are selected in these early sessions and, even though they are rendered accurately most of the times, they represent a very low percentage in the overall number of productions in each session. This issue will be further explored in section 5.8 (see IX).

Except for [Lab…Cor], there are very few attempted [C_{PoA}≠C_{PoA}] combinations in João's data, as shown in appendix G. It seems that this child is in an intermediate period, where [C_{PoA}=C_{PoA}] is still predominant, but [C_{PoA}≠C_{PoA}] development has already started.

To sum up, non-harmonic patterns with Labial and/or Dorsal in word-initial position are amongst the first to be acquired ([Lab…Cor], [Dor…Cor]) across children, whereas the patterns that contain these two features in C2 are among the last to develop

([Cor…Dor], [Dor…Lab]). This means that the appearance of a place feature in a given position does not necessarily co-occur with the appearance of that same feature in the other position in the word, in a non-homorganic sequence. This issue will be further explored in the next section.

5.5.2 Order of acquisition, per word position

The current section describes the order of acquisition of each PoA feature in word-initial (C1) and in intervocalic position (C2). The table given in (194) displays the age in which each feature appears (systematically)[40] in each position, across children.

(194) Order of acquisition of each place feature, per word-position

	Inês		Joana		Luma		Clara		João	
Labial	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	1;8	1;10	2;0	2;6	2;4	2;5	1;5	1;9	1;7	---
Coronal	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	1;10	1;8	2;2	2;0	2;5	2;3	1;9	1;5	---	1;7
Dorsal	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	1;8	2;0	2;0	---	2;3	2;4	1;8	---	---	---

As shown above, there is an important difference between Labial and Dorsal, on the one hand, and Coronal on the other: Coronal is acquired first in C2, while Labial and Dorsal are predominantly acquired first in C1. Note that, in Clara's and João's data, we could not observe an order of acquisition for the three features in the two word-positions; in Clara's *corpus*, there are no combinations with Dorsal in C2 until the last session analyzed. As for João, there is no data available on the age of acquisition of Labial in C2, Coronal in C1, nor for Dorsal in any of the two positions. The general trends observed are the following:

- Labial and Dorsal are acquired first in C1;
- Coronal is acquired first in C2.

The positional asymmetries observed above are reflected in the fact that, as a first step in the development of non-homorganic patterns, children are able to produce some [C_{PoA}≠C_{PoA}] combinations, but not others. For instance, children start producing [Lab…Cor] patterns (see (195), below; examples (a), (c) and (e)), but, at that same time, they either avoid [Cor…Lab] targets or render them in alternative ways (examples (b), (d) and (f), below).

[40] No less than twice in one month and at least once in the two following months.

(195) Positional asymmetries in children's productions: [Lab…Cor] but not [Cor...Lab]

	Child	Age	Orthogr	Gloss	Target	Output	Production patterns		
(a)	Inês	1;8.2	pente	comb	/ˈpẽtɨ/	[ˈpʰitɐ]	/Lab…Cor/	>>	[Lab…Cor]
(b)	Inês	1;8.2	tampa	cover	/ˈtɐ̃pɐ/	[ˈpatɐ]	/Cor…Lab/	>>	[Lab…Cor]
(c)	Luma	2;4.11	passa	(he) passes	/ˈpasɐ/	[ˈpasɐ]	/Lab…Cor/	>>	[Lab…Cor]
(d)	Luma	2;4.11	sapo	frog	/ˈsapu/	[ˈfapu]	/Cor…Lab/	>>	[Lab…Lab]
(e)	João	2;0.6	porta	door	/ˈpɔrtɐ/	[ˈpotɐ]	/Lab…Cor/	>>	[Lab…Cor]
(f)	João	2;0.6	tampa	cover	/ˈtɐ̃pɐ/	[ˈpapɐ]	/Cor…Lab/	>>	[Lab…Lab]

At the stage of development illustrated above, where [Lab…Cor] is observed in children's productions but [Cor…Lab] is not, we can assume that, in non-homorganic forms, Labial is still not acquired in C2 and Coronal is not acquired in C1.

Note, however, that, within the same time frame (or earlier) Labial and Coronal are being accurately produced both in C1 and in C2, in [C=C] forms, as illustrated in (196).

(196) Accurate productions of Labial and Coronal in C1 and C2 – homorganic patterns

	Child	Age	Orthogr.	Gloss	Target	Output	Production
(a)	Inês	1;8.2	bebé	baby	/bɛˈbɛ/	[bɛˈbɛ]	[Lab…Lab]
(b)	Inês	1;8.2	deste	from this one	/ˈdeʃtɨ/	[ˈdetʲi]	[Cor…Cor]
(c)	Luma	2;3.26	parvo	silly	/ˈparvu/	[ˈpavu]	[Lab…Lab]
(d)	Luma	2;3.26	suja	dirty	/ˈsuʒɐ/	[suzɐ]	[Cor…Cor]
(e)	João	1;7.20	papá	daddy	/pɐˈpa/	[paˈpa]	[Lab…Lab]
(f)	João	1;7.20	Natal	Christmas	/nɐˈtaɫ/	[taˈtɐ]	[Cor…Cor]

In fact, by the time the first accurate [C_{PoA}≠C_{PoA}] patterns appear in output forms, all children are already producing the three main PoA features in [C=C] forms (except for Dorsal, in João's data). Thus, the positional asymmetries observed here seem to be related to non-homorganic sequences.

We will recur to a detailed analysis of the alternative production strategies children, when coping with positional asymmetries in [C≠C] forms in chapter 6.

We will now turn to the analysis of the acquisition of place contrasts in [C_{PoA}≠C_{PoA}] forms.

5.5.3 The acquisition of place contrasts

As already mentioned in section 5.1.2, a place feature may be acquired in a given position while it is not used contrastively. For instance, if a child produces only [Lab…Cor] and [Dor…Cor] at a given stage, Coronal is not used contrastively in C2 position, since it is the only PoA that occurs at that position. On the other hand, Labial and Dorsal are already contrastive in word-initial position, at that same stage. The question we want to address in this section is how place contrasts develop in non-homorganic patterns.

Based on the three major place features, three place feature contrasts will be observed. These are summarized in (197).

(197) Place feature contrasts analyzed, per word-position

a) Contrast between Labial and Dorsal (Lab/Dor)

b) Contrast between Labial and Coronal (Lab/Cor)

c) Contrast between Dorsal and Coronal (Dor/Cor)

Since João acquired only a single combination in the period of recording, no information on the development of contrasts can be derived from this child's *corpus* (see Appendix G). The analysis will therefore be based on the data of the other 4 children.

THE ACQUISITION OF THE FIRST PLACE CONTRASTS

In (198), we provide a summary of the order of acquisition of non-homorganic patterns in each child's *corpus*.

(198) Order of acquisition of place word-patterns (summary)

Inês	1;8 [Lab...Cor] [Dor...Cor]	1;10 [Cor...Lab] [Dor...Lab]	2;0 [Lab...Dor]	2;1 [Cor...Dor]
Joana	2;0 [Lab...Cor]	2;2 [Cor...Dor] [Dor...Cor]	2;6 [Lab...Dor] [Cor...Lab]	2;8 [Dor...Lab]
Luma	2;3 [Dor...Cor]	2;4 [Lab...Dor] [Lab...Cor]	2;5 [Cor...Dor] [Cor...Lab]	2;6 [Dor...Lab]
Clara	1;5 [Lab...Cor]	1;8 [Dor...Cor]	1;9 [Cor...Lab]	

Based on the chronology of acquisition of non-homorganic patterns given above, we identified the order of acquisition of place contrasts, per position.

Focusing on the first place contrasts acquired, we can see that Inês starts by acquiring the contrast Lab/Dor, in C1, at the age of 1;8, with the appearance of [Lab…Cor] and [Dor…Cor] output forms. As for Joana, she acquires her first place contrasts at 2;2: Lab/Cor and Lab/Dor, in C1 and Dor/Cor, in C2. At this age, Joana is already producing [Lab...Cor], [Cor…Dor] and [Dor…Cor]. Luma acquires her first two place contrasts at 2;4: Dor/Lab, in C1 and Dor/Cor in C2. As for Clara, she acquires her first homorganic pattern at 1;5, [Lab…Cor]. It is, however, only at 1;8 that this child acquires her first place contrast in [C≠C] patterns, with the appearance of [Dor…Cor]. We assume, then, that the contrast Lab/Dor is acquired in C1, at 1;8, in Clara's data.

ORDER OF ACQUISITION OF PLACE CONTRASTS PER WORD-POSITION

In (199), we identify the age at which each place contrast is acquired in C1 and in C2, per child. Note that, in Clara's *corpus*, some contrasts were only identified in C1.

(199) Order or acquisition of place feature contrasts in [C≠C] forms, in C1 and C2

	Lab/Dor		Lab/Cor		Dor/Cor	
Inês	C1	C2	C1	C2	C1	C2
	1;8	2;0	1;10	1;10	1;10	2;0
Joana	C1	C2	C1	C2	C1	C2
	2;2	2;6	2;2	2;6	2;2	2;2
Luma	C1	C2	C1	C2	C1	C2
	2;4	2;5	2;5	2;5	2;5	2;4
Clara	C1	C2	C1	C2	C1	C2
	1;8	---	1;9	1;9	1;9	---

We can see that the contrast between Labial and Dorsal is acquired in a fixed order: first in C1 and only later in C2 (in Clara's *corpus*, only the data on the acquisition in C1 is available). As for the contrast Lab/Cor, it most often appears in both positions simultaneously (in the data of Inês, Luma and Clara). In Joana's *corpus*, Lab/Cor appears first in C1 and afterwards in C2. More variation was observed regarding the acquisition of the contrast Dor/Cor: it may appear first in C1 (Inês, Clara), in both positions at the same time (Joana) or first in C2 and later in C1 (Luma).

We will now focus on the acquisition of place contrasts within each position.

ORDER OF ACQUISITION OF PLACE CONTRASTS, WITHIN EACH WORD-POSITION (C1; C2)

In (200), we provide the order of acquisition of place contrasts within the word-initial position.

(200) Order of acquisition of place contrasts in C1

C1	Lab/Dor	Lab/Cor	Dor/Cor
Inês	1;8	1;10	1;10
Joana	2;2	2;2	2;2
Luma	2;4	2;5	2;5
Clara	1;8	1;9	1;9

We can see that, in word-initial position, three of the four children studied in this section acquire the contrast Lab/Dor before the other two contrasts. In Joana's data, all contrasts appear at the same time, at 2;2.[41]

The order of acquisition of place contrasts in C2 is summarized in (201).

[41] Of course, we could have missed an order occurring in-between recording sessions.

(201) Order of acquisition of place contrasts in C2

C2	Lab/Cor	Lab/Dor	Dor/Cor
Inês	1;10	2;0	2;0
Clara	1;9		

C2	Dor/Cor	Lab/Dor	Lab/Cor
Joana	2;2	2;6	2;6
Luma	2;4	2;5	2;5

Contrary to what has been observed in the development at C1, Lab/Dor is one of the last contrasts to be acquired in C2. The first contrasts acquired in C2 are the ones that involve Coronal, namely Lab/Cor or Dor/Cor.

INTERIM SUMMARY – PLACE CONTRASTS

We will now proceed to a schematized summary of the main findings regarding the development of place contrasts.

- As for the word-position where children acquire their first contrasts, Inês and Clara introduce contrasts in C1, while Joana and Luma introduce contrasts in both C1 and C2 at the same time. What never occurs is the introduction of a contrast in C2 before at least one contrast has been acquired in C1.
- Regarding the order of acquisition per position, the contrast Lab/Dor is acquired in the order C1>>C2. More variation is found in the acquisition of the two place contrasts that involve Coronal.
- As for the order of acquisition within each position, Lab/Dor is the first to appear in C1, followed by the other two contrasts. On the contrary, the contrasts that involve coronals are the first to appear in C2.

So far, we have seen that [$C_{PoA} \neq C_{PoA}$] combinations are acquired gradually, since some features and contrasts tend to be acquired in one position before being acquired in the other position. The question that arises now is if there is any relation between C1 and C2, during the process of development. That is, does the presence of a certain feature in one position predict which feature can appear in the other position? We will focus on this issue in the next section.

5.5.4 Relation between C1 and C2

In this section, we explore the relation between the PoA of C1 and the PoA of C2, throughout the process of development of $[C_{PoA}\neq C_{PoA}]$ patterns. When a given PoA is acquired in a particular word-position, does it combine immediately with all other PoA features in the other position? For instance, there are two disyllabic [C≠C] combinations containing Labial in C1: [Lab…Cor] and [Lab…Dor]; do they appear at the same time? If not, does the time lag between the acquisition of one pattern and the acquisition of the other result from the late development of one of the features in a given position or is the time lag the result of combinatorial restrictions?

The table given in (202) displays the age at which $[C_{PoA}\neq C_{PoA}]$ patterns with a given PoA in C1 combine with the other two PoA features in C2, per child. In (202.a) and (202.b), we provide the order of acquisition of each PoA in C1 and in C2, respectively (in [C≠C] forms).

(202)Relation between C1 and C2

C1 Lab	[Lab…Cor](1;8) >>[Lab…Dor](2;0)	Inês
	[Lab…Cor](2;0) >>[Lab…Dor] (2;6)	Joana
	[Lab…Cor]/[Lab…Dor](2;4)	Luma
	[Lab…Cor](1;5)	Clara
	[Lab…Cor](1;7)	João
C1 Cor	[Cor…Lab](1;10)>>[Cor…Dor](2;1)	Inês
	[Cor…Dor](2;2) >>[Cor…Lab](2;6)	Joana
	[Cor…Dor]/[Cor…Lab](2;5)	Luma
	[Cor…Lab](1;9)	Clara
C1 Dor	[Dor…Cor](1;8)>>[Dor…Lab](1;10)	Inês
	[Dor…Cor](2;2)>>[Dor…Lab] (2;8)	Joana
	[Dor…Cor](2;3)>>[Dor…Lab] (2;6)	Luma
	[Dor…Cor](1;8)	Clara

(202.a) *Age of acquisition in C1 – [C≠C]*

C1	Labial	Coronal	Dorsal
Inês	1;8	1;10	1;8
Joana	2;0	2;2	2;2
Luma	2;4	2;5	2;3
Clara	1;5	1;9	1;8
João	1;7	___	___

(202.b) *Age of acquisition in C2 - [C≠C]*

C2	Labial	Coronal	Dorsal
Inês	1;10	1;8	2;0
Joana	2;6	2;0	2;2
Luma	2;5	2;3	2;4
Clara	1;9	1;5	___
João	___	1;7	___

As shown in (202), when Labial is acquired in C1, it combines first with a Coronal in C2 and only later with a Dorsal ([Lab…Cor]>>[Lab….Dor]). This pattern occurs in the data of 4 children; the exception is Luma, who acquires both [Lab…Cor] and [Lab…Dor] in the same session, at 2;4.[42] However, note that even though Dorsal may appear at the same time as Coronal in C2, the reverse pattern, where C1 Labial is combined first with a C2 Dorsal and only later with a C2 Coronal, never occurs.

A pattern similar to the one observed when Labial is in C1 was found when Dorsal is acquired in C1: it is first combined with Coronal in C2 and only later with Labial:[43] [Dor…Cor]>>[Dor…Lab]. The reverse pattern never occurs:

[42] Of course, a gradual development may still have taken place, in-between recordings.
[43] No data on Dorsal in João's *corpus*.

*[Dor…Lab]>>[Dor…Cor]. Thus, there is a preference for Coronal in C2, when Labial or Dorsal is present in C1.

As for Coronal in C1, no clear pattern is found: it can appear first in combination with either C2 Labial, or with a C2 Dorsal, or both combinations are possible at the same time.

We will now look at the data from the perspective of acquisition in C2; the table presented in (203) shows the order by which a given PoA feature acquired in C2 combines with a different PoA in C1. The age of acquisition of each PoA in [C≠C] forms, per position is repeated in tables (203.a) and (203.b).

(203)Relation between C2 and C1

C2 Lab	[Cor…Lab]/[Dor…Lab](1;10)	Inês
	[Cor…Lab](2;6) >> [Dor…Lab](2;8)	Joana
	[Cor…Lab](2;5) >> [Dor…Lab](2;6)	Luma
	[Cor…Lab](1;9)	Clara
C2 Cor	[Lab…Cor]/[Dor…Cor] (1;8)	Inês
	[Lab…Cor](2;0) >>[Dor…Cor](2;2)	Joana
	[Dor…Cor](2;3) >>[Lab…Cor](2;4)	Luma
	[Lab…Cor](1;5) >> [Dor…Cor](1;8)	Clara
	[Lab…Cor] (1;7)	João
C2 Dor	[Lab…Dor](2;0) >> [Cor…Dor](2;1)	Inês
	[Cor…Dor](2;2) >> [Lab…Dor](2;6)	Joana
	[Lab…Dor](2;4) >> [Lab…Cor](2;5)	Luma

(203.a) Age of acquisition in C1 – [C≠C]

C1	Labial	Coronal	Dorsal
Inês	1;8	1;10	1;8
Joana	2;0	2;2	2;2
Luma	2;4	2;5	2;3
Clara	1;5	1;9	1;8
João	1;7	___	___

(203.b) Age of acquisition in C2 – [C≠C]

C2	Labial	Coronal	Dorsal
Inês	1;10	1;8	2;0
Joana	2;6	2;0	2;2
Luma	2;5	2;3	2;4
Clara	1;9	1;5	___
João	___	1;7	___

Table (203) shows that for three of the children, when Labial is acquired in C2, it is preferably combined first with a Coronal in C1 and only later with a Dorsal; in Inês' data, it combines with both PoA features at the same time.

As for Dorsal, when it appears in C2, it is first combined with a Labial in C1, in the data of two children (Inês, Luma), or with a Coronal in C1 (Joana). There is no data available for the acquisition of Dorsal in C2 in the data of Clara and João.

When Coronal is acquired in C2, it is preferably combined with a C1 Labial (all children, except for Inês and Luma); however, both the reverse pattern, [Dor…Cor]>>[Lab…Cor] (Luma), and the simultaneous acquisition of both patterns (Inês) was also attested.

In sum, a predominant pattern was observed in the emergence of Labial and Dorsal in C1: they are first combined with a Coronal in C2. Much more variation was found when features first appeared in C2: Labial tends to combine first with a Coronal, but Dorsal can combine first with a Coronal, a Labial or with both simultaneously. Variation was also observed in the emergence of Coronal, in either of the word-positions.

If we compare the order of acquisition of the PoA combinations (see (202) and (203)) to the age at which each PoA is acquired per position (see (202.a-b) and (203.a-b)) we can see that, in the majority of cases, the gradual acquisition of the PoA combinations results from the fact that a given PoA is not yet acquired in one of the positions. The predominant pattern is when two features become available, they tend to combine right away. For instance, in Inês' data, C1 Labial is acquired in a non-homorganic combination at the age of 1;8 ([Lab…Cor]); at this age, it does not combine with C2 dorsal because intervocalic dorsals have not been acquired yet, in non-homorganic combinations ([Lab…Dor] will appear at 2;0). Luma, for instance, acquired [Cor...Dor] at 2;2 but [Cor…Lab] only at 2;6, because it is at this age that Labial first appears in C2 (in non-homorganic structures). Therefore, in most cases, the delay between the acquisition of one combination and another one does not result from combinatorial restrictions; it results from discrepancies in the timing of acquisition of each PoA feature, per word position.

However, there are at least two cases in which the order of acquisition per position cannot explain the delay in the development of a given combination. Those cases correspond to the combination [Dor…Lab] and occur in the *corpora* of Joana and Luma. Both children go through a short period where C1 Dorsal and C2 Labial are already available in non-homorganic combinations, but both features do not combine with each other right away. These two cases are summarized in (204).

(204) Combinatorial restrictions in the acquisition of [Dor…Lab] (Joana and Luma)

		Acquisition in C1 - [<u>C</u>≠C]		Acquisition in C2 - [C≠<u>C</u>]		[<u>C</u>≠<u>C</u>]			
						Age of acquisition		N.º Attempts	
(a)	Joana	Dor	2;2	Lab	2;6	[Dor…Lab]	2;8	1	(2;6)
(b)	Luma	Dor	2;3	Lab	2;5	[Dor…Lab]	2;6	3	(2;5)

As shown in (a) above, Joana acquires C1 Dorsal at 2;2 ([Dor…Cor]) and C2 Labial at 2;6 ([Cor…Lab]), but the combination [Dor…Lab] is only acquired at 2;8. There is one single attempt of a [Dor…Lab] target between 2;6 and 2;8 and it is rendered in an alternative way (see chapter 6). As for Luma (see (b)), she acquires C1 Dorsal at 2;3 and C2 Labial at 2;5; however, the combination [Dor…Lab] is acquired only in the next session, at 2;6. At the age of 2;5, there are 3 attempts of targets [Dor…Lab], all rendered in alternative ways in her production (see chapter 6).

Note, however, that, at the time they are rendering [Lab…Dor] in alternative formats, both children are already producing the reverse pattern accurately: Joana has acquired [Lab…Dor] at 2;6 and Luma at 2;4. So, in fact, the problem here seems to be not only combinatorial (they have C1 Lab and C2 Dor, but do not combine them), but also positional (they have [Lab…Dor] but do not have [Dor…Lab]).

5.6 The acquisition of manner feature patterns in EP

As stated in section 5.3, there are 20 possible disyllabic [C≠C] combinations for manner, if we consider the five MoA: Nasal, Stop, Fricative, Lateral and Rhotic. We recall those 20 combinations in (205).

(205) Disyllabic manner word-patterns [C≠C]

[Stop...Nas]	[Stop...Fric]	[Stop...Lat]	[Stop... Rhot]
[Nas... Stop]	[Nas...Fric]	[Nas...Lat]	[Nas... Rhot]
[Fric...Nas]	[Fric... Stop]	[Fric... Lat]	[Fric... Rhot]
[Lat...Nas]	[Lat... Stop]	[Lat...Fric]	[Lat... Rhot]
[Rhot...Nas]	[Rhot... Stop]	[Rhot...Fric]	[Rhot...Lat]

In the current section, we describe the way the 5 Portuguese children acquire these disyllabic word-patterns. As will be explained in the following section, it was not possible to identify all the combinations, even in the children analyzed until the age of 4;0 (Inês and Joana). In fact, some of the above patterns were attempted only seldom or even never attempted at all.

This section is organized as follows. In 5.6.1, the order of acquisition of [C_{MoA}≠C_{MoA}] forms is presented, per child. Subsection 5.6.2 describes the order of acquisition of manner features in [C≠C], per word-position. In 5.6.3, the order of acquisition of manner contrasts is discussed. Finally, subsection 5.6.4 explores the relation between C1 and C2 throughout the process of development of manner word-patterns.

5.6.1 General order of acquisition of [C_{MoA}≠C_{MoA}] forms

The current section presents the order in which disyllabic [C_{MoA}≠C_{MoA}] patterns are acquired, in each child's *corpus*.

As already mentioned in 5.5.1, regarding the analysis of place patterns, it is important to keep in mind that most [C≠C] combinations are initially not produced according to the target. Before these target structures become fully acquired, they are rendered in alternative ways in children's output forms (see chapter 6).

A. Inês

Inês was studied from the age of 0;11 to 4;2; all sessions were scanned, looking for non-harmonic disyllabic targets and their corresponding output forms. In appendix G, we provide the number of targets attempted for each manner word-pattern and the corresponding quantity of target-like productions, per session.

In Inês' data, we identified the acquisition of 13 of the 20 possible manner word-patterns. The first pattern is [Nas…Stop]; it emerges systematically in a target-like fashion from 1;8 onwards. Then, until the age of 3;4, another 12 patterns are acquired. The order of development of the 13 combinations is depicted in (206).

(206) General order of acquisition of [C_{MoA}≠C_{MoA}] patterns – Inês (appendix G)

1;8.2	1;9.19	1;10.29	2;0.11	2;1.10	2;4.18	2;7.16	2;11.22	3;4.6
[Nas...Stop]	[Stop...Lat]	[Stop...Rhot]	[Stop...Nas]	[Lat...Stop]	[Stop...Fric]	[Fric...Lat]	[Nas...Fric]	[Rhot...Stop]
						[Fric...Nas]	[Lat...Fric]	
						[Fric...Rhot]		
						[Fric...Stop]		

Amongst the first patterns, we find the ones that display a stop or a nasal in C1 [Nas…Stop], [Stop…Lat], [Stop…Rhot]). Among the last to be acquired are the combinations of fricatives and sonorants [Fric…Nas], [Fric…Lat], [Fric…Rhot] and patterns that contain liquids in word-initial position ([Lat…Fric]; [Rhot…Stop].

Some examples of the first target-like productions for each of the 13 patterns are provided in (207).

(207) First target-like productions for each [C_{MoA}≠C_{MoA}] pattern – Inês

	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	1;8.2	manta	blanket	/ˈmɐ̃tɐ/	[ˈmatɐ]	[Nas...Stop]
(b)	1;9.19	colo	lap	/ˈkɔlu/	[ˈkɔlu]	[Stop...Lat]
(c)	1;10.29	tira	take (it)	/ˈtiɾɐ/	[ˈteɾɐ]	[Stop...Rhot]
(d)	2;0.11	cama	bed	/ˈkɐmɐ/	[ˈkɐmɐ]	[Stop...Nas]
(e)	2;1.10	lobo	wolf	/ˈlobu/	[ˈlubu]	[Lat...Stop]
(f)	2;4.18	café	coffee	/kɐˈfɛ/	[kɐˈfɛ]	[Stop...Fric]
(g)	2;7.16	folha	leaf	/ˈfoʎɐ/	[ˈfolɐ]	[Fric...Lat]
(h)	2;7.16	vamos	(we) go	/ˈvɐmuʃ/	[ˈvɐmuʃ]	[Fric...Nas]
(i)	2;7.16	chorão	crying	/ʃuˈɾɐ̃w̃/	[ʃuˈɾɐ̃w̃]	[Fric...Rhot]
(j)	2;7.16	verde	green	/ˈveɾdɨ/	[ˈvedi]	[Fric...Stop]
(k)	2;11.22	novo	new	/ˈnovu/	[ˈnovu]	[Nas...Fric]
(l)	2;11.22	levo	(I)take	/ˈlɛvu/	[ˈlɛv]	[Lat...Fric]
(m)	3;4.6	roda	wheel	/ˈʀɔdɐ/	[ˈʀɔdɐ]	[Rhot...Stop]

In chapter 4, based on output forms only, we observed that until the age of 1;8, more than 80% of all words produced by this child was of the type [C_{MoA}=C_{MoA}]; it was only from 1;9 onwards that the number of [C_{MoA}≠C_{MoA}] words increased. Based on this observation, we hypothesized, in chapter 4, that Inês was still at the harmonic stage until 1;8. However, the analysis of target-like productions data presented in the current chapter show that at 1;8, the [C≠C] stage has already started with the acquisition of [Nas…Stop]; although there are still very few targets at this age, all attemped [Nas…Stop] target patterns are rendered correctly, as shown in appendix G. This issue will be further discussed in section 5.8.

B. Joana

Joana's *corpus* was analyzed from 0;11 to 4;0. The number of targets attempted for each disyllabic [C_{MoA}≠C_{MoA}] combination and the corresponding account of correct renditions, per session, are given in appendix G.

Globally, Joana acquires ten disyllabic [C_{MoA}≠C_{MoA}] patterns. The three first combinations appear systematically from the age of 2;2 onwards; they all contain a stop in one of the positions: [Nas…Stop], [Stop..Nas] and [Fric…Stop]. The last patterns to be acquired display liquids in C2: [Fric…Rhot], [Nas…Lat] and [Stop…Rhot].

The order of acquisition of the ten manner patterns observed in Joana's data is provided in (208).

(208) General order of acquisition of [C_{MoA}≠C_{MoA}] patterns – Joana (appendix G)

2;2.19	2;6.24	2;10.8	3;3.23	3;6.20
[Nas...Stop]	[Stop...Fric]	[Stop...Lat]	[Fric...Rhot]	[Stop...Rhot]
[Stop...Nas]	[Fric...Nas]		[Nas...Lat]	
[Fric...Stop]	[Nas...Fric]			

Some examples of the first target-like productions for each manner pattern are given in (209).

(209) First target-like productions for each [C_{MoA}≠C_{MoA}] pattern – Joana

	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	2;2.19	pernas	legs	/ˈpɛɾnɐʃ/	[ˈpɛɲɐʃ]	[Stop...Nas]
(b)	2;2.19	fita	ribbon	/ˈfitɐ/	[ˈfitɐ]	[Fric...Stop]
(c)	2;6.24	medo	fear	/ˈmedu/	[ˈmedʲu]	[Nas...Stop]
(d)	2;6.24	neve	snow	/ˈnɛvɨ/	[ˈnɛv]	[Nas...Fric]
(e)	2;6.24	chama	(he) calls	/ˈʃɐmɐ/	[ˈʃɐmɐ]	[Fric...Nas]
(f)	2;6.24	casa	house	/ˈkazɐ/	[ˈkazʲɐ]	[Stop...Fric]
(g)	2;10.8	balão	balloon	/bɐˈlɐ̃w̃/	[bɐˈlɐ̃w̃]	[Stop...Lat]
(h)	3;3.23	fora	out	/ˈfɔɾɐ/	[ˈfɔɾɐ]	[Fric...Rhot]
(i)	3;3.23	mala	bag	/ˈmalɐ/	[ˈmalɐ]	[Nas...Lat]
(j)	3;6.20	carro	car	/ˈkaʀu/	[ˈkaɾu]	[Stop...Rhot]

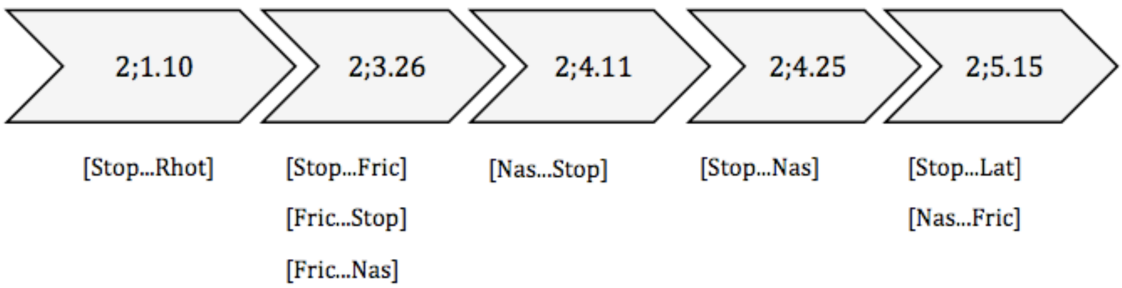
In chapter 4, we observed that Joana's output forms were harmonic in above 80% of the cases, until the age of 1;10. At 2;0, this child's [$C_{MoA}=C_{MoA}$] productions were already decreasing below 80%, leading to the hypothesis that the child entered the [$C_{MoA}\neq C_{MoA}$] stage at that age. However, as shown in the chronology presented above, target-like productions for disyllables appear only at 2;2. We analyzed the [$C_{MoA}\neq C_{MoA}$] output forms that occur at 2;0 again, and found out that there were 6 target-like productions of [Stop…Nas] in that session, all corresponding to polysyllabic targets like, for instance, the word /pɨkɨˈninɐ/ (little) rendered as [ˈp͡k̃iɲɐ] or the word /lɐjˈtiɲu/ (milk), produced as [kaˈkiɲo]. Thus, it seems that the [$C_{MoA}\neq C_{MoA}$] stage starts, in fact, at the age of 2;0, with the pattern [Stop…Nas] being correctly produced for polysyllabic targets. At 2;2, [Stop…Nas] appears also for disyllabic targets, as well as the other two patterns, [Nas…Stop] and [Fric…Stop]. This issue will be further explored in section 5.8.

C. Luma

All sessions in Luma's *corpus* were scrutinized (from 0;11 to 2;6), in order to identify the number of disyllabic [$C_{MoA}\neq C_{MoA}$] targets attempted and the corresponding target-like productions (see appendix G). This child acquires eight manner word-patterns by the age of 2;6. The first combination to be acquired is [Stop…Rhot], at 2;1. The last two patterns are [Stop…Lat] and [Nas…Fric]. No combination with liquids in C1 is acquired.

The order of acquisition of the 8 manner word-patterns attested is presented below.

(210) General order of acquisition of [$C_{MoA}\neq C_{MoA}$] patterns – Luma (appendix G)



The first target-like productions for each manner pattern are illustrated in (211).

(211) First target-like productions for each [C_{MoA}≠C_{MoA}] pattern – Luma

	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	2;1.10	pernas	legs	/ˈkaʀu/	[kaʀo]	[Stop...Rhot]
(b)	2;3.26	toma	take (it)	/ˈtɔmɐ/	[ˈpɔmɐː]	[Stop...Nas]
(c)	2;3.26	parvo	silly	/ˈpaɾvu/	[ˈpavu]	[Stop...Fric]
(d)	2;3.26	santo	saint	/ˈsɐ̃tu/	[ˈsʲɐ̃tu]	[Fric...Stop]
(e)	2;3.26	fumo	smoke	/ˈfumu/	[ˈfumu]	[Fric...Nas]
(f)	2;4.11	mundo	world	/ˈmũdu/	[ˈmũdu]	[Nas...Stop]
(g)	2;5.15	bola	ball	/ˈbɔlɐ/	[ˈbɔlɐ]	[Stop...Lat]
(h)	2;5.15	nova	new	/ˈnɔvɐ/	[ˈmɔvɐ]	[Nas...Fric]

In chapter 4, we observed that Luma's productions were harmonic in above 80% of the cases until the age of 2;3. It was only at 2;4 that the amount of [C_{MoA}≠C_{MoA}] words increased while harmonic productions decreased. However, the relation between target and production in disyllables presented here shows that between the ages of 2;2 and 2;3 four non-harmonic patterns were already being acquired. Similarly to what has been observed for PoA patterns in João's data (see section 5.5.1) the discrepancy as to the threshold of the [C≠C] stage results from the very low number of non-homorganic targets attempted (see section 5.8, for further discussion on this topic).

D. Clara

Clara's *corpus* was analyzed from the age of 1;0 to the last session available, at 1;10. During this period, only two disyllabic [C_{MoA}≠C_{MoA}] patterns are acquired, both at 1;8: [Nas...Stop] and [Stop...Fric]. There are seven other patterns that are hardly ever attempted by this child, and, if attempted, they are not (systematically) produced in a target-like fashion (see appendix G).

Some examples of the first target-like productions of the patterns [Nas…Stop] and [Stop…Fric] in Clara's data are provided in (212).

(212) First target-like productions for each [C_{MoA}≠C_{MoA}] pattern – Clara (appendix G)

	Age	Orthogr.	Gloss	Target	Output	PoA pattern
(a)	1;8.20	Noddy	prop.noun	/ˈnɔdi/	[ˈnɔti]	[Nas...Stop]
(b)	1;8.20	peixe	fish	/ˈpɐjʃɨ/	[ˈpɐjʃi]	[Stop...Fric]

In chapter 4, we observed that the vast majority of Clara's output forms were of the type [C_{MoA}=C_{MoA}] until 1;10. Based on these observations, we hypothesized that Clara was still at the harmonic output stage at the age of 1;10. However, the analysis of disyllabic forms presented here shows that two non-harmonic patterns are already in the process of acquisition from the age of 1;8 onwards. This discrepancy will be explored in section 5.8.

E. João

In João's *corpus*, only two disyllabic [$C_{MoA}≠C_{MoA}$] patterns are acquired: [Stop...Lat], at 1;7 and [Stop...Nas] at 1;10. As shown in appendix G, there are only few targets selected with these two combinations. As for the other [C≠C] patterns, they are seldom selected and not produced (systematically) in a target-like fashion.

The target-like productions of [Stop…Lat] and [Stop…Nas] are illustrated in (213).

(213) First target-like productions for each [$C_{MoA}≠C_{MoA}$] pattern – João (appendix G)

	Age	Orthogr.	Gloss	Target	Output	Target MoA pattern
(a)	1;7.0	bola	ball	/ˈbɔlɐ/	[bɔˈʎa]	[Stop...Lat]
(b)	1;10.11	cama	bed	/ˈkɐmɐ/	[ˈpama]	[Stop…Nas]

In chapter 4, we suggested that João was still at the harmonic stage at the age of 2;0, since we verified that above 80% of all his output forms were of the type [$C_{MoA}=C_{MoA}$]. However, the data described above shows that 2 disyllabic combinations have already been acquired before 2;0. This discrepancy will be explored in section 5.8.

5.6.2 Order of acquisition, per word position

In the current section, we describe the order of acquisition of each manner feature, in word-initial position (C1) and in intervocalic position (C2). The table given in (214) presents the age in which each feature is acquired in C1 and C2, in the data of the 5 children.

(214) Manner acquisition, per word-position (C1 and C2)

	Inês		Joana		Luma		João		Clara	
Nasal	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	1;7	2;0	2;2	2;2	2;4	2;3	---	1;10	1;8	---
Stop	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	1;9	1;7	2;2	2;2	2;1	2;3	1;7	---	1;8	1;8
Fricative	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	2;7	2;4	2;2	2;6	2;3	2;3	---	---	---	1;8
Lateral	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	2;1	1;9	---	2;10	---	2;5	---	1;7	---	---
Rhotic	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	3;4	1;10	---	3;3	---	2;1	---	---	---	---

As shown above, there is a fixed order in the development of liquids: both laterals and rhotics appear first in C2 position. The acquisition of these sound classes in C1 was only observed in the data of Inês. Much more variation is found in the order of acquisition of obstruents and nasals; Inês acquires obstruents in the order C2>>C1 but nasals in the order C1>>C2. Joana acquires nasals and stops simultaneously[44] in both positions and fricatives in the order C1>>C2. Luma acquires nasals first in C2, stops first in C1 and fricatives in both positions at the same time.

To sum up, there is a clear preference for liquids to appear first in C2 (C2>>C1). On the contrary, no clear pattern is observed for the acquisition of nasals and obstruents: three paths were identified for the acquisition of these sound classes – C2>>C1; C1>>C2 and C1/C2.

The positional asymmetries observed above are reflected in the fact that, as a first step in the development of non-homorganic patterns, children are able to produce some [C_{MoA}≠C_{MoA}] combinations, but not others. One systematic example of positional asymmetry across children is the fact that, at the time they start producing [Stop…Lat] accurately, all attempts at [Lat…Stop] lead to alternative production forms. This asymmetry is illustrated below.

(215) Positional asymmetries in children's productions – [Stop…Lat] and [Lat…Stop]

	Child	Age	Orthogr	Gloss	Target	Output	Production patterns	
(a)	Inês	1;9.19	bolos	cakes	/ˈboluʃ/	[ˈboluʃ]	/Stop…Lat/ >>	[Stop…Lat]
(b)	Inês	1;10.29	limpar	to clean	/lĩˈpaɾ/	[paˈpaj]	/Lat…Stop/ >>	[Stop…stop]
(c)	Joana	2;10.8	calor	heat	/kɐˈloɾ/	[kɐˈʎo]	/Stop…Lat/ >>	[Stop…Lat]
(d)	Joana	2;10.8	língua	tongue	/ˈlĩgwɐ/	[ˈgẽguɐ]	/Lat…Stop/ >>	[Stop…stop]
(e)	Luma	2;6.20	cola	glue	/ˈkɔlɐ/	[ˈkɔʎɐ]	/Stop…Lat/ >>	[Stop…Lat]
(f)	Luma	2;6.20	lobo	wolf	/ˈlobu/	[ˈobu]	/Lat…Stop/ >>	Deletion

It is worth emphasizing that, at the same time C1 laterals in non-homorganic combinations are being systematically rendered in alternative ways, C1 laterals in CV or CVV forms can already be produced in a target-like way; in fact, although laterals reach the 80% of target-like productions quite late, in these children's data (see chapter 3), a number of accurate productions are already attested at the time they are still not produced correctly in [C≠C] forms. Some examples of these target-like productions for lateral /l/ are given in (216).

(216) Accurate productions of Lateral in C1 – monosyllables or CVV

	Child	Age	Orthogr.	Gloss	Target	Output	Production patterns
(a)	Inês	1;10.29	lua	moon	/ˈluɐ/	[ˈluɐ]	[C_{Lat}VV]
(b)	Joana	3;0.2	lá	there	/ˈla/	[ˈla]	[C_{Lat}V]
(c)	Luma	2;4.11	lago	lake	/ˈlagu/	[ˈlaː]	[C_{Lat}V]

As observed for PoA, it seems that the positional restrictions observed here affect only non-harmonic sequences.

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44 Or in-between recordings.

5.6.3 The acquisition of manner contrasts

In this section, we will describe the way the five Portuguese children studied in this project acquire manner contrasts. We will focus on 4 main contrasts: the contrast between obstruents (stops and fricatives) and sonorants (henceforth, Obstruent/Sonorant); the contrast between stops and fricatives (henceforth Stop/Fricative); the contrast between nasals and liquids (henceforth Nasal/Liquid) and, finally, the contrast between laterals and rhotics (henceforth Lateral/Rhot). Those fours contrasts are summarized below.

(217) Manner contrasts analyzed

Obstruent/Sonorant

Stop/Fricative

Nasal/Liquid

Lateral/Rhot

ACQUISITION OF THE FIRST MANNER CONTRASTS

The order of acquisition of manner patterns in the *corpora* of the five children is summarized below.

(218) Order of acquisition of manner patterns - summary

Inês	**1;8** [Nas...Stop]	**1;9** [Stop...Lat]	**1;10** [Stop...Rhot]	**2;0** [Stop...Nas]	**2;1** [Lat...Stop]	**2;4** [Stop...Fric]	**2;7** [Fric...Liq] [Fric...Nas] [Fric...Stop]	**2;11** [Nas...Fric] [Lat...Fric]	**3;4** [Rhot...Stop]
Joana	**2;2** [Nas...Stop] [Stop...Nas] [Fric...Stop]	**2;6** [Stop....Fric] [Fric...Nas] [Nas...Fric]	**2;10** [Stop...Lat]	**3;3** [Fric...Rhot] [Nas...Lat]	**3;6** [Stop...Rhot]				
Luma	**2;1** [Stop...Rhot]	**2;3** [Stop...Fric] [Fric...Stop] [Fric...Nas]	**2;4.11** [Nas...Stop]	**2;4.25** [Stop...Nas]	**2;5** [Stop...Lat] [Nas...Fric]				
Clara	**1;8** [Nas...Stop] [Stop...Fric]								
João	**1;7** [Stop...Lat]	**1;10** [Stop...Nas]							

Inês acquires her first manner contrast in [C≠C] combinations at the age of 1;9. At this age the child is already producing [Nas…Stop] and [Stop…Lat] accurately. Thus, the first contrast acquired is between obstruents (stop) and sonorants (Nasal, in C1 and Lateral in C2).

Joana acquires the contrast Obstruent/Sonorant at 2;2, both in C1 (stops and fricatives vs nasals) and in C2 (stops vs nasals). Still at 2;2, Joana acquires the contrast within obstruents (stops vs fricatives), but only in C1.

Luma acquires her first manner contrasts in [C≠C] at the age of 2;3: she acquires the distinction between Stop and Fricative in C1 and in C2 and also the distinction between Obstruent and Sonorant (nasal), in C2.

As for Clara, at 1;8, she acquires the contrast between Obstruent (stop) and Sonorant (nasal) in C1 and the contrast between Stop and Fric in C2.

The first manner contrast acquired by João is within sonorants, in C2: Nasal versus Liquid (lateral), at 1;10.

Regarding the position in which contrasts are first introduced, the predominant pattern is that the first contrasts appear simultaneously in C1 and in C2. Overall, the contrasts between obstruents and sonorants and within obstruents (Stop/Fric) are amongst the first to appear. Note that the first appearance of the contrast between Obstruent and Sonorant is most often of the type Stop versus Nasal; this may constitute evidence for the default status of stops within obstruents and for nasals within sonorants (see section 5.8).

ORDER OF ACQUISITION OF CONTRASTS PER WORD-POSITION

We identified the age at which the four MoA contrasts were acquired in C1 and in C2. The results are provided in (219).

(219) Order or acquisition of manner feature contrasts in [C≠C] forms, in C1 and C2

	Obstr/Sonor		Stop/Fric		Nas/Liq		Lat/Rhot	
Inês	C1	C2	C1	C2	C1	C2	C1	C2
	1;9	1;9	2;7	2;4	2;1	2;0	3;4	1;10
Joana	C1	C2	C1	C2	C1	C2	C1	C2
	2;2	2;2	2;2	2;6	---	2;10	---	3;3
Luma	C1	C2	C1	C2	C1	C2	C1	C2
	2;4	2;3	2;3	2;3	---	2;3	---	2;5
Clara	C1	C2	C1	C2	C1	C2	C1	C2
	1;8	---	---	1;8	---	---	---	---
João	C1	C2	C1	C2	C1	C2	C1	C2
	---	---	---	---	---	1;10	---	---

The gaps in the table reflect the fact that not all contrasts were acquired in both positions; in the case of Joana and Luma, some of the contrasts do not appear in C1. In Clara's data, only two contrasts were identified, one in C1 and another in C2. In João's data, only one contrast is acquired until the last session studied (at 2;0).

As for general patterns, we can see that the contrasts within sonorants (Nas/Liq and Lat/Rhot) are acquired in a fixed order: C2>>C1 (or, at least, first in C2). No fixed order of development was observed in the acquisition of the two other contrasts (Obstruent/Sonorant; Stop/Fric): they can be acquired first in C1, first in C2 or in both positions simultaneoulsy.

ORDER OF ACQUISITION OF CONTRASTS WITHIN EACH WORD-POSITION

In word-initial position, contrasts are acquired in the following order.

(220) Order by which manner contrasts are acquired in C1

C1								
Clara	**1;8** Obstr$_{Stop}$/Sonor$_{Nas}$							
Inês		**1;9** Obstr$_{Stop}$/Sonor$_{Nas}$	**2;1** Nas/Liq				**2;7** Stop/Fric	**3;4** Lat/Rhot
Joana				**2;2** Obstr/Sonor$_{Nas}$ Stop/Fric				
Luma					**2;3** Stop/Fric	**2;4** Obstr/Sonor$_{Nas}$		

The contrast between obstruents and sonorants is (amongst) the first to be acquired in three of the four children (Inês, Joana, Clara). Note that, in C1 position, the first sonorant that appears is always a nasal. The contrast Stop/Fric also appears early in C1, for two of the children (Joana, Luma). The contrasts within sonorants (Nas/Liq and Lat/Rhot) in C1 are only acquired by one of the children (Inês).

As for the intervocalic position, contrasts are acquired in the following order.

(221) Order by which manner contrasts are acquired in C2

C2											
Clara	**1;8** Stop/Fric										
Inês		**1;9** Obstr$_{Stop}$/Sonor$_{Lat}$	**1;10** Lat/Rhot	**2;0** Nas/Liq			**2;4** Stop/Fric				
João			**1;10** Nas/Liq								
Joana					**2;2** Obstr$_{Stop}$/Sonor$_{Nas}$				**2;6** Stop/Fric	**2;10** Nas/Liq	**3;3** Lat/Rhot
Luma						**2;3** Obstr/Sonor$_{Nas}$ Stop/Fric Nas/Liq		**2;5** Lat/Rhot			

The contrast Obstr/Sonor is the first or amongst the first to be acquired in C2 by Inês, Joana and Luma. For two of those children the first sonorant that appears is a nasal, while for one of them (Inês), the sonorant is a lateral. The contrast Lat/Rhot is the last to appear for Joana and Luma and is not acquired by Clara and João. Inês acquires both Lat/Rhot and Nas/Liq relatively early in C2 position (1;10-2;0).

Note that in C2 position we were able to identify the order of development of the four MoA contrasts, in the data of three children (Inês, Joana, Luma); in initial position, the four contrasts were only identified in the data of Inês. If there is a privileged site for the acquisition of manner contrasts, it seems to be the C2 (see section 5.8).

To sum up, the analysis of the acquisition of manner contrasts showed that:

- The first contrasts (Obstruent/Sonorant and/or Stop/Fric) appear in C1 and in C2 at the same age, for three of the children (Inês, Joana, Luma).
- The contrasts within sonorants (Nas/Liq and Lat/Rhot) are acquired first in C2. Variation is found in the acquisition of the two other contrasts (Obstruent/Sonorant;

Stop/Fric): they can be acquired first in C1, first in C2 or in both positions simultaneously;

- There are more contrasts acquired in C2 than in C1 in this period, since most children acquired the contrasts within sonorants in C2 but not yet in C1.
- The contrast Obstruent/Sonorant (most often Obstr/Nas or Stop/Nas) tends to be the first to appear, both in C1 and in C2.
- The contrast Stop/Fric is also one of the first contrasts to appear (except for Inês).
- Except for Inês (and João, for the contrast Nas/Liq), the contrasts within sonorants (Nas/Liq and Lat/Rhot) are either the last to appear or are not acquired.

So far, we observed that there are differences in the patterns of acquisition of manner features and contrasts in word-initial and in intervocalic position. The question that needs to be addressed now is if there is any type of relation between both positions in the process of development, or if manner acquisition takes place separately for each position. This issue is explored in the next section.

5.6.4 Relation between C1 and C2

In this section, we describe the relation between C1 and C2 throughout the development of manner word-patterns.

For a given manner feature in a particular word-position, there are four disyllabic [C≠C] patterns. For instance, for Nasal in C2, we can have the following combinations: [Stop...Nas], [Fric...Nas], [Lat...Nas] and [Rhot...Nas]. Do these four combinations emerge simultaneously in children's data? If not, does the time lag between the acquisition of one pattern and the acquisition of the other result from the late development of the features in the other position or is that lag an outcome of combinatorial restrictions?

We will start with the analysis of the patterns that occur when manner features are acquired in C1. Table (222) shows the order in which each manner that emerges in C1 combines with the other manners in C2, per child. In (222.a) and (222.b), we provide the order of acquisition of each MoA feature in C1 and in C2, respectively (in [C≠C] forms).

(222) Relation between C1 and C2 _MoA

C1 Lat	[Lat…Stop](2;1) >>[Lat…Fric](2;11)	Inês
C1 Rhot	[Rhot…Stop](3;4)	Inês
C1 Nas	[Nas…Stop](1;7) >>[Nas…Fric](2;11)	Inês
	[Nas…Stop](2;2) >>[Nas…Fric](2;6); [Nas…Lat](3;3)	Joana
	[Nas…Stop](2;4) >>[Nas…Fric](2;5)	Luma
	[Nas…Stop](1;8)	Clara
C1 Fric	[Fric…Lat/Nas/Rhot/Stop](2;7)	Inês
	[Fric…Stop](2;2) >> [Fric…Nas](2;6)>> [Fric…Rhot](3;3)	Joana
	[Fric…Stop/Nas](2;3)	Luma
C1 Stop	[Stop…Lat](1;9) >> [Stop…Rhot](1;10)>> [Stop…Nas](2;0) >>[Stop…Fric](2;4)	Inês
	[Stop…Nas](2;2) >>[Stop…Fric](2;6)>> [Stop…Lat](2;10) >> [Stop…Rhot](3;6)	Joana
	[Stop…Rhot](2;1)>>[Stop…Nas/Fric](2;3)>> [Stop…Lat](2;5)	Luma
	[Stop…Lat](1;7) >> [Stop…Nas](1;10)	João
	[Stop…Fric](1;8)	Clara

(222.a) *Age of acquisition in C1 – [C≠C]*

C1	Stop	Nas	Fric	Lat	Rhot
Inês	1;9	1;8	2;7	2;1	3;4
Joana	2;2	2;2	2;2	—	—
Luma	2;1	2;4	2;3	—	—
Clara	1;8	1;8	—	—	—
João	1;7	—	—	—	—

(222.b) *Age of acquisition in C2 – [C≠C]*

C2	Stop	Nas	Fric	Lat	Rhot
Inês	1;8	2;0	2;4	1;9	1;10
Joana	2;2	2;2	2;6	2;10	3;3
Luma	2;3	2;3	2;3	2;5	2;1
Clara	1;8	—	1;8	—	—
João	—	1;10	—	1;7	—

The analysis of the table given above shows that when sonorants (nasals and liquids) emerge in C1, they combine first with a stop in C2. More variation occurs when fricatives emerge in C1: they can combine first with a stop in C2 (Joana) or with both stops and sonorants (Inês and Luma).

When stops emerge in C1, they combine first with a sonorant in C2, and only later with intervocalic fricatives (except for Clara, who acquires the combination [Stop…Fric] first).

We will now turn to the C2 position. Table (223) shows the order in which each manner that emerges in C2 combines with the other manners in C1; the age of acquisition of each MoA, per position is repeated in tables (223.a) and (223.b).

(223) Relation between C2 and C1 _MoA

C2 Lat	[Stop…Lat](1;9) >>[Fric…Lat](2;7)	Inês
	[Stop…Lat](2;10) >>[Nas…Lat](3;3)	Joana
	[Stop…Lat](2;5)	Luma
	[Stop…Lat](1;7)	João
C2 Rhot	[Stop…Rhot](1;10)>>[Fric…Rhot](2;7)	Inês
	[Fric…Rhot](3;3) >>[Stop…Rhot](3;6)	Joana
	[Stop…Rhot](2;1)	Luma
C2 Nas	[Stop…Nas](2;0) >>[Fric…Nas](2;7)	Inês
	[Stop…Nas](2;2) >>[Fric…Nas](2;6)	Joana
	[Stop…Nas]/[Fric…Nas](2;3)	Luma
	[Stop…Nas](1;10)	João
C2 Fric	[Stop…Fric](2;4)>>[Nas/Lat…Fric](2;11)	Inês
	[Nas…Fric]/[Stop…Fric](2;6)	Joana
	[Stop…Fric](2;3)>>[Nas…Fric](2;5)	Luma
	[Stop…Fric] (1;8)	Clara
C2 Stop	[Nas..Stop](1;8) >> [Lat…Stop](2;1); [Fric…Stop](2;7)>> [Rhot…Stop](3;4)	Inês
	[Nas…Stop]/[Fric…Stop] (2;2)	Joana
	[Fric…Stop](2;3) >> [Nas…Stop](2;4)	Luma
	[Nas…Stop](1;8)	Clara

(223.a) *Age of acquisition in C1 – [C≠C]*

C1	Stop	Nas	Fric	Lat	Rhot
Inês	1;9	1;8	2;7	2;1	3;4
Joana	2;2	2;2	2;2	_	_
Luma	2;1	2;4	2;3	_	_
Clara	1;8	1;8	_	_	_
João	1;7	_	_	_	_

(223.b) *Age of acquisition in C2 – [C≠C]*

C2	Stop	Nas	Fric	Lat	Rhot
Inês	1;8	2;0	2;4	1;9	1;10
Joana	2;2	2;2	2;6	2;10	3;3
Luma	2;3	2;3	2;3	2;5	2;1
Clara	1;8	___	1;8	___	___
João	___	1;10	___	1;7	___

We can see that, when fricatives and sonorants appear in C2, the predominant pattern is to combine it first with a stop (there is some variation, though).

When stops first appear in C2, they combine with a nasal or a fricative; combinations with word-initial liquids appear later.

In summary, the predominant pattern for the acquisition of fricatives and sonorants, in C1 and C2, is to be combined first with a stop in the other position in the word: [Stop…x] and [x…Stop] (where x stands for fricatives and sonorants). The alternative to this pattern is to combine fricatives and sonorants not only with stops but also with other features. It only seldom occurs that fricatives and sonorants are combined first with any other feature and only then with a stop.

If we compare the order of acquisition of [C≠C] MoA combinations (see (222) and (223)) to the order of acquisition of each MoA separately, per position, in non-harmonic combinations (see (222.a-b) and (223.a-b)) we can see that, in the majority of cases, the gradual acquisition of the MoA combinations results from the fact that a given MoA is not yet acquired in one of the positions. The predominant pattern is that when two features become available, they tend to combine right away. For instance, in Inês' data, C2 stops are available early ([Nas…Stop], 1;8), but will only combine with C1 fricative or Rhotic later, namely when those PoA features become available in C1 (in non-harmonic sequences): [Fric…Rhot] at 2;7 and [Rhot…Stop] at 3;4. Joana, for instance, acquires the combination [Nas…Stop] at 2;2 but the combination [Nas…Fric] appears only at 2;6, because until that age C2 fricatives were still not available in [C≠C] sequences. Therefore, in most cases, the delay between the acquisition of one combination and the other does not result from combinatorial restrictions; this delay results from the fact that MoA features are not acquired in all positions at the same time.

However, there are at least six cases in which the order of acquisition per position cannot explain the delay in the development of a given combination; those cases are outlined below.

- At 2;1 Inês acquires C1 Lateral in a non-homorganic combination ([Lat…Stop]) and at 2;2 she acquires C2 Fricative ([Stop…Fric]); however, the combination [Lat…Fric] is only acquired at 2;11. The 4 attempts made between 2;4 and 2;7 are submitted to alternative production strategies.
- At 1;8, Inês acquires C1 Nasal and at 2;4 she acquires C2 Fricative (in [C≠C] forms); however, the combination [Nas…Fric] is acquired only at 2;11.
- At 2;2, Joana acquires C1 Nasal and at 2;10 she acquires C2 Lateral; however, [Nas…Lat] is acquired only at 3;3.
- At 2;2, Joana acquires C1 Fricative and at 2;10 she acquires C2 Lateral. Nevertheless, the combination [Fric…Lat] is not acquired until the age of 4;0.
- At 2;2, Joana acquires C1 Stop and at 3;3 she acquires C2 Rhot; however, [Stop…Rhot] is acquired only at 3;6.
- At 2;3, Luma acquires C2 Fricative and at 2;4 she acquires C1 Nasal; the combination [Nas…Fric], however, is only acquired at 2;5.

The data on these combinatorial restrictions is summarized in table (224).

(224) Combinatorial restrictions in the acquisition of $[C_{MoA} \neq C_{MoA}]$

		Acquisition in C1 - [C≠C]		Acquisition in C2 - [C≠C]		[C≠C]			
						Age of acquisition		N.º Attempts	
(a)	Inês	Lat	2;1	Fric	2;4	[Lat…Fric]	2;11	4	(2;4-2;7)
(b)	Inês	Nas	1;8	Fric	2;4	[Nas…Fric]	2;11	7	(2;4-2;8)
(c)	Joana	Nas	2;2	Lat	2;10	[Nas…Lat]	3;3	3	(2;10-3;4)
(d)	Joana	Fric	2;2	Lat	2;10	[Fric…Lat]	___	26	(2;10-4;0)
(e)	Joana	Stop	2;2	Rhot	3;3	[Stop…Rhot]	3;6	11	(3;3-3;4)
(f)	Luma	Nas	2;4	Fric	2;3	[Nas…Fric]	2;5	3	(2;4)

In the cases listed above, the delay in the acquisition of [C≠C] combinations seems to be related to combinatorial restrictions. In general, there are few attempts of those late acquired patterns, but those attempts are systematically rendered in alternative output forms (see chapter 6). Note that the vast majority of the [C≠C] patterns with combinatorial restrictions (see table above) involve sequences of marked MoA, mostly combinations of fricatives with liquids or nasals. This issue will be further discussed in section 5.8.

5.7 Summary

This section presents a schematized overview of the main findings observed in the current chapter.

THE ACCQUISITION OF PLACE WORD-PATTERNS

General order of acquisition

- [Lab…Cor]/[Dor…Cor] >> [Cor…Dor]/[Dor…Lab].

Order of acquisition of features per position

- C2>>C1 for Coronal; C1>>C2 for Labial and Dorsal; positional asymmetries affect [C≠C] sequences but not necessarily CV or CVV structures.

Order of acquisition of place contrasts

- Labial/Dorsal is acquired first in C1 and later in C2. More variation is found in the acquisition of the contrasts that involve Coronal. The first contrasts are acquired in C1 or in both positions simultaneously.

Relation between C1 and C2

- When Labial and Dorsal appear in C1, they are first combined with a coronal in C2. This restriction is not so evident when features first appear in C2 (it still affects Labial, but not Dorsal).
- No specific combinatorial pattern was observed in the emergence of Coronal, in any of the word-positions.
- In most cases, the time lag between the acquisition of one pattern and other results from the order of acquisition of PoA features per position.
- However, some cases of combinatorial restrictions were found, affecting target [Dor…Lab]: both PoA features are available in [C≠C] forms, but are not combined (or not combined in the order Dor…Lab).

THE ACQUISITION OF MANNER WORD-PATTERNS

General order of acquisition

- Combinations of stops and nasals and combinations that contain a stop in one of the word-positions tend to appear first. Amongst the combinations that appear later are the ones that contain liquids in C1 and combinations of fricatives and sonorants.

Order of acquisition of manner features per position

- Liquids are acquired in the order C2>>C1. More variation is observed in the order of acquisition of nasals and obstruents: three paths were identified: C2>>C1; C1>>C2 and C1/C2. Positional asymmetries affect [C≠C] sequences but not necessarily CV or CVV forms.

Order of acquisition of manner contrasts

- The first contrasts tend to be introduced both in C1 and in C2; however, overall, there are more contrasts acquired in C2 than in C1.
- The contrasts Obstruent/Sonorant and Stop/Fric tend to be the first to appear; the contrasts within Sonorants (Nas/Liq and Lat/Rhot) tend to be acquired late.

Relation between C1 and C2

- When fricatives and sonorants appear either in C1 or in C2, they tend to combine first with a stop in the other position of the word.
- The time lag between the acquisition of one pattern and another often results from the order of acquisition of MoA features per position.
- However, six types of combinatorial restrictions were found, affecting mostly patterns that do not contain stops -[Lat…Fric];[Fric…Lat]; [Nas…Fric]; [Nas…Lat].

5.8 Discussion

We will now proceed to a discussion of the acquisition patterns described in the preceding sections, focusing on the issues mentioned in the review of the literature presented in the beginning of this chapter.

I. The acquisition of [C≠C] combinations

The data of the five Portuguese children showed that non-harmonic combinations of place and manner features are not produced in the first recording sessions and that the age of acquisition of the first [C≠C] patterns varies across children; some of them acquire their first [C_{PoA}≠C_{PoA}] or [C_{MoA}≠C_{MoA}] before 2;0 (Clara at 1;5, João at 1;7, Inês at 1;8), for others the acquisition starts later (Joana at 2;0, Luma at 2;1).

As far as [C_{PoA}≠C_{PoA}] patterns are concerned, it was shown that two combinations are amongst the first to be acquired: [Lab…Cor] (Inês, Joana, Clara); and [Dor…Cor] (Inês, Luma). The combinations that contain Dorsal and Labial in C2 are acquired later.

The early preference for combinations that contain labial consonants in word-initial position has already been observed in other languages (Ingram, 1974; Macken, 1979; Levelt, 1994; MacNeilage & Davis, 2000; Fikkert & Levelt, 2008). This preference has often been termed as *fronting*: sequences of consonants in words are organized from forward to backward places of articulation (Ingram, 1974). According to MacNeilage & Davis (2000), word-initial labials reflect a preference of young learners for ease of articulation, since labial consonants do not involve tongue movements.

According to Fikkert & Levelt (2008), early [Lab…Cor] patterns in children's productions might also be a reflection of the high frequency of this structure in the input language. Children would attempt frequent structures in the input more often and, consequently, acquire them early.

It could be the case, though, that the distribution of [Lab…Cor] in the input is, itself, a reflection of the relative ease of articulation. Under this perspective, ease of articulation could be determining both the high frequency of [Lab…Cor] in the adult language and its early acquisition.

Note, however, that except for João, who does not acquire dorsals until the last session studied, at 2;0, the Portuguese children studied also show a preference for [Dor…Cor] combinations: it is the first non-homorganic pattern acquired by Luma; it is acquired at the same time as [Lab…Cor] by Inês and it is the second-acquired combination in the data of Joana and Clara. In this respect, Portuguese data differs from Dutch acquisition data, where a constraint on C1 dorsals has been observed (see stages III and IV as proposed by Fikkert & Levelt, 2008, section 5.1.1). The argument that ease of articulation would be responsible for the early acquisition could hardly account for [Dor…Cor] patterns, since it involves a back to front directionality in the word.

In subsection V, we will show that the early preference of Portuguese children for both word-initial labials and word-initial dorsals in [C≠C] patterns might be related to the distribution of place features in EP adult speech.

As for the development of [C_{MoA}≠C_{MoA}] patterns, we observed that, in general, the first sequences acquired contain a stop in one of the word-positions, while the patterns acquired later tend to be combinations within sonorants of combinations of fricatives with sonorants. Also among the last patterns acquired are the ones the contain liquids in word-initial position.

Portuguese children thus seem to have an early preference for combinations that contain at least one unmarked manner (stop). In this respect, Portuguese children's acquisition patterns are similar to the ones observed in other languages, namely Dutch and German (Langeslag, 2007; Altvater-Mackensen & Fikkert, 2009), where an early emergence of templatic patterns that contain a stop in one of the word positions, or an obstruent in C2, has been reported (see section 5.1.2).

II. Positional effects

The analysis of Portuguese children's acquisition patterns showed that PoA and MoA features in [C≠C] patterns tend to be acquired first in one given position and only later in the other. For instance, Labial and Dorsal are first acquired in C1 and only later in C2; liquids, on the contrary, are first acquired in C2 and afterwards in C1. This gradual acquisition results in positional asymmetries in children's productions; for instance, they produce [Lab…Cor] accurately but, since Labial is still not acquired in C2, they produce the reverse combination ([Cor…Lab]) in alternative ways. Similar findings were reported in manner development: some children acquire [Stop…Lat] combinations early, while [Lat…Stop] combinations are not produced, since laterals are not acquired in C1. Below, it will be shown that the order in which PoA and MoA features are acquired in the two word-positions (C2>>C1 or C1>>C2) may be related to the distribution of those features in adult speech.

Another important finding was that a given feature in a particular position could be systematically submitted to alternative productions in [C≠C] forms but could already be accurately produced in [C=C] or CV/CVV forms. For instance, it was shown that, while a child omitted C1 laterals in [Lat…Stop] combinations (*wolf* /ˈlobu/->[ˈobu] Luma, 2;6) she was already producing accurate CV forms with word-initial laterals (*lake* /ˈlagu/->[ˈlaː] Luma, 2;4) (see sections 5.5.2 and 5.6.2). This finding suggests that non-harmonic sequences do play a role in the acquisition of features per position: a given feature may be acquired in word-initial position but only if it is not part of a [C≠C] sequence. Thus, as claimed by Langeslag (2007), the study of the acquisition of feature patterns must focus both on the development per position and on the interactions that take place between both positions, in [C≠C] forms. This issue is further discussed in the next section.

III. Relation between C1 and C2

In section 5.1.2, we reported on the work of Langeslag (2007), who draws attention to the interactions that take place between C1 and C2 throughout the development of manner word-patterns, in Dutch. According to this author, two templates regulate the process of acquisition:

- [Stop…x] (any MoA feature that appears in C2 must first combine with a Stop in C1. (templatic pattern also observed in German: Altvater-Mackensen & Fikkert, 2009)

- [x…Obstr] (any MoA feature that appears in C1 must first combine with an obstruent in C2).

The author shows that the manner word-patterns that do not fit these templates, for instance [Nas…Liq] are acquired later.

The question that will be discussed in this section is if Portuguese children also show the influence of templatic patterns, involving C1 and C2, both for the development of PoA and of MoA feature patterns.

As for place feature patterns, the relation between C1 and C2 presented in section 5.5.4 showed that there is a fixed pattern when Labial and Dorsal appear in C1; they must be combined with a Coronal in C2: [Lab…Cor] and [Dor…Cor]. However, when Labial and Dorsal first appear in C2, they do not necessarily combine with a Coronal in C1. As for Coronal, when it appears in one given position, it can combine with any other PoA in the other position in the word.

In conclusion, the only fixed combinatorial pattern found involving C1 and C2 in the development of [C_{PoA}≠C_{PoA}] combinations is [Lab/Dor…Cor]. This combinatorial pattern is summarized in (225).

(225) Combinatorial patterns observed in early [C_{PoA}≠C_{PoA}] forms - EP

a) When Labial is acquired in C1, it is first combined with a coronal in C2 – [Lab…Cor]
b) When Dorsal is acquired in C1, it is first combined with a coronal in C2 – [Dor…Cor]

In fact, [Lab…Cor] and [Dor…Cor] are the first [C_{PoA}≠C_{PoA}] combinations acquired (see subsection I, above), thus they are produced at the very beginning of the non-homorganic stage. One possible interpretation for the fixed combinatorial pattern given in (225) is that when these two combinations appear, children are still not contrasting C1 and C2; only C1 is available and C2 is filled with the default PoA, which is Coronal (see representation in (231)). If this is the case, then, no particular relation is taking place between C1 and C2 at this stage (a similar proposal is presented by Levelt, 1994, in Dutch).

When Coronal appears in C1 and Labial and Dorsal in C2, both positions are already available and children may combine different PoA features. This could be the reason why the only fixed order occurs at the beginning and involves a Coronal in C2.

As for combinatorial templates in the development of manner feature patterns, it was shown in section 5.6.4 that when fricatives and sonorants appear either in C1 or in C2, they tend to combine first with a stop in the other position in the word. These patterns are summarized in (226).

(226) Combinatorial patterns observed in early [C_{MoA}≠C_{MoA}] forms - EP

a) When fricatives and sonorants appear in C1, they combine first with a stop in C2

b) When fricatives and sonorants appear in C2, they combine first with a stop in C1

Note that, just as observed for PoA, where children combine marked features (Labial and Dorsal) with the unmarked coronals, the patterns listed in (226) also combine the marked manner features of continuants (fricatives) and sonorants with stops. The early combinatorial patterns observed involving C1 and C2 show a clear preference for combinations that contain at least one unmarked feature and avoidance of combinations of marked features. This pattern finds additional support in the combinatorial restrictions reported in section 5.5.4 and 5.6.4, where two marked features are available in different [C≠C] forms, but are not combined in the same [C≠C] form right away.

These combinatorial restrictions constitute additional evidence for the fact that the development of [C≠C] patterns is not only influenced by the order of acquisition of features per word position but it is also determined by constraints on the combination of features in the two positions (see also subsection II).

IV. The acquisition of feature contrasts in [C≠C] forms

As for the position in which the first contrasts are acquired, the predominant pattern, both for the acquisition of PoA and of MoA contrasts, is the initial acquisition in either C1 only, or in C1 and C2 simultaneously (see sections 5.5.3 and 5.6.3). What rarely occurs is the acquisition of a contrast in C2 before at least one contrast has been acquired in C1. It seems that the word-initial position is the privileged site for the acquisition of the first contrast(s). Similar results were observed in Dutch children in the study of Altvater-Mackensen & Fikkert (2009).

From the viewpoint of the building of a lexicon, introducing contrasts in initial position seems logical, since initial segments form the entrance to the lexicon. We might also hypothesize that the acquisition of the first contrast in word-initial position results from the fact that, in the period when the first [C≠C] combinations are acquired, in fact only C1 can be specified. C2 is at this point not separately specifiable yet, and receives the default feature assessment (see subsection VIII). An alternative hypothesis is that children are assigning a different status to C1 and C2. If this is the case, then we might expect children to produce different alternative output forms for C1 and for C2. This issue will be explored in the next chapter.

V. The development of [C≠C] patterns and distributional properties in the input

In the beginning of this chapter, we referred to a line of research where input frequency is assumed to have an important influence on phonological development (Jusczyk *et al.* 1994; Edwards & Beckman, 2007, among others). In that section, we focused on the study of Fikkert, Levelt & Van de Weijer (2002); these authors argue that the difference between Dutch and English acquisition patterns regarding word-initial dorsals (contrary to English children, Dutch learners show an initial constraint on C1 dorsals) may be related to the distribution of PoA features in the two languages (see section 5.8.4).

In the data of the five Portuguese children studied in this project, we saw that both [Lab…Cor] and [Dor…Cor] are amongst the first combinations acquired. Contrary to Dutch but similarly to English, Portuguese learners do not show a constraint on C1 dorsal, in non-homorganic combinations. The question that arises now is if, as proposed by Fikkert, Levelt & Van de Weijer (2002), the preference for specific PoA patterns can be traced back to the distribution of PoA features in the input.

In section 5.2, we saw that the distribution of place feature patterns in a subsample of CVCV words in EP adult speech is the following.

(227) Distribution of non-harmonic place feature patterns in adult speech

	Nº	%
[Lab…Cor]	689	36%
[Dor…Cor]	436	23%
[Cor…Lab]	428	22%
[Lab…Dor]	142	7%
[Cor…Dor]	136	7%
[Dor…Lab]	93	5%

In section 5.5.1, it was shown that the general order of acquisition of place feature patterns is [Lab….Cor]/[Dor….Cor] >> [Cor…Dor]/[Cor…Lab]/[Lab…Dor]. Thus, we can see that the two most frequently produced place patterns in adult speech, [Lab…Cor] and [Dor…Cor] are also the two first acquired PoA combinations. It thus seems that the hypothesis put forward by Fikkert, Levelt & Van de Weijer (2002), that the order of acquisition of place patterns can be related to the distribution of features in the input languages finds further support with EP acquisition data.

Similar correlations between order of acquisition and distribution in the input were found in the acquisition of manner feature patterns. In section 5.2, we observed the following distribution of manner patterns in the subsample of adult speech.

(228) Distribution of non-harmonic manner feature patterns in adult speech

	Nº	%
[Nas…Stop]	354	23%
[Stop…Fric]	321	21%
[Stop…Nas]	240	15%
[Stop…Lat]	125	8%
[Fric…Stop]	120	8%
[Stop…Rhot]	92	6%
[Fric…Nas]	79	5%
[Lat…Stop]	57	4%
[Nas….Lat]	51	3%
[Fric…Rhot]	31	2%
[Lat…Nas]	25	2%
[Nas…Fric]	24	2%
[Fric…Lat]	22	1%

In section 5.6.1, it was shown that first sequences acquired contain a stop in one of the word-positions, while the patterns acquired later tend to be combinations within sonorants of combinations of fricatives with sonorants. Also among the last patterns acquired are the ones the contain liquids in word-initial position. If we compare the order of acquisition of [C_{MoA}≠C_{MoA}] patterns to the distribution of these types of combinations in the input, we can see that the most frequently produced forms in adult speech ([Nas...Stop], [Stop...Nas], [Stop…Fric], [Stop…Lat]) are amongst the first to be acquired, while infrequent patterns in adult speech, such as [Fric…Liq] or [Liq…Fric] tend to be acquired late.

In sum, there is, in fact, a close relation between the distribution of place and manner feature patterns in EP adult speech and the order by which Portuguese children acquire [C≠C] combinations. In this respect, the patterns observed in chapter 5 differ from the findings described in chapters 3 and 4 (which include the analysis of the early stages of development), where no straightforward relation was found between acquisition and adult speech data. It thus seems that, as soon as [C≠C] patterns start being acquired (in general, after the age of 1;8), a closer resemblance between order of acquisition and distributional properties of adult speech is achieved; similar results were reported for Dutch, in Fikkert & Levelt (2008).

We observed that, as soon as [C≠C] patterns start being acquired, a closer relation is found between the order of acquisition and the distribution of feature patterns in adult speech. However, the nature of this relation is not clear; it could be case that, after a certain developmental stage, the acquisition patterns are determined by frequency effects of the input, but it could also be the case that the resemblance between acquisition patterns and adult speech derives from the fact that both systems are ruled by the same set of articulatory, phonological and morphological restrictions and not necessarily from a cause-effect relationship. The nature of the relation between acquisition and adult speech needs to be further investigated, namely on the basis of more *corpora* of adult speech, including data on child directed speech.

VII. The acquisition of [C≠C] patterns and the developing lexicon

In section 5.3, we presented some of the findings of chapter 3, concerning children's intake. It was shown that the frequency of consonants (independently of word position) in children's intake became closer to the frequency of occurrence of consonants in a sample of adult speech only after a certain point in the development. That shift in the relation between intake and adult *corpora* coincided with an increase in the number of different target-words (types) each child selected per session. The number of target types attempted by each child in the first sessions is repeated in (229) below. The age at which the first [C≠C] are acquired is shaded.

(229) Number of target-words (types) attempted per session

	0;11	**1;0**	**1;1**	**1;2**	**1;3**	**1;4**	**1;5**	**1;6**	**1;7**	**1;8**	**1;9**	**1;10**	**2;0**	**2;1**	**2;3**
Clara	2	2	5	5	7	6	14	9	13	26	55	51			
João		2	4	5	9	13	18	17	16	24	62	81			
Inês	6	8	25		36	31	53	48	56	95	118				
Joana	2	1		4		2	2	10		10	33	50	102		
Luma	2	2	4	7	7	3	6	8	7	11	17	17	25	31	70

As shown above, there is a relation between the increase in the number of types attempted by each child and the age of acquisition of the first [C≠C] patterns. For two children (Inês, Joana), the first non-harmonic patterns occur immediately after the 50-word threshold has been reached. In the data of the other children, the first non-harmonic combinations are acquired before the 50-word boundary, but already in a period where the number of types selected has increased above 10 types.

Overall, the increase in the number of types attempted by Portuguese children tends to co-occur with the acquisition of the first [C≠C] forms; in other words, the expansion of children's vocabulary appears to go hand in hand with developments in their production patterns. In line with Langeslag (2007) and Fikkert & Levelt (2008), we may hypothesize that children's representations have become more detailed at this point, in order to be able to distinguish between the different target forms that constitute their rapidly increasing lexicon. In this view, word- or holistic representations would give way to segmental representations. The development in children's representations results in developments in children's productions, where we find the first [C≠C] patterns. The issue of children's representations will be further discussed in the next subsection.

VIII. Children's developing representations

One of the aims of the current chapter is to discuss the nature of Portuguese children's representations, on the basis of the acquisition trends observed for place and manner feature patterns.

In chapter 4, we hypothesized that Portuguese children go through an initial stage where one single feature (PoA and MoA) is assigned to all the consonants of the word, resulting in [C=C] forms. During this period, children do not distinguish between word positions in their lexical representations.

At the stage studied in the current chapter, where [C≠C] patterns are acquired, it becomes clear that children's representations have become more detailed. But to what extent are those representations detailed, when the first [C≠C] appear? Do both word positions become available from the start?

The table given in (230) shows the age at which the first [C≠C] combinations appear in each child's *corpus*, both for PoA and for MoA feature patterns.

(230) Age of acquisition of the first [C≠C] patterns, per child

Clara		**João**		**Inês**		**Joana**		**Luma**	
1;5	[Lab…Cor]								
		1;7	[Lab…Cor] [Stop…Lat]						
1;8	[Dor…Cor] [Nas…Stop] [Stop…Fric]			**1;8**	[Lab…Cor] [Dor…Cor] [Nas…Stop]				
1;9	[Cor…Lab]			**1;9**	[Stop…Lat]				
		1;10	[Stop…Nas]	**1;10**	[Cor…Lab] [Dor…Lab] [Stop…Rhot]				
						2;0	[Lab…Cor]		
								2;1	[Stop…Rhot]
						2;2	[Cor…Dor] [Dor…Cor] [Nas…Stop] [Stop…Nas] [Fric…Stop]		
								2;3	[Dor…Cor] [Stop…Fric] [Fric…Stop] [Fric…Nas]
								2;4	[Lab…Dor] [Lab…Cor] [Stop…Nas]

As shown above, in the data of three children (Inês, Joana, Clara) the first non-harmonic patterns acquired contain an unmarked PoA or MoA in C2 position: Coronal and Stop. It is only after at least one of those [x…Cor] and [x…Stop] patterns surface, that combinations that contain (i) a labial or a dorsal in C2 or (ii) a nasal, a fricative or a liquid in C2, surface in production. We could, then, hypothesize that these three children start the process of acquisition of [C≠C] forms by assigning feature specification to C1 only, and leave C2 unspecified. The latter position would still not be available for specification in children's lexical representations (for a similar proposal in Dutch, see Levelt, 1994). This procedure is formalized in (231.a). The representation given in (231.b) illustrates PoA and MoA feature specification at a later point within the [C≠C] stage, where marked features are produced in C2, showing that this position is at this point available for feature assignment.

(231) Inês, Joana, Clara

(a) *First acquired [C≠C] patterns*	(b) *Later acquired [C≠C] patterns*
[Lab…Cor]; [Dor…Cor]; [Nas…Stop] PoA/MoA ↓ [WORD ↓ Default (Coronal/Stop)	[Cor…Dor]; [Stop..Lat]; [Stop…Fric] PoA/MoA ↙ ↘ [C_1 v C_2 v]

Our proposal is that Inês, Joana and Clara go from an early WORD representation, where all consonants in the words are unsegmentalized, resulting in [C=C] output forms (see chapter 4) to a later stage where the word-initial position is already available [WORD (see 231.a, above) and, finally, get to a stage where both C-slots are available [C_1VC_2V] (see 231.b)

As for João's data, he acquires one single non-homorganic pattern, ([Lab…Cor]) until the last session studied, at 2;0. For this child, no data is available concerning the acquisition of PoA combinations that contain non-defaults in C2. However, at the same age João acquires [Lab…Cor] (1;7), he also acquires an MoA pattern with a non-default feature in C2: [Stop…Lat]. If a non-default is associated to C2 position, it may be the case that this position is already available at that age.

In Luma's data, the first [C≠C] pattern acquired is [Stop…Rhot], at 2;1. Similarly to João, Luma enters the [C≠C] stage with a pattern that contains a non-default in C2, in this case, a rhotic. At 2;3, Luma acquires the first [C_{PoA}≠C_{PoA}] combination, which is [Dor…Cor] and at 2;4 the first non-homorganic pattern with a non-default PoA in C2 is acquired ([Lab…Dor]).

In summary, João and Luma follow the same pattern as the other three children (the first combination acquired contain a default feature in C2), but only as far as PoA is concerned. As for MoA, the two children acquire combinations with a non-default feature (liquid) before any other pattern. Thus, in the development of PoA patterns, João and Luma show the same path of development as the other three children. Regarding

MoA patterns, João and Luma seem to change directly from a WORD to a [C_1VC_2V] representation.

Overall, we found evidence supporting the following developments in children's representations: WORD >> [WORD >> C̲VC̲V. However, the intermediate [WORD stage does not occur for MoA patterns, in the data of two children. This difference may result from individual variation or from an overlap of two developmental periods. Alternatively, it might result from different representations for place and for manner specification. This issue needs to be further investigated on the basis of more data, namely on the development of polysyllabic forms.

IX. Methodology: identifying the threshold of the [C≠C] stage

Throughout sections 5.5 and 5.6, we reported that there were some discrepancies between the age at which children would enter the [C≠C] stage, according to the analysis presented in chapter 4, and the age at which children acquire their first [C≠C] disyllabic patterns.

In chapter 4, the analysis was based on all multisyllabic output forms and the relation between target words and corresponding renditions was not explored. As soon as [C=C] output forms patterns decreased below 80%, we assumed that children would be entering the [C≠C] stage. On the contrary, the analysis presented in the current chapter is based on the relation target/production, in disyllables.

The cases of mismatch between chapters 4 and 5 are of two types: (i) Children acquire disyllabic [C≠C] patterns *before* the age where, in chapter 4, we predicted that the non-harmonic stage would start; (ii) Children acquire disyllabic [C≠C] patterns *after* the age predicted in chapter 4. The second type of mismatch is the least frequent; it occurs only in the data of Inês (for PoA patterns) and Joana (for MoA). These cases are not real mismatches, though. As shown in sections 5.5.1 and 5.6.1, both children start producing [C≠C] combinations at the age predicted in chapter 4 (Inês [$C_{PoA}≠C_{PoA}$] at 1;7 and Joana [$C_{MoA}≠C_{MoA}$] at 2;0), but those productions correspond to target polysyllables; accurate non-harmonic productions for disyllabic targets will only appear in the following session. As for the other type of mismatch, where children acquire non-harmonic disyllables before the age predicted for the beginning of the [C≠C] stage, it results from the fact that there are few [C≠C] targets attempted in the first sessions. Children may be producing all (or the majority of) attempted forms of a given pattern in a correct fashion but if few targets are attempted, those correct productions will be quite marginal in a study of all output forms, as the one presented in chapter 4.

Note that, in spite of the discrepancies regarding the boundaries of [C=C] and [C≠C] stages, the general picture of development provided in chapter 4 is corroborated by the results presented in the current chapter: (i) [C≠C] forms do not appear at the first sessions; (ii) they appear mostly from 1;7 onwards. However, the analysis of the relation between targets and productions performed in this chapter provided a more detailed path of development of the different structures, showing that there is an overlap between harmonic and non-harmonic stages, for some of the children: they may still be at the overall [C=C] output stage, but the acquisition of some [C≠C] patterns is already on the way.

5.9 Concluding remarks

In the current chapter, it was shown that [C≠C] patterns are challenging linguistic structures for young learners; they are not available from the onset of speech and appear gradually in children's productions. In this respect, Portuguese data supports the findings observed in other languages, namely Dutch, German and French (Langeslag, 2007; Fikkert & Levelt, 2008; Altvater-Mackensen, Dos Santos & Fikkert, 2008; Altvater-Mackensen & Fikkert, 2009). Throughout this chapter, it was shown that the development of non-harmonic forms is regulated by both positional and combinatorial restrictions; in order to cope with these constraints, children recur to alternative production strategies. Research questions that arise at this point are therefore: (i) Which alternative productions predominate? (ii) Are the alternative productions of the initial [C=C] stage similar to the ones used when at least some [C≠C] forms have been acquired? (ii) What can those strategies tell us about children's underlying representations? All these questions will be explored and discussed further in chapter 6.

Chapter 6 – Children's alternative output forms

Introduction

In the two previous chapters, it was shown that [C≠C] patterns are problematic for the five Portuguese children studied in this project, particularly at early ages. In chapter 4, we saw that the vast majority of children's early output forms are harmonic, both for place and for manner features ([C=C] stage). In chapter 5, it was shown that most [C≠C] patterns are acquired only after 1;8 and that some combinations are acquired later than others, due to positional or combinatorial restrictions. In the current chapter, we will focus on the alternative strategies children recur to, when coping with target non-harmonic patterns (/C_{PoA}≠C_{PoA}/ and /C_{MoA}≠C_{MoA}/) both in the [C=C] stage and in the [C≠C] stage. Based on the type of alternative strategies used, we aim to contribute for the discussion of children's lexical- and output representations at both stages.

The research on phonological acquisition has shown that children's output forms tend to deviate from adult forms, particularly in early stages of development. Researchers have focused not only on the description of those deviations but also on the organization of children's phonological system and what those mismatches are able to reveal about this organization (Smith, 1975, Macken, 1979; Fee, 1995; Fikkert, 2007).

The discrepancy between adult words and children's output forms has often been defined in terms of phonological processes; Stampe (1969, 1973) proposed that early phonological systems are constrained by a set of natural processes that represent innate mental constraints on the child's productive abilities. Ingram (1986) suggested that processes could be divided into three types: syllable structure (cluster reduction, deletion of unstressed syllables or of final consonants, reduplication), assimilation processes (voicing, harmony) and substitution processes (stopping, fronting, gliding).

In general terms, the processes listed above can be viewed as a means of phonological simplification, whereby adult target words are rendered in ways that are feasible for young learners (Macken, 1979). However, as mentioned by Fee (1995), the true nature of those 'phonological processes' can only be discussed in relation to the nature of children's phonological representations. Are those representations adult-like or child-specific? If children's representations are identical to the adult form, then a set of processes has to occur, changing target-like underlying structures into deviating surface productions (through a set of rules in linear phonology (Smith, 1973) or through constraint interactions, in an OT framework (Prince & Smolensky, 2004; McCarthy & Prince, 1993). If, on the contrary, children's early representations are different from those of the adult, alternative output forms may not derive from processes that shape input forms, but can be the natural outcome of developing representations (Fikkert, 2007; Fikkert & Levelt, 2008).

The analysis of the strategies children implement to cope with adult target words can be used as a window to the young learner's representations. In order to do this, we will have to compare children's productions to adult forms and track the differences between both structures. For this reason, we will refer to alternative strategies such as substitutions, metathesis or reduplications; however, this will only be a comparison-at-the-surface; those terms will be used as descriptive tools and do not derive from any prior assumption that children's underlying forms are adult-like or not. The discussion of the nature of children's phonological representations will follow in section 6.7, based on the alternative strategies observed both for /C_{PoA}≠C_{PoA}/ and /C_{MoA}≠C_{MoA}/ targets.

This chapter is organized as follows. Section 6.1 presents an overview of the literature on alternative strategies in children's speech, focusing on the ones that result in multisyllabic output forms: reduplication, consonant harmony, metathesis and substitutions, as well as on lexical selection. Section 6.2 provides a summary of the main topics, followed by an outline of the research questions and specific goals that underlie the current chapter. The methodological issues are described in section 6.3. Section 6.4 presents the results for the analysis of the alternative strategies that affect [C_{PoA}≠C_{PoA}] target forms, while the results for [C_{MoA}≠C_{MoA}] targets are provided in section 6.5. A summary of the main findings is given in section 6.6, followed by a general discussion in 6.7. The concluding remarks are presented in section 6.8.

6.1 Cross-linguistic alternative strategies in children's speech

This section presents a review of the literature on alternative strategies, cross-linguistically. In 6.1.1, we explore the issue of reduplication in early productions. Section 6.1.2 discusses consonant harmony, a well-known phenomenon in child language. Section 6.1.3 is dedicated to metathesis, a strategy that is usually associated with consonant harmony. Substitution patterns and its relation to positional asymmetries and place/manner interaction are explored in section 6.1.4. Finally, section 6.1.5 explores the issue of lexical selection as an early alternative strategy.

6.1.1 Reduplication

Reduplication occurs mostly in early output forms and resembles canonical babbling (Ferguson & Macken, 1983). Some children are frequent reduplicators; others use this strategy, but not in a systematic way. Some authors consider it a universal phenomenon in language acquisition (Moskowitz, 1973); other authors consider it an individual strategy, used by some children (Ferguson 1979; Lléo, 1990).

Reduplication patterns are characterized by the production of multisyllabic words with a repetitive syllable structure, mostly of the type $C_iV_jC_iV_j$. This strategy is illustrated in (232), with data from English, French and Spanish.

Most often, it is the target stressed syllable that is reduplicated, as illustrated in the examples provided above.

Reduplication usually affects multisyllabic target words, although it has also been observed in monosyllabic ones (Klein, 2005).

(232) Examples of reduplication in child language

		Gloss	Orthogr.	Output	
(a)	English		biscuit ->	[be:be:]	Waterson (1971:186)
(b)	French	mouth	bouche ->	[bubu]	Ingram (1979:140)
(c)	Spanish	shoe	zapato ->	[paˈpapa]	Lléo (1996:220)

Several hypotheses have been put forward in the literature as to the cause of reduplication patterns in child language. According to Ingram (1974) reduplication is a strategy to compensate children's inability to produce the other syllable of the word; other authors have proposed that it is a way of coping with multisyllabic target forms, whether motivated by the preference for such forms (Fee & Ingram, 1982) or by the avoidance of its complexity (Schwartz et al., 1980; see review in Klein, 2005). According to Lléo (1996), reduplication can be viewed as a way of the child (in this case, José, between 1;7 and 1;11) to match the expected length of the word and, at the same time, to comply with the requirement of place feature identity between the consonants of the word.

Note that some studies classify both [$C_iV_jC_iV_j$] (identical syllables) and [$C_iV_jC_iV_k$] (identical consonants, but different nucleus) forms as instances of reduplication (complete or partial) (Klein, 2005). In these studies, the difference between reduplicated forms and consonant harmony forms is not clear. In the current dissertation, both types of output forms will be distinguished, since only [$C_iV_jC_iV_j$] will be considered reduplications. We will explore the consonant harmony strategy in the following section.

6.1.2 Consonant harmony

Consonant Harmony (henceforth, CH) is one of the most discussed production patterns in the literature on phonological acquisition, across languages. This scientific interest is primarily motivated by the saliency of that phenomenon in acquisition data, added to the intriguing fact that it has no direct correlate in adult phonologies.[45]

Two main types of CH have been reported in the literature, involving the major place features Labial and Dorsal. Some examples of those CH patterns are provided in (233).

(233) Typical examples of CH in child language

a. Labial harmony

		Orthogr.	Gloss	Target	Output	Child	
(a)	Dutch	sloffen	(slippers)	/slɔfə/	[bɔfə]	Robin	Levelt (1994)
(b)	English	table		/ˈteɪbəl/	[beːbu]	Amahl	Smith (1973)
(c)	French	debout	(standing)	/dəbu/	[bɑˈbuː]	Clara	Rose (2000)
(d)	French	tombé	(fallen)	/tɔ̃be/	[pəmə]	Marilyn	Dos Santos (2007)

b. Dorsal harmony

		Orthogr.	Target	Output	Child	
(a)	English	big	/bɪg/	[gɪg]	Trevor	(Compton & Streeter, 1977; Pater & Werle, 2003)
(b)	English	dog	/dɔg/	[gɔg]	Trevor	
(c)	English	duck	/dʌk/	[gʌk]	Amahl	(Smith, 1973)
(d)	French	gateau (cake)	/gato/	[kako]	Marilyn	(Dos Santos, 2007)

The examples provided in (233.a) are typical instances of labial harmony, in which a coronal consonant surfaces as a labial, in the presence of another labial consonant in the word. These cases have been reported in several languages, namely Dutch,[46] English and French (Rose, 2000; Dos Santos, 2007; Fikkert & Levelt, 2008). The cases illustrated in (233.b) have been reported particularly in English (Pater & Werle, 2003); in this case, coronal and labial consonants surface as dorsals in children's output forms, in the presence of another dorsal consonant in the word. Note that, as illustrated above, the most common directionality in this harmony process is from right-to-left.

CH forms have been approached from several different theoretic angles in the literature on child language. We will present a brief overview of some of those accounts in the following subsections.

CH within Linear phonology

The first studies of CH patterns were performed within the framework of linear phonology, in a SPE tradition.[47] In Smith (1973), we find a report on systematic cases of consonantal harmonized forms in the speech of an English learning child (Amahl);

[45] The most common patterns of CH in child speech involve assimilation of primary place features between non-adjacent consonants; this pattern is not found in the adult languages (Hansson, 2001).

[46] As will be shown further below, typical instances of labial CH in Dutch are re-interpreted by Fikkert & Levelt (2008) and Levelt (to appear) as cases of left-alignment of Labial, that occurs independently of the PoA of the other consonant in the word.

[47] *Sound Pattern of English*, Chomsky & Halle (1968).

according to Smith, those CH cases follow from the child's compliance with a set of realization rules: for instance, the pattern /Cor…Dor/->[Dor…Dor] (as in /ˈdʌk/->[ˈgʌk]) would result from the rule '*velarizing coronals before a velar'* (Smith, 1973:165). Note that the set of realization rules in Smith's proposal is assumed to be child-specific. As has been frequently discussed in the literature, Smith's rule system provides a detailed descriptive report of CH patterns in Amahl's speech, but fails to provide an explanation of the phenomena. Providing a phonological explanation for CH patterns in child language has become the main goal of several studies developed thereafter. Some of those studies will be outlined in the following sections.

CH within autosegmental phonology

Within the autosegmental framework, Menn (1978) describes /C≠C/->[C=C] patterns as one of the strategies children recur to when coping with an output constraint requiring that all consonants in the word share place feature specification. In order to comply with this structural requirement, children either delete consonants (or syllables) or render them in a [C_{PoA}=C_{PoA}] output format. In Menn's perspective, harmonic outputs do not result from assimilation rules between non-adjacent consonants; instead, those forms are the outcome of the association of one single place feature to all C-slots available in the word. A similar perspective is provided by Iverson & Wheeler (1987), who claim that children's outputs are regulated by well-formedness templates, in which one single place feature can be associated to suprassegmental constituents, namely the word.

Still within the autosegmental framework, some studies have suggested a different line of approach towards CH phenomena in child language; according to authors such as Sagey (1986), Spencer (1986), Stemberger & Stoel-Gammon (1991) and Stoel-Gammon & Stemberger (1994), CH patterns are the result of an assimilation process between non-adjacent consonants. Most studies performed within this theoretical line suggest that the assimilation process takes place between a fully specified consonant (the trigger, a Labial or a Dorsal) and an underspecified consonant (the target, a Coronal). Two main problems have been pointed out in the literature, regarding the 'assimilation-at-a-distance' approach: it violates the Locality Principle (the two consonants involved in the process are not adjacent, at least at surface level) and the Line Crossing Prohibition (the spreading of one feature from one consonant to the other occurs across intervening vowels). Aiming to circumvent these problems, some authors have argued for planar segregation between consonants and vowels (McDonough and Myers, 1991): if consonants and vowels are specified on different planes, then consonants are adjacent at an underlying level and both the Locality and the Line Crossing Prohibition principles are not violated. However, several authors have argued that there is no empirical evidence for planar segregation in child language, particularly at the time CH forms occur (Levelt, 1994; Goad, 1997; Rose, 2000; Levelt, to appear)

Aiming to circumvent these problems, more recent studies have approached CH from a different perspective, as it will be discussed next.

CH as a result on an AGREE constraint

Within the framework of Optimality Theory (OT) (Prince & Smolensky, 2004; McCarthy & Prince, 1993) Pater & Werle (2001, 2003) suggest that CH in child language results from a high-ranked markedness constraint that requires feature agreement between the consonants in the word. According to Pater & Werle, children display an initial preference for repeated articulatory gestures in their output forms. This preference is captured by the markedness constraint AGREE,[48] in early grammars.

Pater & Werle analyze the CH patterns that affect PoA features in the longitudinal data of one English learning child (Trevor, from Compton and Streeter, 1977), between the ages of 1;5 to 2,4. The authors observed that the most frequent CH pattern produced by Trevor is /Cor…Dor/->[Dor…Dor],[49] as illustrated in the well-known pattern /ˈdɔg/->[ˈgɔg]. According to Pater & Werle, this regressive dorsal harmony pattern reflects the high-ranking of AGREE–L-[DOR], which requires that any consonant at the left of a dorsal must assume its dorsality.

Pater & Werle (2003) argue that AGREE is still active in adult languages, although its domain of occurrence changes: in adult systems, it applies only under strict adjacency. According to Levelt (to appear) this shift in the domain of AGREE would impose a large set of re-rankings for the learner. Children would have to learn a set of constraint rankings in order to pull FAITH(PLACE) constraints above AGREE constraints, thus allowing for [C≠C] forms to occur and ruling out CH candidates. At the time the domain of the constraint AGREE changed to strict adjacency, children would have to unlearn the previous ranking, in order to allow for place-agreement in adjacent consonants (see Levelt, to appear).

CH as a result of a Foot Licensing constraint

Based on the comparison of the CH patterns observed in the data of two English children (Amahl, in Smith, 1973 and Trevor, in Compton and Streeter, 1977) and one

[48] The constraint AGREE is, in essence, the renaming of the markedness constraint REPEAT, proposed by Pater (1997).

[49] The coding [TVK] >> [KVK], used in Pater and Werle (2001, 2003) was converted in the coding adopted in the current dissertation, i.e. /Cor…Dor/>>[Dor…Dor].

French child (Clara), Rose (2000) shows that, contrary to the English learners, who produced CH forms both in CVCV and CVC words, the French subject produced harmonized outputs in disyllables only.

Rose argues that the asymmetry between English and French CH patterns results from a distinct foot structure in the two languages; in English, the final consonant in CV<u>C</u> words is syllabified within the Foot, which is binary, while in French that same final consonant is syllabified as the onset of an empty-headed syllable that falls out of the Foot and is directly licensed by the prosodic word. The tenet of Rose's approach is that the Foot is the prosodic licensor of place features, thus being the domain in which CH takes place. From this perspective, CVC target forms are not affected by harmony in the French child's data because the final consonant is syllabified outside the Foot, therefore being out of the range of CH.

According to Rose, there are two obligatory place harmony patterns and one optional, in Clara's data. These patterns are illustrated in (234).

(234) CH patterns in French - Clara (1;3-1;10) (Rose, 2000)

	Ortho.	Gloss	Target	Output	Target PoA -> Output PoA
(a)	debout	standing	/dəbu /	[bɑˈbuː]	/Cor…Lab/->[Lab…Lab]
(b)	café	coffee	/kafe/	[pəˈfɛ]	/Dor…Lab/->[Lab…Lab]
(c)	gâteau	cake	/gɑto/	[tæˈto]	/Dor…Cor/->[Cor…Cor]

In the same age period, Clara is able to produce [Lab…Cor] and [Lab…Dor] in a target-like fashion, but targets /Cor...Lab/, /Dor…Lab/ and /Dor…Cor/ are rendered in a labial or coronal harmony format. According to Rose, the following generalizations can be made, about Clara's CH patterns (i) Labial can occur in the unstressed syllable (C1, in French); (ii) Coronal and Dorsal do not surface in the unstressed syllable, unless they also appear in the stressed one.

Within Rose's approach, the /Cor…Lab/->[Lab…Lab] patterns observed in Clara's data is explained by a high-ranking of LIC(Cor, Ft), which requires Coronal to emerge at the Head of the Foot (C2). Since the target combination displays Coronal at C1, the child will have to use an alternative strategy in order to avoid the violation of LIC(Cor, Ft). The force of the also high ranked faithfulness constraint MAX(Lab) will culminate in the [Lab…Lab] output form. A similar interpretation is provided for patterns /Dor…Lab/->[Lab…Lab] and /Dor…Cor/->[Cor…Cor], but then the active markedness constraint would be LIC(Dor, Ft) (see Rose 2000 for a detailed account).

Rose (2000) provides an account of the frequent /Cor…Dor/->[Dor…Dor] pattern in the English data: the high-ranked markedness constraint LIC(Dor, Ft) requires the feature Dorsal to be licensed by the Head of the Foot, which in a trochaic language such as English, would be C1. The author also makes reference to another CH pattern, observed in Amahl's data: /Cor…Lab/->[Lab…Lab].[50] This pattern would result, in Rose's view, from a high ranking of LIC(Lab, Ft), that requires Labial to be licensed by C1 (stressed syllable). Note that, in this case, the same pattern, attested in both French and English, /Cor…Lab/->[Lab…Lab] would be accounted by different constraints: in English, it would result from a requirement that Labial must be licensed at the stressed syllable; in French, it would result from a requirement that Coronal must be licensed at the stressed syllable.

A case study of another French child (Marilyn), discussed in Dos Santos (2007), makes reference to the same CH-like pattern: /Cor…Lab/->[Lab…Lab]. The analysis proposed by Dos Santos, however, departs from the one presented in Rose (2000). According to Dos Santos (2007), the /Cor…Lab/->[Lab…Lab] pattern results from the high ranking of the markedness constraint Align-L(Lab,PW).[51] This constraint requires that Labial must surface at the leftmost position within the prosodic word.

A re-analysis of CH: homorganics and PoA-Alignment

According to Levelt (1994; to appear) and Fikkert & Levelt (2008), one of the crucial problems associated to most of the theoretical approaches to CH is the fact that this phenomenon is analyzed in isolation: the way harmonized outputs relate to the other forms in the children's lexicon is frequently overlooked.

Based on longitudinal Dutch acquisition data,[52] Levelt (1994; to appear) and Fikkert & Levelt (2008) argue that CH patterns are only apparent, since they do not actually involve any feature sharing between the two consonants of the word. These authors claim that PoA harmonized productions are an artifact of two specific stages in the process of development of place features. As was already discussed in chapters 4 and 5, five main stages were identified for PoA development in Dutch; those stages are repeated in (235) below (see chapters 4 and 5, for further details).

(235) Stages in the development of place feature specification– Dutch (Fikkert & Levelt, 2008)

Stage I	One PoA for the whole word – [$C_iV_{i/low}C_i$]
Stage II	Vowels are specified independently of consonants [$C_iV_jC_i$]
Stages III, IV	Consonants can be specified independently of each other [C_iVC_j]. Two emerging constraints: [Labial and *[Dorsal
Stage V	No restrictions to PoA feature assignment

[50] Also referred to in Pater & Werle (2003).
[51] Translation into English of the French formulation presented in Dos Santos (2007): Align-G(Lab,MtP)
[52] Five children, from the CLPF database.

As for stage I, Levelt (1994) claims that, at the beginning of phonological development, children's output representations are not segmentalized yet. The only unit available for PoA feature specification is the WORD,[53] as an unanalyzed whole. At this initial stage, there are three possible outputs: all segments produced (consonants and vowels) either are Labial, Coronal or Dorsal.[54] These three types of word-specification are illustrated below, with Dutch data (see chapter 4, for further detail on this initial stage, in Dutch).

(236) Place specification at the level of the WORD (Levelt, 1994)

	Orthogr.	Gloss	Target	Output	Target PoA->Output PoA	
(a) {WORD, Labial}	poes	cat	/pus/	[puf]	/Lab...Cor/->[Lab…Lab]	Eva 1;4
(b) {WORD}	prik	injection	/prɪk/	[tɪt]	/Lab...Dor/->[Cor…Cor]	
(c) {WORD}	bed	bed	/bɛt/	[dɛt]	/Lab…Cor/->[Cor…Cor]	

According to Levelt (1994) and Fikkert & Levelt (2008), the output form presented in (a) is interpreted in the following way. The child assigns the PoA feature of the target stressed vowel (Labial) to the underlying representation. At this stage, the unit of specification is the WORD; subsequently, all segments of the word surface as labial. In examples (b) and (c), the output forms emerge with the PoA feature Coronal. The authors claim that the classification of forms such as the ones illustrated in (236) as instances of CH would be problematic, since (i) there is no fixed directionality (note that /Lab…Cor/ target patterns can be produced as [Lab…Lab] or as [Cor…Cor], in the same period (examples (a) and (c)); (ii) in some cases, the PoA produced is not even present in any of the consonants in the target form (see example (b)). According to Fikkert & Levelt, these forms do not involve interaction between the two consonants; they are artifacts of highly unspecified lexical representations, in which the unit of specification is word-sized.

Fikkert and Levelt (2008) state that 'typical' cases of CH in Dutch data occur mostly at stage III of the development of place specification. As already discussed in chapter 5, this stage is characterized by the fact that consonants in a word can already be independently specified ([$C_i V C_j$]). However, strict limitations are imposed on feature assignment to specific word positions, within these early non-homorganic words. The first pattern acquired is [Lab…Cor], which is also the most frequent pattern attempted. Fikkert & Levelt argue that, at this point, the child analyzes his/her early active vocabulary and observes that Labial is always found at the left edge of the word. On the

[53] The term WORD is used by Levelt (1994) and Fikkert & Levelt (2008) as an abstract category; it can be constituted by CVC in monosyllables or by <u>CVC</u>V in disyllables (Levelt, 1994: 84-85).

[54] Within this approach, the category Labial gathers round vowels and bilabial/labiodental consonants; the category Coronal assembles front vowels and dental/alveolar/palatal consonants; finally, the category Dorsal refers to back vowels and velar/uvular consonants.

basis of this observation, an overgeneralization emerges and is phonologized in the form of a constraint, which requires Labial to be aligned with the word-initial position. It is at this point of the development that the patterns /Cor…Lab/->[Lab…Lab] or /Dor…Lab/->[Lab…Lab] appear in Dutch children's productions. These patterns are illustrated below, with Dutch data.

(237) CH-like forms in Dutch as a result of overgeneralization of [LABIAL (Levelt, to appear)

	Orthogr.	Gloss	Target	Output	Target PoA	Output PoA	
(a)	sloffen	slippers	/slɔfə/	[bɔfə]	/Cor...Lab/	[Lab..Lab]	Robin (1;10.7)
(b)	tafel	table	/tafəl/	[pafy]	/Cor...Lab/	[Lab..Lab]	Robin (1;10.7)
(c)	klimmen	to climb	/klɪmə/	[pɪmə]	/Dor...Lab/	[Lab…Lab]	Robin (1;10.7)

In examples given above, the target non-homorganic combinations that present Labial at C2 are rendered in a [Lab…Lab] output form. According to Fikkert & Levelt, these forms do not result from any pressure in Dutch children's grammar for the two consonants to share the same PoA; they are the result of children's compliance to the requirement that Labial cannot be associated to C2 unless it is also present in C1. Additional support for this non-harmonic approach comes from metathesis such as /kip/>>[pik] (Noortje) and from vowel-to-consonant assimilation patterns such as /xut/>>[fut] (Robin), (Levelt, 2004). In both cases, the [Labial constraint forces Labial to be assigned to C1, but the output form is not homorganic. The relation between metathesis and CH-like forms will be further explored in the next subsection.

In summary, Fikkert & Levelt argue that there are two main developmental periods in which apparent CH forms appear in Dutch data: in early productions, when one single place specification is assigned to the whole word and in the beginning of [C≠C] productions, when children's outputs are being constrained by a requirement that Labial must be aligned with the left edge of the word. The authors argue that none of the two sets of data should be classified as instances of CH, since they do not involve feature interaction between the two consonants of the word. Levelt (to appear) proposes two new designations for the two sets of data: *homorganics*, for the /C_{PoA}≠C_{PoA}/->[C_{PoA}=C_{PoA}] cases that occur in early productions and *PoA-alignment* for the /Cor…Lab/->[Lab…Lab] and /Dor…Lab/->[Lab…Lab] patterns that occur at the later stage. According to Levelt (to appear), both types of patterns are due to specific developmental states of the phonological system and, therefore, are transient and child-specific. The overgeneralization [LABIAL disappears with the expansion of the lexicon, which provides increasing evidence that Labial is not necessarily always left-aligned.

Fikkert & Levelt (2008) and Levelt (to appear) suggest that different types of PoA alignment constraints can be found in child language, depending on the distribution of place feature patterns in the input languages. Corroborating evidences for this proposal were found in Fikkert, Levelt & Van de Weijer (2002), who show that different PoA distributions in Dutch and English could account for the fact that in English child language both Dorsal and Labial PoA alignment occurs, while in Dutch child language mainly Labial alignment is found (see chapter 5).

6.1.3 Metathesis

In general terms, metathesis can be defined as the production of two segments (or syllables) in the reverse order from the target, or underlying, form. Several studies have reported cases of consonant metathesis in children's speech (Ingram, 1974; Macken, 1979; Velleman, 1996; Jaeger, 1997, Dos Santos, 2007; Fikkert & Levelt, 2008). Some examples of this pattern are provided in (238), based on the acquisition data of different languages.

(238) Examples of metathesis in child language

		Orthogr.	Gloss	Output	Target PoA	Output PoA	
(a)	Spanish	book	libro	[pito]	/Cor...Lab/	[Lab...Cor]	Si (Macken, 1979)
(b)	English	cup		[pʌkʰ]	/Dor...Lab/	[Lab...Dor]	Alice (Jaeger, 1997)
(c)	French	to cross	couper	[peke]	/Dor...Lab/	[Lab...Dor]	Marilyn (Dos Santos, 2007)
(d)	Dutch	chicken	kip	[pɪk]	/Dor...Lab/	[Lab...Dor]	Noortje (Fikkert & Levelt, 2008)

Most cases of metathesis have been related to the process of fronting, (Ingram, 1974): children tend to produce consonant PoA sequences in a front to back order within a word; when the target form attempted presents the reverse sequence, metathesis tends to occur. This approach could account for all the examples provided above, where the sequences /Cor...Lab/ and /Dor...Lab/ are produced as [Lab...Cor] and [Lab...Dor], respectively. However, as emphasized by Menn (1975) and Velleman (1996) a fronting strategy cannot account for all metathesis patterns observed in children's data, across languages.

Some authors have suggested that CH-like patterns and at least some types of metathesis may result from the same type of underlying constraints. Levelt (to appear) shows that, in some children's data, the /Cor...Lab/->[Lab...Lab] and the /Dor...Lab/->[Lab...Lab] patterns co-occur with metathesized forms of the type /Cor...Lab/->[Lab...Cor] or /Dor...Lab/->[Lab...Dor]. According to this author, both production strategies emerge as a way of complying with an alignment constraint that directs Labial to the word-initial position. A similar view is presented in Velleman (1996), who also argues that a single set of constraints, with slightly different rankings, is able to account for both harmony and metathesis patterns in child language. According to Velleman, metathesis implies – in OT terms - more faithfulness to the input form than harmony: through metathesized forms, the child manages to preserve the consonants in the input, at the expense of linearity. On the contrary, in harmony forms, faithfulness to positional requirements outranks faithfulness to some of the consonants in the input form.

6.1.4 Substitution patterns

As already described in chapter 3, research in child language has shown that substitution patterns constitute a widespread phenomenon in early productions. This fact is mainly due to the reduced segmental inventory children have to work with in the early stages. Place and manner features are acquired gradually and, while a given feature is not mastered, it tends to be either deleted or replaced by another feature, acquired earlier. The processes of stopping, fronting and gliding are amongst the most frequently reported substitutions that imply changes in place and manner features.

A general overview of the substitution patterns that affect Portuguese children's consonantal productions has already been presented in chapter 3. In the current chapter, two main aspects concerning substitution patterns will constitute the focus of analysis: (i) word-positional effects and (ii) interaction between place and manner features.

As for the effect of word-position on substitution patterns (in this particular case, C1 and C2 onsets), some studies have shown that the special environment in which C2 consonants appear (i.e., an intervocalic context) makes them prone to vowel feature assimilation, for instance, in terms of voicing or its continuancy; this fact has been defined as an instance of '*plateauing'* (Bernhardt & Stemberger, 1998; Stemberger & Bernhardt (2001)). In fact, a strong affinity has been observed between continuant consonants (especially sonorants) and intervocalic position (Bernhardt & Stemberger, 2002).

One of the questions addressed in recent literature is if intervocalic consonants pattern with word-initial onsets or with final codas, in children's speech. One way to establish that comparison is by analyzing the correct scores of consonants in each of the positions, as well as analyzing the substitution patterns that affect consonants in each of those word (and syllable) positions (Kehoe & Lléo, 2002). The results of the different studies on this matter have not been conclusive, though; it seems that intervocalic onsets can sometimes present behavior similar to codas, in other times pattern like word-initial onsets or even show a unique developmental pattern (Bernhardt &

Stemberger, 1998; Kehoe & Lléo, 2002; Bernhardt & Stemberger, 2002; Stoel-Gammon, 2002).

Since the analysis of developmental patterns in coda position is beyond the scope of the current investigation, we will limit the discussion to the relation between C1 and C2 onsets. In chapter 5, it was shown that there were asymmetries between C1 and C2, in the process of development of place and manner patterns in EP: some features and feature contrasts tend to be developed first in one position and only later in the other. These asymmetries are, at least in some of the cases, the cause for the different timings in the acquisition of certain consonantal sequences; for instance, /Stop…Liquid/ target patterns are acquired much earlier than /Liquid…Stop/ combinations. Based on the observed positional asymmetries, we hypothesized, at the end of chapter 5, that C1 and C2 may have a different status in these children's representations. This hypothesis will be further investigated in the current chapter, based on the analysis of the substitution patterns that affect consonants in each of those word-positions.

The potential influence of manner in the substitution patterns that affect place features will also be analyzed and discussed in the current chapter. The research in this field has shown that the substitution of a non-acquired MoA feature may cause the substitution of the PoA as well, even though the latter may already be acquired; for instance Dunphy (2006) shows that the Dutch child Jarmo[55] is already producing target-like labial stops at 2;0 (/ˈpɑula/>>[ˌpɑuˈʋa]), but, at the same age, he substitutes labial fricatives by coronal stops (/ˈvoχəl/>>[ˈtoχɔ]). In this case, Labial is acquired, but only in combination with [-continuant] features. Dunphy emphasized that Jarmo also recurs to stopping, rendering target labial fricatives as labial stops. However, the most frequent strategy used by this child is to replace both place and manner features by a default coronal stop. In chapter 3, we observed that, in general, PoA is acquired before MoA. This means that, by the time /C_{PoA}≠C_{PoA}/ sequences are being acquired, some manner features are still not available in children's inventory and are submitted to alternative strategies, namely substitutions. The question that will be addressed here is if those manner substitution patterns also affect place and if that interaction plays any role in the developmental order of /C_{PoA}≠C_{PoA}/ sequences.

6.1.5. Lexical selection

One of the first strategies used by some children in order to cope with problematic adult structures is not to attempt them at all. In fact, children tend to select

[55] Data from the CLPF database (Fikkert, 1994; Levelt, 1994).

target words that comply with their early phonological ability (Ferguson and Farwell, 1975; Kiparsky & Menn (1977)). According to Levelt (1994), the lexical selection strategy provides evidence that young children are able to identify, at least to some extent, the phonological properties of words and sounds in their input language.

As far as place and manner feature patterns are concerned, several studies have reported that children initially tend to avoid non-harmonic sequences; young learner's productive vocabularies are mainly of the type [C=C] (Macken, 1979; Levelt, 1994; Stoel-Gammon, 2002). According to Fikkert & Levelt (2008), the selection of [C_{PoA}≠C_{PoA}] words in the intake of Dutch children takes place in a gradual fashion; the first and the most frequent pattern selected is /Lab…Cor/, which is the first to be acquired and motivates the emergence of the over-generalization that Labial must be aligned with the word-initial position (see section 6.1.2.) According to these authors, a place pattern that does not contain a Labial in word initial position tends to be attempted later. The preference for word-initial labial (stops and nasals) in children's vocabularies has also been reported for other languages, namely English and Cantonese (Stoel-Gammon, 1998; Fletcher et al. 2004).

According to Fikkert (2007) and Fikkert & Levelt (2008), the selection strategy results in an initial state of "faithfulness" in children's phonological development: learners select what they can actually produce. Unfaithful output forms, i.e. forms deviating from the target form, will appear more often with the gradual expansion of the children's lexicon, concomitant with a gradual decline of the selection strategy.

However, it is important to emphasize that some children are non-selectors (for instance, Eva, in Levelt, 1994 and Marilyn, in Dos Santos, 2007). Non-selectors attempt problematic patterns from an early age on, rendering them in alternative ways, which will be discussed in this chapter.

6.2 Summary and research questions

Five main alternative strategies were explored in the previous sections; they are summarized below.

(a) REDUPLICATION

It is a frequent strategy in early productions, for some children. Usually, the target stressed syllable is the one that is reduplicated (Fee & Ingram, 1982).

(b) CONSONANT HARMONY

Two main constraint-based perspectives were outlined. In studies such as Pater (1997, 2002) and Pater & Werle (2001, 2003), CH is described as the result of a high-ranked markedness constraint that requires place feature agreement between the consonants of a word. In studies such as Rose (2000), Fikkert & Levelt (2008), Dos Santos (2007) and Levelt (to appear), the claim is that CH-like forms result from constraints that require specific features to be assigned to specific prosodic domains. In this sense, CH does not necessarily imply any type of relationship between consonants in a word.

Levelt (to appear) proposes two new terms for CH-like forms in Dutch: (i) *homorganics*, for the /C_{PoA}≠C_{PoA}/->[C_{PoA}=C_{PoA}] patterns that occur in an early stage in the development of PoA sequences, in which one single feature is assigned to the whole word and (i) PoA-*Alignment*, for the patterns that occur in the beginning of the acquisition of /C≠C/ sequences, characterized by the emergence of a constraint [Labial.

According to Fikkert & Levelt (2008), alignment constraints such as [Labial emerge from generalizations over a child's own lexicon, which, in turn, can be traced back to properties of the input: frequent [C≠C] structures in adult speech (such as [Lab…Cor]) tend to be amongst the most frequently attempted sequences by young Dutch learners. The authors further suggest (see also Fikkert, Levelt & Van de Weijer (2002)) that different PoA distributions across languages may lead to the emergence of different alignment constraints.

(c) METATHESIS

This strategy usually involves single segments and re-ordering from back-to front- to front-to-back (e.g. /Dor…Lab/)->[Lab…Dor]) although variation is attested (Velleman, 1996). Some authors (Fikkert & Levelt, 2008; Levelt, to appear) assume that metathesis is motivated by the same set of alignment constraints that cause CH-like productions.

(d) SUBSTITUTION PATTERNS

The literature has shown that substitution patterns can be determined by the position of a given consonant in the word (Bernhardt & Stemberger, 1998). There is a strong affinity between sonorants and the intervocalic position (Bernhardt & Stemberger, 2002). The research has also shown that some manner substitutions may affect place features (Dunphy, 2006).

(e) LEXICAL SELECTION STRATEGY

Some children tend to select only the words they can produce. Initially, mostly /C=C/ forms are attempted (Macken, 1979; Stoel-Gammon, 2002). According to Fikkert & Levelt (2008; Levelt, to appear), alignment constraints may originate from generalizations made over small vocabularies: high frequency of /Lab…Cor/ in early inventories is assumed to lead to the emergence of the constraint [Labial in Dutch. Constraints loose its strength with the gradual expansion of the inventory and concomitant decline in the selection strategy.

Based on the findings and theoretical issues reviewed in the previous sections, two main research questions are formulated for the current chapter.

(239) Research questions

a) What strategies do Portuguese children recur to, when coping with /C≠C/ targets?
b) What can those strategies tell us about children's lexical- and output representations?

In order to gather empirical evidence to discuss the two questions listed above, some specific goals were devised; they are listed in (240).

(240) Specific goals

a) Describe the alternative strategies that affect /C_{PoA}≠C_{PoA}/ and /C_{MoA}≠C_{MoA}/ targets in the period when non-harmonic patterns have not been acquired ([C=C] stage).
b) Describe the alternative strategies that affect /C_{PoA}≠C_{PoA}/ and /C_{MoA}≠C_{MoA}/ targets in the period when at least one non-harmonic pattern has been acquired ([C≠C] stage).
c) Relate the type of strategy used to the stage where it occurs.
d) Discuss interactions between place and manner features, in alternative strategies.
e) Analyze the influence of word-position in the type of alternative strategy used.
f) Analyze the relation between combinatorial restrictions and alternative strategies
g) Compare intake patterns to the distribution of [C≠C] patterns in adult speech

6.3 Method

The analysis presented in the current chapter is based on the data of five Portuguese children. The age period covered and the number of sessions are presented in (241).

(241) The data: age and number of sessions, per child

Child	Age at the 1st session	Age at the last session	N.º of sessions (total)
Inês	0;11.14	4;2.18	30
Joana	0;11.24	4;10.7	33
Luma	0;11.23	2;6.27	39
Clara	0;11.1	1;10.15	12
João	1;0.1	2;0.20	22

The analysis was restricted to productions of disyllabic targets with two non-branching onsets: /CV(c)CV(c)/. Taking into consideration the primary features for place (Labial, Coronal, Dorsal) and for manner (Stop, Nasal, Fricative, Lateral and Rhotic), six disyllabic place patterns and 20 disyllabic manner patterns could be expected in children's data; they are listed below.

(242) Disyllabic place word-patterns /C≠C/

/Lab…Cor/	/Dor…Lab/	/Cor…Lab/
/Lab…Dor/	/Dor…Cor/	/Cor…Dor/

(243) Disyllabic manner word-patterns /C≠C/

/Stop...Nas/	/Stop...Fric/	/Stop...Lat/	/Stop... Rhot/
/Nas... Stop/	/Nas...Fric/	/Nas...Lat/	/Nas... Rhot/
/Fric...Nas/	/Fric... Stop/	/Fric... Lat/	/Fric... Rhot/
/Lat...Nas/	/Lat... Stop/	/Lat...Fric/	/Lat... Rhot/
/Rhot...Nas/	/Rhot... Stop/	/Rhot...Fric/	/Rhot...Lat/

We searched for each of the place and manner combinations listed above in the target words selected by each child (intake), per session (the same methodological procedure as the one described in chapter 5, section 5.4). Then, the child's renditions of each of the targets selected were analyzed in order to find the number of occurrences and the type of each alternative strategy used (see appendix H).

As mentioned in the previous section, one of the specific goals of this chapter is to compare children's intake patterns (namely the type of /C≠C/ patterns attempted, and order and frequency of selection) to the distribution of [C≠C] combinations in a sample of the 100 most frequent CVCV words in EP adult speech (extracted from the *corpus Spoken Portuguese - Português Falado*; TA90PE; CLUL/Instituto Camões, using the electronic tool *FreP*).[56] This sample was presented in chapter 5, section 5.2, but will be repeated here, for ease of exposition.

[56] More information on this tool can be found at http://www.fl.ul.pt/LaboratorioFonetica/FreP.

(244) Distribution of place [C≠C] patterns in EP adult speech (appendix B)

	Nº	%
[Lab…Cor]	689	36%
[Dor…Cor]	436	23%
[Cor…Lab]	428	22%
[Lab…Dor]	142	7%
[Cor…Dor]	136	7%
[Dor…Lab]	93	5%

(245) Distribution of manner [C≠C] patterns in EP adult speech (appendix B)

	Nº	%
[Nas…Stop]	354	23%
[Stop…Fric]	321	21%
[Stop…Nas]	240	15%
[Stop…Lat]	125	8%
[Fric…Stop]	120	8%
[Stop…Rhot]	92	6%
[Fric…Nas]	79	5%
[Lat…Stop]	57	4%
[Nas….Lat]	51	3%
[Fric…Rhot]	31	2%
[Lat…Nas]	25	2%
[Nas…Fric]	24	2%
[Fric…Lat]	22	1%

As shown above, [Lab…Cor], [Dor…Cor] and [Cor…Lab] are the most frequently produced [C_{PoA}≠C_{PoA}] sequences in the EP adult speech sample (36%, 23% and 22%, respectively). As for manner combinations, [Nas…Stop] and [Stop…Fric] are produced more often (23% and 21%, respectively), followed by [Stop…Nas] (15%) and [Stop…Lat] (8%). This distribution will be compared to children's intake patterns in section 6.7.

A note on the truncation strategy

In a preliminary analysis, we observed that the most frequent strategy used in the first sessions is syllable truncation, of the type: /liˈmɐ̃w̃/->[ˈmɐ̃w̃] (limão, *lemon*; João, 1;2.13); /ˈkɔɾdɐ/->[ˈkɔ] (corda, *rope*; Inês, 1;5.11); /ˈvɛlɐ/->[ˈfɛ] (vela, *candle*; Joana, 2;0.9). This strategy tends to affect above 50% of the /C≠C/ patterns attempted, particularly in the first sessions (see appendix H). In these cases, children tend to preserve the target stressed syllable and delete the unstressed one, independently of the place or manner specification of the consonant in onset of the omitted syllable. It appears that truncation in these children's early productions tends not to be motivated by the segmental content of the target word but by a preference for monosyllabic forms. A similar preference for early truncation patterns has been reported for other languages (Allen & Hawkins, 1980; Echols & Newport, 1992; Ota, 2006). Since truncation seems not to be related to the segmental properties of the target form, this strategy will not be explored in the current chapter; we will focus only on the production strategies that result in multisyllabic output forms. However, the number of occurrences of truncation patterns, per session, is provided in appendix H.

6.4 Alternative strategies for /$C_{PoA} \neq C_{PoA}$/ targets in EP

The current section focuses on the most frequent alternative strategies Portuguese children recur to, when attempting non-homorganic place word-patterns.[57] The analysis covers the period between the first attempts of a given pattern and the age it becomes produced in a target-like fashion, according to the acquisition criteria used in chapter 5.[58] When no regular target-like productions occur, the analysis goes from the first attempt until the last session of the *corpus*.

Note that by alternative strategy we refer not only to alternative production forms but also to lexical selection: as mentioned in section 6.1.5, one of the strategies used by young learners to cope with problematic target sequences is to avoid them. For this reason, we will also explore the intake forms, in each child's data.

This section is organized as follows. In 6.4.1, we analyze the order and the frequency in which children attempt non-homorganic patterns, both in the [$C_{PoA}=C_{PoA}$] stage (when no [C≠C] pattern has been acquired yet) and in the [$C_{PoA} \neq C_{PoA}$] stage. In section 6.4.2, we present an overview of the most frequent alternative output forms for each attempted /$C_{PoA} \neq C_{PoA}$/ pattern, per child. Section 6.4.3 focuses on the alternative output forms that occur at the homorganic stage. Finally, section 6.4.4 explores the alternative output forms that occur at the [$C_{PoA} \neq C_{PoA}$] stage.

6.4.1 Attempting /$C_{PoA} \neq C_{PoA}$/ patterns

The current section is dedicated to the analysis of the set of non-homorganic sequences attempted by each child (intake).

For ease of exposition, we will start by repeating the order of acquisition of non-homorganic patterns in each child's *corpus*, as observed in chapter 5. We will, then, present the order of appearance of non-homorganic sequences in the intake, as well as the frequency of occurrence of each intake sequence both in the [$C_{PoA}=C_{PoA}$] stage (period when non-homorganic combinations are still not acquired) and in the [$C_{PoA} \neq C_{PoA}$] stage (from the moment at least one /C≠C/ sequence has been acquired).

A. Inês

In chapter 5, the following order of acquisition was observed for disyllabic [$C_{PoA} \neq C_{PoA}$] patterns, in Inês' data.

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[57] Only the most frequent patterns will be analyzed here; however, a full quantitative report of all the production patterns that affect each target combination (per child, per session) is provided in appendix H.

[58] Recall that the criteria used for determining if a pattern was acquired was 'no less than two target-like productions in one month and at least one in the two following months (see chapter 5, section 5.4).

(246) Order of acquisition of [C_{PoA}≠C_{PoA}] patterns – Inês (chapter 5)

1;8	1;10	2;0	2;1
[Lab…Cor]	[Cor…Lab]	[Lab…Dor]	[Cor…Dor]
[Dor…Cor]	[Dor…Lab]		

As for the intake, the first non-homorganic sequence attempted by Inês is /Cor…Lab/, at the age of 1;0. Then, at 1;3, she starts selecting words of the type /Lab…Cor/, /Dor…Cor/ and /Lab…Dor/. At 1;5, the first attempts of /Dor…Lab/ appear. Finally, at 1;8, Inês starts selecting /Cor…Dor/ forms. The order of appearance of each /C≠C/ pattern in this child's intake is depicted in (247).

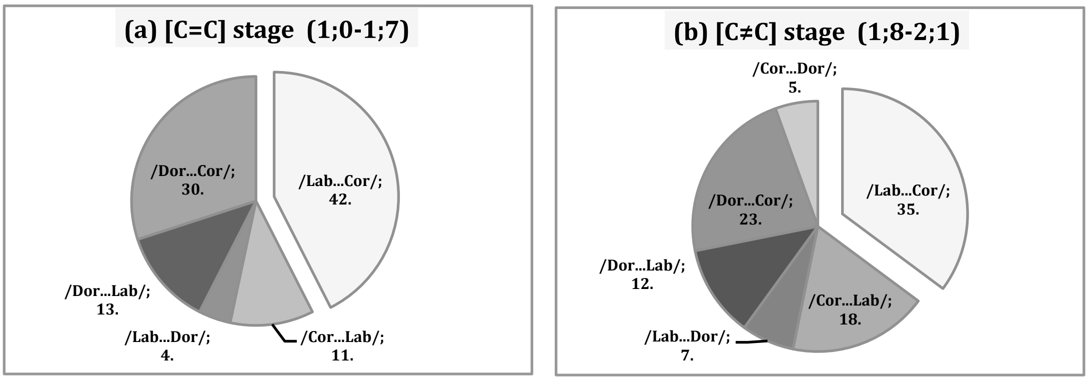
(247) Order of appearance of /C_{PoA}≠C_{PoA}/ patterns in the intake – Inês

1;0	1;3.6	1;5.11	1;8.2
/Cor…Lab/	/Lab…Cor/ /Dor…Cor/ /Lab…Dor/	/Dor…Lab/	/Cor…Dor/

We can see that, at the age the first [C_{PoA}≠C_{PoA}] patterns are acquired, being 1;8, the six non-homorganic patterns were already being attempted.

The percentage of attempts of each non-homorganic pattern in the [C_{PoA}=C_{PoA}] output stage (before 1;8) and in the [C_{PoA}≠C_{PoA}] stage (after 1;8) is provided in two graphs depicted in (248).

(248) Distribution of each /C_{PoA}≠C_{PoA}/ pattern in the intake – Inês



As shown, above, the most frequently selected patterns until 1;7 are precisely the first to be acquired: /Lab…Cor/ and /Dor…Cor/. From 1;8 onwards, the two most frequent targets are still /Lab…Cor/ and /Dor…Cor/ but there is an increase in the number of attempts of the other patterns.

Note that the last combination acquired by Inês, /Cor…Dor/, is also the least frequently attempted: only 25 tokens (5%) between 1;8 and 2;1 (see above).

B. Joana

In chapter 5, we observed the following order of acquisition of non-homorganic patterns, in Joana's data.

(249) Order of acquisition of [C_{PoA}≠C_{PoA}] patterns – Joana (chapter 5)

2;0	2;2	2;6	2;8
[Lab…Cor]	[Cor…Dor]	[Lab…Dor]	[Dor…Lab]
	[Dor…Cor]	[Cor…Lab]	

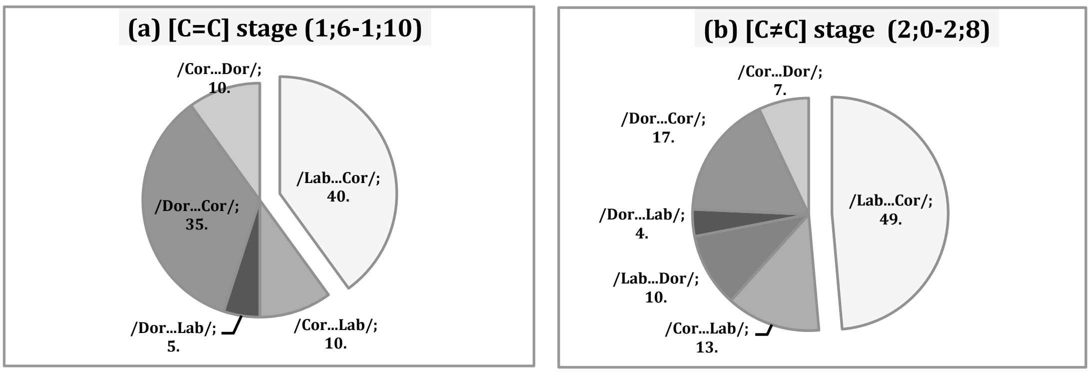
As for the intake, Joana starts attempting disyllabic /C≠C/ patterns only at 1;6. The two combinations attempted first are /Dor…Cor/ and /Lab…Cor/. The last pattern selected is /Lab…Dor/, at 2;0, age at which the first non-homorganic combination is acquired in production. The order of selection of the different patterns in this child's data is depicted in (250).

(250) Order of appearance of /C_{PoA}≠C_{PoA}/ patterns in the intake – Joana

1;6	1;8.4	1;9.25	1;10.22	2;0.9
/Dor…Cor/	/Lab…Cor/	/Cor…Dor/ /Dor…Lab/	/Cor…Lab/	/Lab…Dor/

In (251), we provide the distribution of attempts of each non-homorganic pattern in Joana's data, both in the [C_{PoA}=C_{PoA}] (before 2;0) and in the [C_{PoA}≠C_{PoA}] stage (after 2;0).

(251) Distribution of each /C_{PoA}≠C_{PoA}/ pattern in the intake – Joana



Before 2;0, very few attempts of /C_{PoA}≠C_{PoA}/ patterns occur in this child's data. The most frequently attempted patterns in this period are /Lab…Cor/ and /Dor…Cor/, but only 8 and 7 times, respectively (corresponding to 40 and to 35% of the total number of [C≠C] words attempted). From 2;0 onwards, the number of attempts increase for all patterns, although /Lab…Cor/ and /Dor…Cor/ remain the most frequently selected (see the two graphs above).

Contrary to Inês, who starts attempting /C_{PoA}≠C_{PoA}/ patterns from 1;0, Joana starts only at 1;6 and, until 1;10, there are very few attempts of non-homorganic sequences (overall, 20 attempts, in a period of 4 months). It seems that this child is avoiding non-homorganic patterns until the age of 2;0.

C. Luma

In chapter 5, the following order of acquisition for disyllabic [C_{PoA}≠C_{PoA}] patterns was observed, in Luma's data.

(252) Order of acquisition of [C_{PoA}≠C_{PoA}] patterns – Luma (chapter 5)

2;3	2;4	2;5	2;6
[Dor…Cor]	[Lab…Dor]	[Cor…Dor]	[Dor…Lab]
	[Lab…Cor]	[Cor…Lab]	

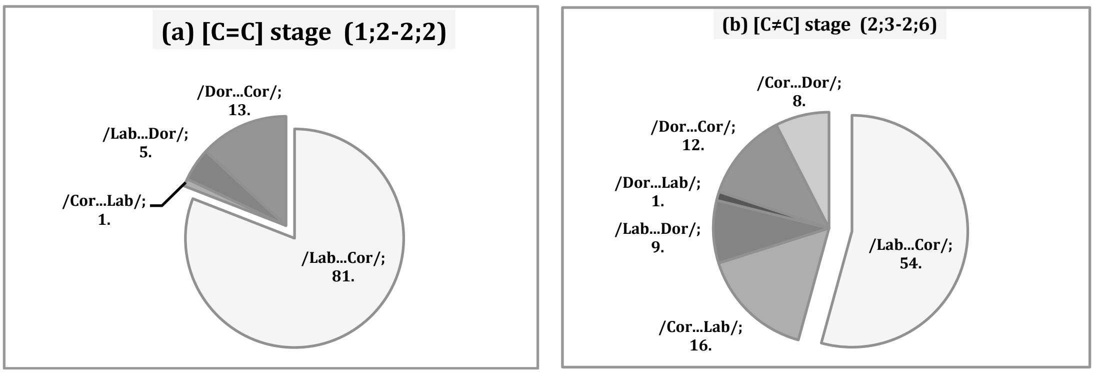
Regarding the intake, Luma started attempting disyllabic /C_{PoA}≠C_{PoA}/ patterns quite early, at the age of 1;2. The two patterns selected first are /Lab…Cor/ and /Dor…Cor/. The next patterns attempted are /Lab...Dor/ and /Cor…Lab/, only at 1;11 and 2;2, respectively. /Cor…Dor/ and /Dor…Lab/ appear only at 2;3 and 2;4, a period when non-homorganic combinations are already being acquired by this child (see (252) above). This order of selection is summarized in (253).

(253) Order of appearance of /C_{PoA}≠C_{PoA}/ patterns in the intake – Luma

1;2	1;11	2;2	2;3	2;4
/Lab…Cor/	/Lab…Dor/	/Cor…Lab/	/Cor…Dor/	/Dor…Lab/
/Dor…Cor/				

The distribution of attempts of each target pattern in the two stages (before and after 2;2) in Luma's data is provided in (254).

(254) Distribution of each [C_{PoA}≠C_{PoA}] pattern in the intake – Luma



As shown in the graphs provided above, the pattern /Lab…Cor/ is frequent in Luma's data (216 tokens, between 1;2-2;2, corresponding to 81%); this high frequency is mostly related to the fact that /Lab…Cor/ is the place feature composition of the child's own name, which is recurrently attempted in all recording sessions. Still in the [C=C] stage, the second most frequently attempted pattern is /Dor…Cor/ (35 tokens, 13%), which is the first to be acquired, at 2;3.

/Lab…Cor/ and /Dor…Cor/ are almost exclusively the /C≠C/ patterns attempted until 2;2. However, a sudden burst in the intake takes place from 2;3 onwards, evident in the graphs provided in (254), above.

Similarly to Joana, it seems that Luma avoids most of the non-homorganic patterns in the first sessions: until the age of 1;10, only /Lab…Cor/ and /Dor…Cor/ were selected.

D. Clara

In chapter 5, we observed that Clara acquires three disyllabic [C_{PoA}≠C_{PoA}] patterns, in the order presented in (255).

(255) Order of acquisition of [C_{PoA}≠C_{PoA}] patterns – Clara (chapter 5)

1;5	1;8	1;9
[Lab…Cor]	[Dor…Cor]	[Cor…Lab]

The three patterns listed above are the only non-homorganic sequences attempted by Clara. Furthermore, the age of first attempts of each pattern matches the age of acquisition. The order of appearance of the three patterns in Clara's intake is given in (256).

(256) Order of appearance of /C_{PoA}≠C_{PoA}/ patterns in the intake – Clara

1;5.16	1;8.20	1;9.23 →
/Lab…Cor/	/Dor…Cor/	/Cor…Lab/

Contrary to all other children, Clara acquires each of the three target patterns right from the first attempts. The other three disyllabic combinations are not attempted at all. This child seems to be a selector, attempting only the sequences that she is already able to produce.

E. João

João acquires [Lab…Cor] patterns at 1;7; as described in chapter 5, this is the only non-homorganic sequence that surfaces systematically in a target-like fashion in João's speech, until the last session analyzed (2;0).

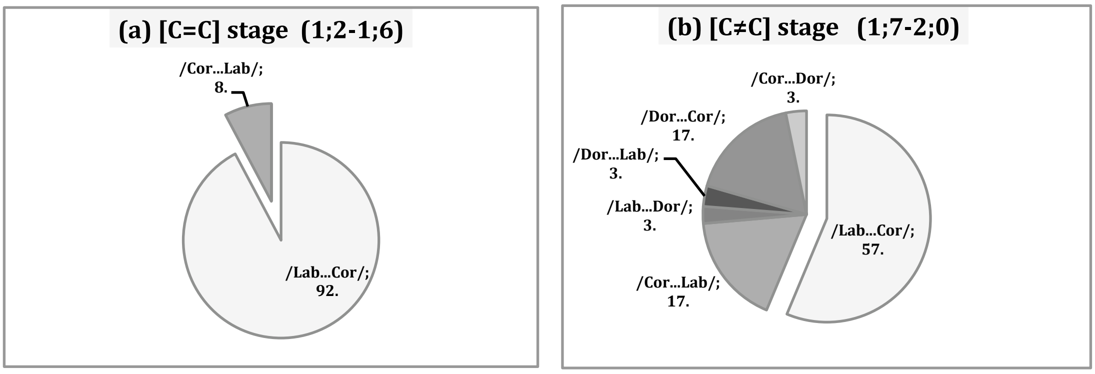
As for the intake, the first non-homorganic pattern attempted by João is also /Lab…Cor/, at the age of 1;2, followed by /Cor...Lab/ at 1;4. All other patterns are selected for the first time at 1;9 or onwards, period in which /Lab…Cor/ is already acquired. This order is summarized in (257).

(257) Order of appearance of /C_{PoA}≠C_{PoA}/ patterns in the intake – João

1;2.13	1;4.17	1;9.25	1;10.11 →
/Lab…Cor/	/Cor…Lab/	/Dor…Cor/ /Dor…Lab/ /Lab…Dor/	/Cor…Dor/

The distribution of attempts of non-homorganic patterns in the [C=C] stage (before 1;7) and in the [C≠C] stage (from 1;8 onwards), in João's data, is provided in (258).

(258) Distribution of each /C_{PoA}≠C_{PoA}/ pattern in the intake – João



As shown in the graphs above, /Lab…Cor/ is highly frequent in João's intake, particularly in the first stage (95 of the 103 tokens, from 1;2 to 1;6). Between 1;7 and 2;0, /Lab…Cor/ is still the most frequently attempted pattern, but other /C≠C/ forms are already selected with relative frequency, namely /Dor…Cor/ and /Cor…Lab/ (59 attempts each, in this second period). The least frequently attempted patterns are, as observed in the data of the other children, /Cor…Dor/, /Lab…Dor/ and /Dor…Lab/.

To summarize, /Lab…Cor/ and /Dor…Cor/ are the earliest and most frequently attempted patterns (/Lab…Cor/ being the most frequent of all). These patterns are amongst the first to be acquired, for most children. The later and least frequently attempted are /Cor…Dor/ and the combinations of Labial and Dorsal: /Lab…Dor/ and /Dor…Lab/. These patterns are often amongst the ones that are acquired later.

It is also worth emphasizing that the place feature patterns that are most frequently attempted and acquired earlier tend to be the ones that are more often produced in EP adult speech, according to the 100 most frequent CVCV word-sample analyzed in chapter 5 (section 6.3); this issue will be further discussed in section 6.7.

For all children except Inês, very few /C≠C/ patterns are attempted in the [C=C] output stage. It is from the moment the first non-homorganic combination is acquired, that we observe an increase in the number and in the types of /C≠C/ sequences attempted. These children seem to be using a selection strategy, avoiding problematic sequences in the first sessions. As far as selection strategies are concerned, Clara is the prime example: she attempts only the sequences that she is already able to produce accurately.

We will now turn to the analysis of the alternative output forms children (all except Clara) produce whenever they attempt a target /C≠C/ sequence that is still not acquired.

6.4.2 Alternative output forms: an overview

In the current section, we present a summary of the most frequent alternative output forms that affect each /C_{PoA}≠C_{PoA}/ target, in the data of all children except Clara (recall that the three non-homorganic patterns acquired by this child are produced accurately from the first attempts). The tables given from (259) to (262) provide information on: (i) the age of first attempts and of first accurate productions of [C_{PoA}≠C_{PoA}] sequences; (ii) the number of occurrences of each alternative production (and percentage, relative to the number of target patterns); (iii) the time frame in which each output form occurs more often; (iv) the alternative forms that already co-occur with target-like productions (in bold).

A. Inês

All non-homorganic patterns attempted by Inês are rendered in alternative ways before they surface in a target-like fashion. The most frequent output patterns (truncations excluded, see section 6.3) are depicted in (259).

(259) Most frequent output forms for targets /C_{PoA}≠C_{PoA}/ – Inês

	Target pattern	First attempt	Target-like Production	Output form	Occur./targets		Period
(a)	/Cor…Lab/	1;0.25	1;10.29	[Lab…Lab]	14/47	30%	1;0-1;9
				[Lab…Cor]	20/34	59%	1;8-1;9
				[Lab…Cor]	**8/22**	**36%**	**2;0.11**
(b)	/Lab…Cor/	1;3.6	1;8.2	[Lab…Lab]	13/51	25%	1;3-1;7
				[Cor…Cor]	**48/222**	**22%**	**1;8-2;2**
(c)	/Dor…Cor/	1;3.6	1;8.2	[Cor…Cor]	1/1	100%	1;3.6
				[Dor…Dor]	13/35	37%	1;5-1;7
(d)	/Lab…Dor/	1;3.6	2;0.11	[Dor…Cor]	6/11	55%	1;9.19
				[Cor…Dor]	3/5	60%	1;10.29
(e)	/Dor…Lab/	1;5.11	1;10.29	[Dor…Dor]	5/15	33%	1;5-1;7
				[Lab…Dor]	4/4	100%	1;8.2
				[Dor…Cor]	6/9	67%	1;9.19
(f)	/Cor…Dor/	1;8.2	2;1.10	[Dor…Cor]	8/9	89%	1;8.2
				[Cor…Cor]	1/2	50%	2;0.11

As shown above, Inês produces both homorganic and non-homorganic alternative output forms; for instance, she produces /Cor…Lab/ targets as [Lab…Lab], between 1;0 and 1;9 and as [Lab…Cor] between 1;8 and 2;0 (see (a), above). Note, however, that the /C_{PoA}≠C_{PoA}/->[C_{PoA}≠C_{PoA}] patterns, such as /Cor…Lab/->[Lab…Cor], occur only after 1;8, the age at which this child acquires the first non-homorganic forms and enters the [C≠C] stage. The relation between the type of alternative output form and the developmental stage will be further explored in sections 6.4.3 and 6.4.4. Note that some alternative forms co-occur with target-like productions for targets /Cor…Lab/ and /Lab…Cor/ from 2;0 and 1;8, respectively (see information in bold, in the table given in (259).

B. Joana

An outline of the most frequent alternative output forms for target /C_{PoA}≠C_{PoA}/ patterns in Joana's data is provided in (260). Recall that Joana avoids attempting /C≠C/ words until 2;0 (section 6.4.1); for this reason, the number of attempts depicted in (260) is low.

(260) Most frequent output patterns for targets /C_{PoA}≠C_{PoA}/ – Joana

	Target pattern	First attempt	Target-like Production	Output form	Occur./targets		Period
(a)	/Dor…Cor/	1;6.24	2;2.19	**[Cor…Cor]**	**3/17**	**18%**	**2;2-2;4**
(b)	/Lab…Cor/	1;8.4	2;0.9	**[Lab…Lab]**	**8/55**	**15%**	**2;0-2;4**
(c)	/Dor…Lab/	1;9.25	2;8.5	[Dor…Dor]	1/1	100%	1;9.25
				[Cor…Cor]	1/1	100%	2;6.24
(d)	/Cor…Lab/	1;10.22	2;6.24	**[Lab…Lab]**	**5/23**	**22%**	**2;6-2;8**

The predominant alternative output form in Joana's data is of the type [C_{PoA}=C_{PoA}] and it occurs mostly from 2;0 onwards, which corresponds to the age of acquisition of the first non-homorganic pattern (see (249)). Before 2;0, the predominant strategy in this child's data is syllable truncation, rendering multisyllabic target words as monosyllables (see appendix H). Note that, from 2;0 onwards, alternative forms tend to co-occur with target-like productions (see information in bold, in the table given in (260)).

C. Luma

The most frequent alternative output patterns for targets /C_{PoA}≠C_{PoA}/ in Luma's data are summarized in (261).

(261) Most frequent output patterns for targets /C_{PoA}≠C_{PoA}/ – Luma

	Target pattern	First attempt	Target-like Production	Output form	Occur./targets		Period
(a)	/Dor…Cor/	1;2.22	2;3.26	[Cor…Cor]	5/5	100%	2;2.22
				[Cor…Cor]	**7/20**	**35%**	**2;3-2;4**
				[Dor…Dor]	**6/20**	**30%**	**2;3-2;4**
(b)	/Lab…Cor/	1;2.22	2;4.11	[Lab…Lab]	75/226	33%	1;2-2;3
				[Cor…Cor]	39/88	44%	1;9-2;3
				[Lab…Lab]	**5/12**	**42%**	**2;4.11**
(c)	/Cor…Lab/	2;2.4	2;5.20	[Lab…Lab]	32/36	89%	2;2-2;5.15
				[Lab…Lab]	**6/8**	**75%**	**2;5.20**
(d)	/Dor…Lab/	2;4.25	2;6.20	[Dor…Cor]	1/1	100%	2;4.25
				[Lab…Lab]	4/4	100%	2;5-2;6.6

Similarly to Joana, the most common output form in Luma's data is of the type [C_{PoA}=C_{PoA}]. Note that, from 2;3 onwards, some alternative forms co-occur with target-like productions (see information in bold, in the table given in (261)).

D. João

The most frequent alternative output patterns for targets /C_{PoA}≠C_{PoA}/ in João's data are summarized in (262).

(262) Most frequent output patterns for targets /C_{PoA}≠C_{PoA}/ – João

	Target pattern	First attempt	Target-like Production	Alternative strategies: Output form	Occur./targets		Period
(a)	/Lab…Cor/	1;2.3	1;7.0	[Lab…Lab]	19/83	23%	1;4-1;6
				[Lab…Lab]	**15/54**	**28%**	**1;7-1;8**
(b)	/Cor…Lab/	1;4.17	____	[Lab…Lab]	42/56	75%	1;10-2;0
(c)	/Lab…Dor/	1;9.25	____	[Lab…Lab]	1/1	100%	1;9.25
				[Cor…Cor]	3/4	75%	1;10-1;11
(d)	/Dor…Lab/	1;9.25	____	[Cor…Cor]	5/11	45%	1;9-2;0
				[Lab…Lab]	3/11	27%	1;9-2;0
(e)	/Dor…Cor/	1;9.25	____	[Cor…Cor]	45/59	76%	1;9-2;0
(f)	/Cor…Dor/	1;10.11	____	[Cor…Cor]	11/11	100%	1;10-1;11

Similarly to Joana and Luma, the predominant alternative output form in João's data is homorganic (/C_{PoA}≠C_{PoA}/->[C_{PoA}=C_{PoA}]). Note that, from 1;7 onwards, alternative forms tend to co-occur with target-like productions for /Lab…Cor/ sequences (see information in bold, in the table given in (262)).

In sum, the pattern /C_{PoA}≠C_{PoA}/->[C_{PoA}=C_{PoA}] is predominant in the data of Joana, Luma and João, particularly from the moment the first [C_{PoA}≠C_{PoA}] pattern is acquired (until then, syllable truncation tends to predominate, rendering multisyllabic target words in monosyllabic output forms – see appendix H). As for Inês, both homorganic and non-homorganic output forms were found, but the latter type of production occurs only from the moment the first /C_{PoA}≠C_{PoA}/ pattern has been acquired (at 1;8).

As described in sections 6.4.3 and 6.4.4, there are important differences in the output strategies that occur in the period when no /C_{PoA}≠C_{PoA}/ has been acquired (the [C_{PoA}=C_{PoA}] stage) and the output strategies that occur in the period when at least one /C_{PoA}≠C_{PoA}/ is being produced accurately (the C_{PoA}≠C_{PoA}] stage). For instance, it will be shown that most of the [C_{PoA}=C_{PoA}] output patterns that occur in the first stage are syllable reduplications, while the homorganic patterns that appear in the second stage appear to result from substitution patterns of non-acquired consonants in specific word positions. Further details are given in the following two subsections.

6.4.3 Alternative output forms in the [C_{PoA}=C_{PoA}] stage

In this section, we will explore the alternative output forms that occur in the period in which children have not acquired any non-homorganic sequence: Inês until 1;7, Joana until 1;10; Luma until 2;2 and João until 1;6.

As shown in the previous section, all (multisyllabic) alternative forms produced in this early stage are homorganic ([C_{PoA}=C_{PoA}]). The /C_{PoA}≠C_{PoA}/->[C_{PoA}=C_{PoA}] patterns that occur in the homorganic stage tend to result in output forms of the type [$C_iV_jC_iV_j$], and, thus, can be interpreted as reduplication forms. As illustrated below, it is the target stressed syllable that tends to be reduplicated. Particularly in the later sessions of this initial stage, some homorganic productions displaying non-identical syllables start to appear.

Some examples of the /C_{PoA}≠C_{PoA}/>>[C_{PoA}=C_{PoA}] pattern in this period are provided in (263).

(263) Examples of /C_{PoA}≠C_{PoA}/->[C_{PoA}=C_{PoA}] patterns in the [C_{PoA}=C_{PoA}] stage

	Child	Age	Orthogr.	Gloss	Target	Output	Target PoA	Output PoA
(a)	Inês	1;3.6	tampa	cover	/ˈtapɐ/	[papa]	/Cor…Lab/	[Lab…Lab]
(b)	Inês	1;4.9	porta	door	/ˈpɔɾtɐ/	[pu̯ˈpɐː]	/Lab…Cor/	[Lab…Lab]
(c)	Inês	1;6.11	limpar	to clean	/lĩˈpaɾ/	[paˈpa]	/Cor…Lab/	[Lab…Lab]
(d)	Inês	1;5.11	copo	glass	/ˈkɔpu/	[kɔkoː]	/Dor…Lab/	[Dor…Dor]
(e)	Inês	1;5.11	faca	knife	/ˈfakɐ/	[ˈkaka]	/Lab…Dor/	[Dor…Dor]
(f)	Inês	1;6.11	colher	spoon	/kuˈʎɛɾ/	[kɛˈkɛ]	/Dor…Cor/	[Dor…Dor]
(g)	Inês	1;6.11	pêlo	fur	/ˈpelu/	[pepe]	/Lab…Cor/	[Lab…Lab]
(h)	Joana	1;9.25	pato	duck	/ˈpatu/	[paˈpa]	/Lab…Cor/	[Lab…Lab]
(i)	Luma	2;0.13	bola	ball	/ˈbɔlɐ/	[papa]	/Lab…Cor/	[Lab…Lab]
(j)	Luma	1;9.29	Pati	prop.noun	/paˈti/	[tiˈti]	/Lab…Cor/	[Cor…Cor]
(k)	Luma	2;2.4	Pati	prop.noun	/paˈti/	[ˈtati]	/Lab…Cor/	[Cor…Cor]
(l)	Luma	2;2.22	gato	cat	/ˈgatu/	[ˈtatu]	/Dor…Cor/	[Cor…Cor]
(m)	Luma	2;2.22	bola	ball	/ˈbɔlɐ/	[poˈpɐ]	/Lab…Cor/	[Lab…Lab]
(n)	João	1;6.16	panda	panda	/ˈpɐ̃dɐ/	[ˈpapɐ]	/Lab…Cor/	[Lab…Lab]
(o)	João	1;6.16	bola	ball	/ˈbɔlɐ/	[ˈbɐwɐ]	/Lab…Cor/	[Lab…Lab]

As for the reduplication forms, children tend to reproduce the target stressed syllable, as illustrated in (c), (d), (g), (h), (j)) or reduplicate a 'new' syllable, which results from the combination of the nucleus of the target stressed syllable with the onset of the unstressed one (examples (a), (e) and (f)).

As for the /C≠C/->[C=C] patterns that result in non-reduplicated homorganic forms, they are illustrated in (b), with data of Inês, from (k) to (l), with data of Luma and in (o), with data of João. These forms tend to appear in the later sessions within this period, at least for two of the children (João at 1;6 and Luma at 2;2). The pattern that occurs across the three children is /Lab…Cor/->[Lab…Lab]. There are also two other patterns, in Luma: /Lab…Cor/->[Cor…Cor] and /Dor…Cor/->[Cor…Cor]. Note that Luma presents, for the same target combination (/Lab…Cor/), two different outputs: [Lab…Lab] and [Cor…Cor] (examples (i) and (j)). These patterns will be discussed in section 6.7.

6.4.4 Alternative output forms in the [$C_{PoA}\neq C_{PoA}$] stage

This section focuses on the alternative strategies that occur from the moment the first /$C_{PoA}\neq C_{PoA}$/ sequences are acquired: Inês from 1;8, Joana from 2;0, Luma from 2;3 and João from 1;7. In section 6.4.2, we observed that two general types of alternative patterns occur in this period: /$C_{PoA}\neq C_{PoA}$/->[$C_{PoA}=C_{PoA}$] and /$C_{PoA}\neq C_{PoA}$/->[$C_{PoA}\neq C_{PoA}$] (the latter case occurs only in the data of Inês). A preliminary analysis of these output forms showed that they are best described if divided into three categories, outlined below.

(a) Patterns affecting non-acquired features in any position of the word.

(b) Patterns related to positional asymmetries (some features are acquired in one of the positions of the word but not in the other).

(c) Patterns related to combinatorial restrictions.

The three categories listed above will be explored in the following subsections.

Patterns affecting non-acquired features: substitutions

Some of the alternative output forms that occur in the beginning of the [$C_{PoA}\neq C_{PoA}$] stage result from the substitution of consonantal classes that are still not acquired in any of the two positions of the word (word-initial C1 and intervocalic C2). Two main PoA features are frequently affected by substitution patterns: target labial fricatives (particularly in the data of Inês and João) and dorsals, in João's data (see tables in appendix G). In both cases, the replacing consonant is a coronal stop, resulting in patterns such as /Lab…Cor/->[Cor…Cor] and /Dor…Cor/->[Cor…Cor]. These substitutions are illustrated in (264).

(264) Examples of substitutions for non-acquired features in the [$C_{PoA}\neq C_{PoA}$] stage

	Child	Age	Orthogr	Gloss	Target	Output	Target PoA	Output PoA
(a)	Inês	1;8.2	fita	ribbon	/ˈfitɐ/	[ˈtʲitʲɐ]	/Lab_{Fric}…Cor/	[Cor…Cor]
(b)	Inês	2;0.11	verde	green	/ˈveɾdɨ/	[ˈdedi]	/Lab_{Fric}…Cor/	[Cor…Cor]
(c)	Inês	2;2.1	fazer	to do	/fɐˈzeɾ/	[dɐˈde]	/Lab_{Fric}…Cor/	[Cor…Cor]
(d)	Inês	1;9-1;10	garfo	fork	/ˈgaɾfu	[ˈgato]	/Dor…Lab_{Fric}/	[Dor…Cor]
(e)	Inês	1;9.19	faca	knife	/ˈfakɐ/	[ˈkatɐ]	/Lab_{Fric}…Dor/	[Dor…Cor]
(f)	Inês	1;10.29	vaca	cow	/ˈvakɐ/	[dakaː]	/Lab_{Fric}…Dor/	[Cor…Dor]
(g)	João	1;10.11	vaca	cow	/ˈvakɐ/	[ˈtata]	/Lab_{Fric}…Dor/	[Cor…Cor]
(h)	João	1;9.25	café	coffee	/kɐˈfɛ/	[tɐˈtɛ]	/Dor…Lab_{Fric}/	[Cor…Cor]
(i)	João	2;0.6	gosta	likes	/ˈgɔʃtɐ/	[ˈdɔtɐ]	/Dor…Cor/	[Cor…Cor]
(j)	João	1;10.11	cinco	five	/ˈsĩku/	[ˈtitu]	/Cor…Dor/	[Cor…Cor]

The pattern /Lab…Cor/->[Cor….Cor] (see examples (a) to (c), in (264), above) affects targets where the labial consonant is a fricative (/Lab_{Fric}…Cor/) and it appears when [Lab…Cor] outputs are already being produced accurately if the target labial consonant is either a stop or a nasal.[59] In this case, the cause for the substitution pattern is the MoA specification (continuant). A similar substitution pattern is observed for targets /Lab_{Fric}…Dor/ and /Dor…Lab_{Fric}/ (examples (d) to (h)): here target labial fricatives surface as coronal stops. Note that the problematic issue here is not the PoA sequence (not only /Lab…Cor/ is affected, but also /Lab…Dor/ and /Dor…Lab/): labial fricatives are replaced by a coronal stop, independently of the type of PoA combination they occur in.

As for the patterns illustrated from (g) to (j), they result from the fact that dorsal consonants are not acquired in João's data, until the age of 2;0 (the last session analyzed is at 2;0). In the vast majority of cases, target dorsals surface as coronal (stops) in João's data (see appendix G). Again, in this case, it is not the PoA sequence that is posing problems to the child: target dorsals are always submitted to alternative strategies in João's data, independently of the PoA sequence (different types of combinations are affected: /Dor…Lab/, /Dor…Cor/ and /Cor…Dor/, see examples above).

The fact that some output forms are of the type [C=C] and others are [C≠C] depends on the target combination: if it already contains a coronal or if it contains two non-acquired features (dorsals and labial fricatives, in João's data), then the result is [Cor…Cor]; on the contrary, if the target combination does not contain a coronal and if only one PoA (dorsal) or one PoA/MoA combination (labial fricative) is not acquired, then the outcome form is non-homorganic: [Cor…x] or [x…Cor].

Patterns affecting PoA features in specific word-positions

Also in the non-homorganic stage, there are some alternative strategies that affect specific features, in specific word-positions. In these cases, the problem is no longer the fact that sounds are not acquired (as observed for labial fricatives or dorsals). The difficulty is now related to the fact that features are already acquired, but not in the two positions of the word (see also chapter 5).

There is one particular set of target words that is problematic for the children studied, in the beginning of the non-homorganic stage: the ones that contain Labial in C2 position. These words are affected by alternative strategies in the speech of Inês, Luma and João, but coexist with target-like productions for words with Labial in C1. The alternative strategies used for those /$C{\neq}C_{Labial}$/ targets can be /C≠C/->[C=C] (most frequently) or metathesis. These patterns are illustrated and described below, per child.

[59] In Inês' data, the 120 cases of target-like productions of /Lab…Cor/ that occur between 1;8 and 2;3 correspond to /$Lab_{Stop/Nas}$…Cor/ targets. On the contrary, all attempts of /Lab_{Fric}…Cor/ that occur in this same time frame (58 cases) are rendered in alternative output forms (truncation or [Cor…Cor]).

(265) Alternative strategies affecting [$C \neq C_{Labial}$] target words - Inês

		Age	Orthogr.	Gloss	Target	Output	Target PoA	Output PoA
Lab C1	(a)	1;8.2	manta	blanket	/ˈmɐ̃tɐ/	[ˈmatɐ]	/Lab…Cor/	[Lab…Cor]
	(b)	1;8.2	pente	comb	/ˈpẽtɨ/	[ˈpʰitɐ]	/Lab…Cor/	[Lab…Cor]
Lab C2	(c)	1;8.2	tampa	cover	/ˈtɐ̃pɐ/	[ˈpatɐ]	/Cor…Lab/	Metathesis
	(d)	1;8.2	lápis	pencil	/ˈlapiʃ/	[ˈpatu]	/Cor…Lab/	Metathesis
	(e)	1;8.2	chapéu	hat	/ʃɐˈpɛw/	[peˈbɛw]	/Cor…Lab/	[Lab…Lab]
	(f)	1;8.2	sabão	soap	/sɐˈbɐ̃w̃/	[maˈbaw]	/Cor…Lab/	[Lab…Lab]
	(g)	1;8.2	copo	glass	/ˈkɔpu/	[ˈpɔku]	/Dor…Lab/	Metathesis
	(h)	1;9.19	roupa	clothes	/ˈʁopɐ/	[ˈbopɐ]	/Dor…Lab/	[Lab…Lab]

Inês starts producing /Lab…Cor/ targets at 1;8 (examples (a) and (b) in (265)). However, at 1;8-1;9, the attempts of words containing a labial in C2 (/Cor…Lab/ and /Dor…Lab/) are systematically submitted to alternative strategies, resulting in metathesized or [Lab…Lab] output forms (examples from (c) to (h) in (265)). Note that both target trochees and iambs are affected and that the target consonants involved belong to different MoA, including stops and nasals, which are already acquired at this age. For this reason, the MoA specification and the word stress position do not seem to play a role in these production patterns. Note also that the problem seems not to be related with the sequence itself - both /Cor…Lab/ and /Dor…Lab/ are affected - but with the fact that Labial is in intervocalic position.

(266) Alternative strategies affecting /$C \neq C_{Labial}$/ target words - Luma

		Age	Orthogr	Gloss	Target	Output	Target PoA	Output PoA
Lab C1	(a)	2;4.11	mundo	world	/ˈmũdu/	[ˈmũdu]	/Lab…Cor/	[Lab…Cor]
	(b)	2;4.11	passa	(he) passes	/ˈpasɐ/	[ˈpasɐ]	/Lab…Cor/	[Lab…Cor]
Lab C2	(c)	2;4.11	sapo	frog	/ˈsapu/	[ˈfapu]	/Cor…Lab/	[Lab…Lab]
	(d)	2;4.11	lobo	wolf	/ˈlobu/	[ˈbobu]	/Cor…Lab/	[Lab…Lab]
	(e)	2;4.11	toma	take (it)	/ˈtɔmɐ/	[ˈpɔmɐ]	/Cor…Lab/	[Lab…Lab]
	(f)	2;4.25	nove	nine	/ˈnɔvɨ/	[ˈvov]	/Cor…Lab/	[Lab…Lab]
	(g)	2;5.15	sofá	sofa	/suˈfa/	[fuˈfa]	/Cor…Lab/	[Lab…Lab]

Luma acquires /Lab…Cor/ combinations at 2;4 (see examples (a) and (b) in (266)). However, at 2;4-2;5.15, words with the reverse pattern (/Cor…Lab/) are rendered systematically in a [Lab…Lab] format, as illustrated from (c) to (g) in (266). Similarly to what was observed in Inês, both trochees and iambs are affected and the target consonants involved can belong to any MoA class.

(267) Alternative strategies affecting /C≠C_{Labial}/ target words – João

		Age	Orthogr.	Gloss	Target	Output	Target PoA	Output PoA
Lab C1	(a)	1;7.0	bola	ball	/ˈbɔlɐ/	[bɔˈʎa]	/Lab…Cor/	[Lab…Cor]
	(b)	1;10.26	mota	motorcycle	/ˈmɔtɐ/	[ˈpɔtɐ]	/Lab…Cor/	[Lab…Cor]
	(c)	2;0.6	porta	door	/ˈpɔɾtɐ/	[ˈpotɐ]	/Lab…Cor/	[Lab…Cor]
Lab C2	(d)	1;10.26	toma	take (it)	/ˈtɔmɐ/	[ˈpɔmɐ]	/Cor…Lab/	[Lab…Lab]
	(e)	2;0.6	tampa	cover	/ˈtɐ̃pɐ/	[ˈpapɐ]	/Cor…Lab/	[Lab…Lab]
	(f)	1;10.26	kivi	kiwi	/kiˈvi/	[biˈbi]	/Dor…Lab/	[Lab…Lab]

As shown above, João produces words with C1 labial from 1;7 onwards (see examples (a) to (c) in (267)). However, in the same time period, words with C2 labial are rendered in an alternative output format: [Lab…Lab] (examples from (d) to (f) in (267)). Both trochees and iambs are affected and the consonants involved are mostly stops and nasals, which are already acquired at this age. The PoA sequences also seem not to play a role, since both /Cor…Lab/ and /Dor…Lab/ are affected.

A behavior similar to the one described above for words with C2 labial was also observed for words with C2 dorsal, in the data of Inês, between 1;8 and 1;9. However, in this case, the alternative output is systematically a metathesized form. This pattern is illustrated in (268).

(268) Alternative strategies affecting /C≠C_{Dorsal}/ target words – Inês

		Age	Orthogr.	Gloss	Target	Output	Target PoA	Output PoA
Dor C1	(a)	1;8.2	queijo	cheese	/ˈkɐjʒu/	[ˈgɛtu]	/Dor…Cor/ ->	[Dor…Cor]
	(b)	1;8.2	carta	letter	/ˈkaɾtɐ/	[ˈkatu]	/Dor…Cor/ ->	[Dor…Cor]
Dor C2	(c)	1;8.2	talco	powder	/ˈtałku/	[ˈkatu]	/Cor…Dor/ ->	Metathesis
	(d)	1;8.2	jogo	game	/ˈʒogu/	[guˈdo]	/Cor…Dor/ ->	Metathesis
	(e)	1;9.19	faca	knife	/ˈfakɐ/	[ˈkatɐ]	/Lab…Dor/ ->	Metathesis

This child starts producing words with initial dorsals at the age of 1;8, as illustrated in (a) and (b) in (268). However, between 1;8-1;9, the target words containing a dorsal in C2 (/Cor…Dor/ or /Lab…Dor/) are submitted to metathesis, as shown in the examples from (c) to (e)[60] in (268).

Patterns affecting specific /C_{PoA}≠C_{PoA}/ combinations

In this section, we describe a production pattern observed in the *corpus* of Luma, affecting the target sequence /Dor…Lab/, between the ages of 2;5 and 2;6.6; during this period, Luma produces /Dor…Lab/ targets as [Lab…Lab] forms. This pattern is different from all the other described in this [C_{PoA}≠C_{PoA}] stage, because it occurs at an age where

[60] In the case illustrated in (e), there is also a coronal insertion to replace a labial fricative.

the child is already producing both C1 dorsals and C2 labials, in other [C_{PoA}≠C_{PoA}] sequences (see examples (a) and (b) in (269), below). Thus, the child is already able to produce, in non-homorganic sequences, a dorsal in C1 and a labial in C2, but still does not combine them in her productions (see examples (c) and (d) in (269)).

(269) Combinatorial (and positional) restrictions - Luma

	Age	Orthogr.	Gloss	Target	Output	Target PoA	Output PoA
(a)	2;3.26	queda	(a) fall	/ˈkɛdɐ/	[ˈkedɐ]	/<u>Dor</u>…Cor/	[<u>Dor</u>…Cor]
(b)	2;5.20	tampa	cover	/ˈtɐ̃pɐ/	[ˈtɐ̃pɐ]	/Cor…<u>Lab</u>/	[Cor…<u>Lab</u>]
(c)	2;5.20	cama	bed	/ˈkɐmɐ/	[ˈpɐmɐ]	/Dor…Lab/	[Lab…Lab]
(d)	2;5.20	copo	glass	/ˈkɔpu/	[ˈpɔpu]	/Dor…Lab/	[Lab…Lab]

At least at a first sight, this pattern could be interpreted as the result of a combinatorial restriction on two marked place features. This can, in fact, be the case; however, it is worth noticing that Luma has already acquired the combination /Lab…Dor/ at this stage (for instance, /ˈbokɐ/>>[ˈbokɐ] (mouth), at 2;5.20). Thus, this may not be just a combinatorial issue, but also a positional one, since [Lab…Dor] is possible, but [Dor…Lab] is not. The child may be dealing with both types of restrictions, at this stage.

In sum, the following conclusions can be drawn from the analysis of the alternative strategies that affect /C_{PoA}≠C_{PoA}/ target words:

(a) Most children avoid non-homorganic targets in the first sessions.

(b) The patterns /Lab...Cor/ and /Dor...Cor/ tend to be amongst the first sequences attempted and acquired. These are also the most frequently produced place feature word-patterns in an EP adult speech sample.

(c) In the [C_{PoA}=C_{PoA}] stage, syllable reduplication is the predominant output strategy, resulting in /C_{PoA}≠C_{PoA}/->[$C_iV_jC_iV_j$] patterns.

(d) In the [C_{PoA}≠C_{PoA}] stage, three types of output strategies occur:

- substitutions affecting non-acquired PoA in any position of the word;
- metathesis and /C≠C/->[C=C] patterns resulting from positional asymmetries (Labial (or Dorsal) is acquired in C1 but not in C2);
- /C≠C/->[C=C] patterns resulting from combinatorial restrictions of two marked features ([Dor...Lab], in Luma's data).

A finding that is worth emphasizing is that most of the alternative output forms for target /C≠C/ combinations result not from the PoA combination itself but from independent factors, namely the fact that some features are acquired late in some word-positions. There is, however, one pattern that appears to result from combinatorial restrictions, namely the /Dor…Lab/->[Lab…Lab] in Luma's data.

6.5 Alternative strategies for /C_{MoA}≠C_{MoA}/ targets in EP

In the current section, we will focus on the alternative strategies that affect non-harmonic manner patterns. Similarly to the description made for place feature patterns, the analysis covers the period comprehended between the first attempts of each pattern and target-like production (or, in the case of non-acquired target patterns, until the last session available in the *corpus* of each child).

This section is organized as follows. In 6.5.1, we analyze the order and the frequency in which children attempt the different /C_{MoA}≠C_{MoA}/ patterns. In 6.5.2, we present a summary of the alternative strategies that affect each /C_{MoA}≠C_{MoA}/ target pattern, per child. Section 6.5.3 focuses on the alternatives that occur in the [C_{MoA}=C_{MoA}] stage. Lastly, section 6.5.4 presents the alternatives that occur at a later stage, when /C≠C/ forms start being acquired ([C_{MoA}≠C_{MoA}] stage).

6.5.1 Attempting /C_{MoA}≠C_{MoA}/ patterns

In this section, we present an overview of the order and frequency of selection of /C_{MoA}≠C_{MoA}/ patterns, in the *corpora* of the five children observed in this dissertation. Due to the large number of different patterns attempted, per child, it is not feasible to present a detailed analysis as the one provided for place feature patterns. For this reason, the main observations are presented here and the full quantitative report is provided in appendix I.

The general trends in the selection of non-harmonic manner patterns are the following:

(a) Attempted earlier and more frequently:

/Stop…Liq/, /Stop…Fric/, /Fric…Stop/, /Nas…Stop/

(b) Attempted later and less frequently:

/Nas…Liq/, /Rhot….Obstr/Sonor/, /Lat…Fric/Sonor/

As outlined above, the most frequently attempted /C_{MoA}≠C_{MoA}/ patterns are usually the ones that are selected earlier, while the least frequent ones tend to appear in the children's intake only in later sessions.

In the majority of cases, the less and later attempted patterns are the ones that contain combinations of sonorants or combinations of sonorants and fricatives. Note that, as shown in chapter 5, these manner sequences are also amongst the ones that are acquired later by most children (see also section 6.5.2).

There is a correlation between some of the MoA patterns that are attempted earlier by the five children and the patterns that are produced more often in EP adult speech: sequences such as [Stop…Nas], [Stop…Fric] and [Stop…Liq] are included in both sets of data (see 6.3). This issue will be further discussed in section 6.7.

Similarly to what was observed in the development of PoA intake patterns, there is a substantial increase in the number and types of /$C_{MoA}{\neq}C_{MoA}$/ targets attempted, from the moment children acquire the first /$C_{MoA}{\neq}C_{MoA}$/ combinations; this increase is more evident in the data of Joana, Luma and Clara, although it also occurs in the data of Inês and João (see tables in appendix I). It thus seems that one of the alternative strategies children use during the [$C_{MoA}{=}C_{MoA}$] stage is lexical selection.

Even though lexical selection may play an important role, particularly in the early sessions, children do attempt /$C_{MoA}{\neq}C_{MoA}$/ sequences; in the next sections, we will explore the alternative strategies used to cope with those problematic targets.

6.5.2 Alternative output forms: an overview

In this section, we present a summary of the most frequent alternative output forms that affect each /$C_{MoA}{\neq}C_{MoA}$/ target, per child.

A. Inês

In chapter 5, thirteen disyllabic [$C_{MoA}{\neq}C_{MoA}$] patterns were considered acquired in Inês' data.[61] We recall that order of acquisition in (270).

(270) Order of acquisition of [$C_{MoA}{\neq}C_{MoA}$] patterns – Inês (chapter 5)

1;8	1;9	1;10	2;0	2;1	2;4	2;7	2;11	3;4
[Nas Stop]	[Stop Lat]	[Stop Rhot]	[Stop Nas]	[Lat Stop]	[Stop Fric]	[Fric..Lat] [Fric…Nas] [Fric…Rhot] [Fric…Stop]	[Nas..Fric] [Lat..Fric]	[Rhot Stop]

A summary of the most frequent alternative output forms for target /$C_{MoA}{\neq}C_{MoA}$/ words is given in (271), where we provide information on the age of first attempts of each target pattern and of first accurate productions, as well as on the number of occurrences and the period in which each alternative output forms occurs.[62] The highlights (in bold) indicate that alternative output forms already co-occur with target-like productions.

[61] Recall that the criteria used for determining if a pattern had entered the process of acquisition was 'no less than two target-like productions in one month and at least one in the two following months (see chapter 5, section 5.4).

[62] As already mentioned, only the most frequent alternative productions are described here, for each target pattern; for a list of all types of productions that affect each target pattern, per child and per session, see appendix H.

(271) Most frequent output patterns for targets /C_{MoA}≠C_{MoA}/ – Inês

	Target pattern	First attempt	Target-like Production	Output form	Occur./targets		Period
(a)	/Stop…Nas/	1;0.25	2;0.11	[Stop…Stop]	6/16	37%	1;0-1;8
				[Stop…Glide]	10/12	83%	1;9.19
(b)	/Fric…Stop/	1;1.30	2;7.16	[Stop…Stop]	111/132	84%	1;1-2;5
				[Stop…Stop]	**18/50**	**36%**	**2;7-2;10**
(c)	/Stop…Lat/	1;3.6	1;9.19	[Stop…Stop]	10/40	25%	1;3-1;8
				[Stop…Rhot]	**5/44**	**11%**	**1;9-2;1**
				[Stop…Glide]	**3/44**	**7%**	**1;9-2;1**
(d)	/Stop…Rhot/	1;3.6	1;10.29	[Stop…Stop]	124/16	25%	1;3-1;9
				[Stop…Lat]	**18/60**	**30%**	**2;0-2;5**
(e)	/Stop…Fric/	1;3.6	2;4.18	[Stop…Stop]	76/102	75%	1;3-2;3
				[Stop…Stop]	**12/26**	**46%**	**2;4-2;7**
(f)	/Lat…Stop/	1;5.11	2;1.10	[Stop…Stop]	12/20	60%	1;5-1;10
				[Stop…Liq]	6/13	46%	2;0.11
(g)	/Rhot…Stop/	1;7.2	3;4.6	[Stop…Stop]	9/13	69%	1;7-3;0
(h)	/Fric…Lat/	1;8.2	2;7.16	[Stop…Liq]	8/18	44%	1;8-2;3
				[Stop…Glide]	6/18	33%	1;8-2;3
(i)	/Lat…Fric/	1;8.2	2;11.22	[Stop…Stop]	3/6	50%	1;10-2;0
				[Lat…Stop]	11/18	61%	1;10-2;7
(j)	/Fric…Nas/	1;9.19	2;7.16	[Stop…Nas]	40/42	95%	1;10-2;5
				[Stop…Nas]	**7/13**	**54%**	**2;7-2;10**
(k)	/Nas…Fric/	1;9.19	2;11.22	[Nas…Stop]	16/26	62%	1;9-2;8
(l)	/Nas…Rhot/	2;0.11	____	[Nas…Lat]	9/12	75%	2;3-3;7
(m)	/Fric…Rhot/	2;1.10	2;7.16	[Stop…Rhot]	3/3	100%	2;1.10
				[Fric…Lat]	**20/35**	**57%**	**2;7-3;7**

Overall, the alternative output forms used by Inês can be divided into two main types: (i) /C_{MoA}≠C_{MoA}/->[Stop…Stop] and (ii) /C_{MoA}≠C_{MoA}/->[C_{MoA}≠C_{MoA}]; in this latter case, the output forms already match the target in the fact that consonants do not share MoA specification, but at least one of the MoA produced does not coincide with the target. Until the age of 1;7, only [Stop…Stop] occurs. The strategies that result in non-harmonic output forms emerge only from 1;8 onwards, which coincides with the age of acquisition of the first disyllabic /C_{MoA}≠C_{MoA}/ pattern (see (270)).

B. Joana

As described in the previous chapter, Joana acquires ten disyllabic [C_{MoA}≠C_{MoA}] patterns. We recall that order of acquisition in (272).

(272) Order of acquisition of [C_{MoA}≠C_{MoA}] patterns in Joana's data (chapter 5)

2;2	2;6	2;10	3;3	3;6
[Nas…Stop]	[Stop…Fric]	[Stop…Lat]	[Fric…Rhot]	[Stop…Rhot]
[Stop…Nas]	[Fric…Nas]		[Nas…Lat]	
[Fric…Stop]	[Nas…Fric]			

The most frequent alternative output forms for target /C_{MoA}≠C_{MoA}/ sequences in Joana's data are listed in (273).

(273) Most frequent output patterns for targets /C_{MoA}≠C_{MoA}/ - Joana

	Target pattern	First attempt	Target-like Production	Output	Occur./targets		Period
(a)	/Stop…Lat/	1;6.24	2;10.8	[Stop…Glide]	13/30	43%	2;2-2;8
				[Stop…Glide]	**36/75**	**48%**	**2;10-3;11**
(b)	/Stop…Rhot/	1;10.22	3;6.20	[Stop…Glide]	13/65	20%	2;6-3;6
(c)	/Nas…Lat/	1;9.25	3;3.23	[Nas…Glide]	6/7	86%	2;4-3;2
				[Nas…Glide]	**2/10**	**20%**	**3;3-4;0**
(d)	/Nas…Stop/	1;9.25	2;2.19	**[Nas…Nas]**	**5/7**	**71%**	**2;2.19**
(e)	/Rhot…Stop/	1;9.25	____	[Stop…Stop]	24/60	40%	1;9-4;0
(f)	/Lat…Stop/	1;10.22	____	[Stop…Stop]	11/35	31%	2;4-4;0
				[Glide…Stop]	5/34	15%	2;6-3;10
(g)	/Fric…Lat/	2;0.9	____	[Fric…Glide]	14/29	48%	2;6-4;0
(h)	/Lat…Nas/	2;4.1	____	[Stop…Nas]	2/8	25%	2;4-3;8
(i)	/Rhot…Nas/	2;10.8	____	[Stop…Nas]	2/5	40%	2;10-3;2

As in Inês' data, two main categories of alternative productions are found in Joana's *corpus*: /C_{MoA}≠C_{MoA}/->[C_{MoA}=C_{MoA}] and /C_{MoA}≠C_{MoA}/->[C_{MoA}≠C_{MoA}]. The latter pattern appears only from 2;2 onwards (coinciding with the age the first non-harmonic combinations are acquired, see (272)).

C. Luma

In chapter 5, eight manner word-patterns were considered acquired in Luma's data. The order of acquisition is repeated in (274).

(274) Order of acquisition of [C_{MoA}≠C_{MoA}] word-patterns – Luma (chapter 5)

2;1	2;3	2;4.11	2;4.25	2;5
[Stop…Rhot]	[Stop…Fric] [Fric…Stop] [Fric…Nas]	[Nas…Stop]	[Stop…Nas]	[Stop…Lat] [Nas…Fric]

The most frequent alternative output forms for /C_{MoA}≠C_{MoA}/ targets in Luma's data are given in (275).

(275) Most frequent output patterns for targets /C_{MoA}≠C_{MoA}/ – Luma

	Target pattern	First attempt	Target-like Production	Output	Occur./targets		Period
(a)	/Fric…Stop/	1;8.15	2;3.26	[Stop…Stop]	3/7	43%	1;8-2;2
(b)	/Nas…Stop/	1;11.1	2;4.11	[Nas…Nas]	7/10	70%	1;11.1
(c)	/Stop…Fric/	2;0.13	2;3.26	[Stop…Stop]	1/2	50%	2;0.13
				[Stop…Glide]	1/1	100%	2;2.22
(d)	/Lat…Stop/	2;2.4	____	[Stop…Stop]	4/5	80%	2;2-2;3
				[Nas…Stop]	17/31	55%	2;4-2;6
(e)	/Stop…Lat/	2;3.26	2;5.15	[Stop…Stop]	14/21	67%	2;3-2;4
				[Stop…Nas]	5/21	24%	2;3-2;4
(f)	/Fric…Lat/	2;3.26	____	[Fric…Nas]	3/4	75%	2;5-2;6
(g)	/Fric…Rhot/	2;4.25	____	[Fric…Lat]	4/12	33%	2;4-2;6
(h)	/Nas…Fric/	2;4.25	2;5.15	[Stop…Fric]	2/3	67%	2;4.25
				[Fric…Fric]	**6/15**	**40%**	**2;5**
(i)	/Lat…Fric/	2;5.20	____	[Nas…Fric]	3/4	75%	2;5-2;6

Similarly to the other two children, both /C_{MoA}≠C_{MoA}/->[C_{MoA}=C_{MoA}] and /C_{MoA}≠C_{MoA}/->[C_{MoA}≠C_{MoA}] patterns can be found in Luma's data. Until the age of 2;2, it is mostly the first pattern that appears.

D. Clara

There are very few attempts of /C_{MoA}≠C_{MoA}/ targets in Clara's data, until the last session analyzed, at 1;10.[63] In spite of the few tokens, two MoA patterns are acquired: [Nas…Stop] and [Stop…Fric], at the age of 1;8.[64] These two patterns are produced accurately from the first attempt.[65] Seven other /C_{MoA}≠C_{MoA}/ combinations are attempted by this child but are overwhelmingly submitted to syllable truncation patterns (see appendix H).

E. João

In chapter 5, two disyllabic [C_{MoA}≠C_{MoA}] patterns were considered acquired in João's data: [Stop…Lat], from 1;7 onwards, and [Stop…Nas], from 1;10. The targets [Stop…Nas] are produced accurately from the first attempts; all other patterns attempted by João are rendered in alternative output forms. A summary of those forms is provided in (276).

(276) Most frequent output patterns for targets /C_{MoA}≠C_{MoA}/ – João

	Target pattern	First attempt	Target-like Production	Alternative strategies			
				Output	Occur./targets		Period
(a)	/Stop…Lat/	1;2.13	1;7.0	**[Stop…Glide]**	**42/67**	**63%**	**1;7-1;11**
(b)	/Nas…Fric/	1;4.17	____	[Nas…Nas]	10/14	71%	1;4-1;10
(c)	/Lat…Nas/	1;4.17	____	[Nas…Nas]	12/13	92%	1;10.26
(d)	/Nas…Stop/	1;5.12	____	[Stop…Stop]	32/45	71%	1;5-2;0
(e)	/Fric…Stop/	1;8.25	____	[Stop…Stop]	37/42	88%	1;8-2;0
(f)	/Stop…Fric/	1;8.25	____	[Stop…Stop]	15/19	79%	1;8-1;11
(g)	/Stop…Rhot/	1;10.26	____	[Stop…Glide]	9/9	100%	1;10-2;0
(h)	/Fric…Nas/	1;11.29	____	[Stop…Nas]	3/5	60%	1;11-2;0

The predominant alternative output form in João's data is of the type [C_{MoA}=C_{MoA}]: [Nas…Nas] and [Stop…Stop]. Some non-harmonic alternative output forms appear, however, from 1;10 onwards ([Stop…Glide] and [Stop…Nas], see (g) and (h), in (276)).

[63] Only 87 attempts of /C_{MoA}≠C_{MoA}/ patterns, between 0;11 and 1;10 (see appendix G). These attempts correspond to only 11 target words (11 types, 87 tokens).
[64] There is one other combination that surfaces target-like: a /Stop…Nas/ target word is attempted 4 times at 1;10.15 and all the attempts are rendered accurately. However, this pattern was not considered to be in acquisition in chapter 5, since we do know if it is an isolated production (remember that 1;10 is the last session available in this child's *corpus*).
[65] For /Nas…Stop/, all accurate productions correspond to one single target-word (32 tokens, one type, between 1;8 and 1;10), for /Stop…Fric/, target-like productions correspond to only two targets words (20 tokens, 2 types) (see appendix H).

In summary, just as observed with the place feature patterns, there are two general types of alternative output forms: harmonic and non-harmonic. The latter forms tend to occur only from the moment the first [C_{MoA}≠C_{MoA}] has been acquired.

We will now turn to a more detailed analysis of the alternative output forms that occur in the [C_{MoA}=C_{MoA}] stage (section 6.5.3) and in the [C_{MoA}≠C_{MoA}] stage (section 6.5.4).

6.5.3 Alternative output forms in the [C_{MoA}=C_{MoA}] stage

The current section is dedicated to the analysis of the alternative output forms that occur in the period when no /C_{MoA}≠C_{MoA}/ target patterns are acquired yet: Inês and Clara until 1;7, João until 1;6; Joana until 2;1 and Luma until 2;0.

One main type of strategy occurs in this period: /C_{MoA}≠C_{MoA}/ targets are rendered in a [C_{MoA}=C_{MoA}] output format. As already observed for PoA patterns, most of the [C=C] output forms in this first period can be interpreted as reduplications. In these cases, children mostly pick up the target stressed syllable and reduplicate it. Some examples are provided in (277), where the affected target MoA is underlined.

(277) Examples of /C≠C/>>[C=C] patterns in the [C=C] stage

	Child	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	Inês	1;3;6	chapéu	hat	/ʃɐˈpɛw/	[pɛˈpæː]	/Fric…Stop/	[Stop…Stop]
(b)	Inês	1;4.9	carro	car	/ˈkaʀu/	[kaka]	/Stop…Rhot/	[Stop…Stop]
(c)	Inês	1;5.11	queijo	cheese	/ˈkɐjʒu/	[keˈkeː]	/Stop…Fric/	[Stop…Stop]
(d)	Inês	1;5.11	banho	bath	/ˈbɐɲu/	[bɐˈbɐ]	/Stop…Nas/	[Stop…Stop]
(e)	Inês	1;6.11	limpar	to clean	/lĩˈpaɾ/	[paˈpa]	/Lat…Stop/	[Stop…Stop]
(f)	Inês	1;7.2	colher	spoon	/kuˈʎɛɾ/	[keˈke]	/Stop…Lat/	[Stop…Stop]
(g)	Inês	1;7.2	roupa	clothes	/ˈʀopɐ/	[ˈbopɐ]	/Rhot…Stop/	[Stop…Stop]
(h)	Joana	1;9.25	Raquel	prop.noun	/ʀɐˈkɛɫ/	[kɛˈkɛ]	/Rhot…Stop/	[Stop…Stop]
(i)	Luma	1;11.1	Noddy	prop.noun	/ˈnɔdi/	[ˈnɐne]	/Nas…Stop/	[Nas…Nas]
(j)	Luma	2;0.13	polvo	octopus	/ˈpoɫvu/	[bobo]	/Stop…Fric/	[Stop…Stop]
(k)	Luma	2;1.10	Fimbo	prop.noun	/ˈfĩbu/	[biˈboː]	/Fric…Stop/	[Stop…Stop]
(l)	João	1;4-	maçã	apple	/mɐˈsɐ̃/	[mɐːˈmɐ	/Nas…Fric/	[Nas…Nas]
(m)	João	1;6.16	mota	motorcycle	/ˈmɔtɐ/	[taˈta]	/Nas…Stop/	[Stop…Stop]

The reduplication of the target stressed syllable is illustrated in (a), (b), (d), (e), (h), (j) in (277)). In some other cases, the reduplicated syllable is the unstressed one (examples in (l) and (m) in (277)). There are also some other patterns, where the reduplicated syllable keeps the target stressed vowel but replaces the consonants in onset (mostly liquids) by a stop (see example in (f) in (277)).

Lastly, there are some occurrences of /C≠C/->[C=C] that do not result in two identical syllables (examples (g), (i), (k) in (277)). Note that these cases occur at the later sessions within the [C_{MoA}=C_{MoA}] stage.

6.5.4 Alternative output forms in the [$C_{MoA} \neq C_{MoA}$] stage

This section focuses on the patterns that occur at the period when at least some /$C_{MoA} \neq C_{MoA}$/ target patterns are acquired: Inês and Clara from 1;8, Joana from 2;2, Luma from 2;1 and João from 1;7.

Similarly to what has been observed for PoA, the alternative strategies that occur at the [$C_{MoA} \neq C_{MoA}$] stage can be divided into three main categories: (i) the ones that affect patterns containing non-acquired MoA features, in any of the two word positions; (ii) the ones that target specific MoA, in specific word-positions; (iii) the ones that seem to result from combinatorial restrictions between the two MoA features of the word (see section 6.5.2)

Patterns affecting non-acquired features: substitutions

Particularly in the beginning of the [$C_{MoA} \neq C_{MoA}$] stage, children tend to attempt patterns containing MoA features that are still not acquired, in any of the positions in the word (C1 and C2). Those non-acquired consonants are submitted to substitutions. The consonant that is used to replace the problematic MoA tends to be a stop for target fricatives and liquids. However, there are also some cases where the substitute is a nasal (for laterals) or a glide (mostly for liquids, in C2). Some examples of these substitution patterns are given in (278).

(278) Examples of substitution patterns for non-acquired features in the [C≠C] stage

	Child	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	Inês	1;8.2	carro	car	/ˈkaʀu/	[ˈkaːdʲu]	/Stop…Rhot/	[Stop…Stop]
(b)	Inês	1;8.2	limpar	to clean	/lĩˈpaɾ/	[ɐgeˈpa]	/Lat…Stop/	[Stop…Stop]
(c)	Inês	2;1.10	café	coffee	/kɐˈfɛ/	[kɐˈpe]	/Stop…Fric/	[Stop…Stop]
(d)	Inês	2;1.10	fala	talk	/ˈfalɐ/	[ˈtalɐ]	/Fric…Lat/	[Stop…Lat]
(e)	Joana	2;4.1	leite	milk	/ˈlɐjtɨ/	[ˈgɛtʰɨ]	/Lat…Stop/	[Stop…Stop]
(f)	Joana	2;4.1	mala	bag	/malɐ/	[ˈmawɐ]	/Nas…Lat/	[Nas…Glide]
(g)	Joana	3;2.13	cara	face	/ˈkaɾɐ/	[ˈkajɐ]	/Stop…Rhot/	[Stop…Glide]
(h)	Joana	3;0.26	renas	reindeer	/ˈʀenɐʃ/	[ˈgenɐz]	/Rhot…Nas/	[Stop…Nas]
(i)	Luma	2;1.10	Fimbo	prop.noun	/ˈfibu/	[biˈboː]	/Fric…Stop/	[Stop…Stop]
(j)	Luma	2;3.26	lobo	wolf	/ˈlobu/	[ˈbobu]	/Lat…Stop/	[Stop…Stop]
(k)	Luma	2;4.11	linda	beautiful	/ˈlĩdɐ/	[ˈnĩdɐː]	/Lat…Stop/	[Nas…Stop]
(l)	Luma	2;4.11	colo	lap	/ˈkɔlu/	[aˈkoɴũ]	/Stop…Lat/	[Stop…Nas]
(m)	Clara	1;9.23	bola	ball	/ˈbɔlɐ/	[ˈbɔbɐ]	/Stop…Lat/	[Stop…Stop]
(n)	João	1;8.25	peixe	fish	/ˈpɐjʃɨ/	[ˈpetʲi]	/Stop…Fric/	[Stop…Stop]
(o)	João	1;11.1	fino	thin	/ˈfinu/	[ˈtinu]	/Fric…Nas/	[Stop…Nas]
(p)	João	1,10.2	pêra	pear	/ˈpeɾɐ/	[ˈpɛjɐ]	/Stop…Rhot/	[Stop…Glide]

Note that the substitution patterns may result either in a [Stop…Stop] or in a [$C_{MoA} \neq C_{MoA}$] output form, depending on the composition of the target pattern: if the adult form already contains a stop, the insertion of another stop to replace a problematic consonant renders a harmonic form for manner (see, for instance, examples from (a) to (c) in (278)).

The replacement of liquids by glides occurs mostly in C2 position (examples in (f), (g), (p) in (278)), while liquids in C1 are almost exclusively replaced by stops (see, instance, the examples in (i) and (h) in (278)). The cases where a sonorant is replaced by another sonorant in C1 position occur mostly in Luma's data, where laterals can be substituted by a nasal, in both positions (see examples in (k) and (l) in (278)).

Patterns affecting MoA features in specific word positions

Alternative strategies may affect some consonantal classes in a given position, while in the other position of the word that same class is already being produced accurately. Most often, these positional asymmetries affect liquids, particularly laterals, since they are amongst the first MoA to appear in C2 in [C_{MoA}≠C_{MoA}] patterns, but are amongst the last to appear in C1. Note that, as shown in chapter 5 (section 5.6.2), these positional asymmetries affect laterals in <u>C</u>VCV sequences but not in <u>C</u>V or <u>C</u>VV structures: /lĩˈpaɾ/->[paˈpaj] (*to clean*) but /ˈluɐ/->[ˈluɐ] (*moon*); Inês (1;10.29) (see chapter 5, for further details).

Positional asymmetries can also affect other MoA beside laterals in some children's *corpora*: fricatives in Inês and nasals in João. We will explore these patterns separately.

A. Alternative strategies affecting words with laterals in C1

Inês starts producing laterals in C2, in the combination [Stop…Lat], at the age of 1;9, but words with laterals in C1 are systematically submitted to alternative strategies, as illustrated in (279).

(279) Alternative strategies affecting target /$C_{Lateral}$≠C/ sequences - Inês

		Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
Lat C2	(a)	1;9.19	bolos	cakes	/ˈboluʃ/	[ˈboluʃ]	/Stop…<u>Lat</u>/	[Stop…Lat]
	(b)	1;10.29	colher	spoon	/kuˈʎɛɾ/	[ˈkeli]	/Stop…<u>Lat</u>/	[Stop…Lat]
Lat C1	(c)	1;10.29	limpar	to clean	/lĩˈpaɾ/	[paˈpaj]	/<u>Lat</u>…Stop/	[Stop…Stop]
	(d)	2;0.11	lobo	wolf	/ˈlobu/	[ˈbolu]	/<u>Lat</u>…Stop/	metathesis
	(e)	1;10-2;0	lenço	scarf	/ˈlẽsu/	[ˈditu]	/<u>Lat</u>…Fric/	[Stop…Stop]

As shown in examples (a) and (b) in (279), laterals are produced in a target-like fashion in C2 from 1;9 onwards (although there is still some instability in the contrast [± anterior], see (b) in (279)). However, in the same time frame, word-initial laterals either surface as stops (examples (c) and (e) in (279)) or become submitted to metathesis (example (d) in (279)).[66] Note that different target combinations of MoA containing Lateral in C1, /Lat…Stop/ and /Lat…Fric/, are affected by alternative strategies, thus the particular MoA sequence does not seem to play a role in the process: C1 laterals are problematic at this stage, independently of the MoA combination they occur in.

Similarly to what was observed in Inês' data, there are also positional asymmetries in the way Joana copes with laterals. Note that from 2;10 onwards, C2 laterals in [Stop…Lat] and [Nas…Lat] combinations are produced accurately, but, contrastively, C1 laterals are systematically affected by alternative strategies until the last session analyzed (see table in (271)). This asymmetry is illustrated in (280).

(280) Alternative strategies affecting /$C_{Lateral}$≠C/ sequences - Joana

		Age	Orthogr	Gloss	Target	Output	Target MoA	Output MoA
Lat C2	(a)	2;10.8	calor	heat	/kɐˈloɾ/	[kɐˈʎo]	/Stop…Lat/	[Stop…Lat]
	(b)	3;3.23	mala	bag	/ˈmalɐ/	[ˈmalɐ]	/Nas…Lat/	[Nas…Lat]
Lat C1	(c)	2;10.8	língua	tongue	/ˈlĩgwɐ/	[ˈgẽguɐ]	/Lat…Stop/	[Stop…Stop]
	(d)	3;6.20	limões	lemons	/liˈmõj̃ʃ/	[diˈmõĩːʃ]	/Lat…Nas/	[Stop…Nas]
	(e)	2;6-2;8	lobo	wolf	/ˈlobu/	[ˈwobu]	/Lat…Stop/	[Glide…Stop]
	(f)	2;6.24	laço	lace	/ˈlasu/	[ˈɲasu̥]	/Lat…Fric/	[Nas…Fric]
	(g)	3;0.2	liso	smooth	/ˈlizu/	[ˈdiʒu]	/Lat…Fric/	[Stop…Fric]

The examples provided in (a) and (b) in (280) show that laterals are produced in a target-like fashion from (2;10),[67] in word-medial position. However, in the time-span between 2;10 and 3;11, word-initial laterals are either replaced by stops (examples (c), (d) and (g) in (280) or, less often, by a glide or a nasal (examples (e) and (f) in (280)). Note that different combinations containing Lateral in C1 are affected by alternative strategies, showing that the problematic issue is Lateral appearing in word-initial position and not the MoA combination where C1 lateral is inserted.

As for Luma, she starts producing C2 laterals at the age of 2;5 (see examples (a) and (b), in (281) below), but word-initial laterals are replaced by nasals in the same time frame (see examples (c) and (d) in (281)).

(281) Alternative strategies affecting /$C_{Lateral}$≠C/ sequences - Luma

		Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
Lat C2	(a)	2;5.15	bola	ball	/ˈbɔlɐ/	[ˈbɔlɐ]	/Stop…Lat/	[Stop…Lat]
	(b)	2;6.20	cola	glue	/ˈkɔlɐ/	[ˈkɔʎɐ]	/Stop…Lat/	[Stop…Lat]
Lat C1	(c)	2;5.15	liga	(you) call	/ˈligɐ/	[ˈnigɐ]	/Lat…Stop/	[Nas…stop]
	(d)	2;5-2;6	leva	carries	/ˈlɛvɐ/	[ˈnɛvɐ]	/Lat…Fric/	[Nas…Fric]

[66] Note that, although most of the examples provided above for [Lat…Stop] are also [Cor…Lab], the alternative strategies seem not to be caused by PoA, since [Cor…Lab] targets are acquired by Inês at the age of 1;10.

[67] Though there is still instability in the PoA contrast [±anterior], evident in example (a).

In João's data, laterals start being produced accurately in intervocalic position at the age of 1;7[68] (see examples (a) and (b) below), but C1 laterals are replaced by a stop or a nasal, in the same period (examples (c) and (d)).

(282) Alternative strategies affecting /$C_{Lateral}$≠C/ sequences – João

		Age	Ortho	Gloss	Target	Output	Target MoA	Output MoA
Lat C2	(a)	1;7.20	bola	ball	/ˈbɔlɐ/	[ˈbɔjlɐː]	/Stop…Lat/	[Stop…Lat]
	(b)	1;9.25	bolo	cake	/ˈbolu/	[ˈbolu]	/Stop…Lat/	[Stop…Lat]
Lat C1	(c)	1;10.11	limpar	to clean	/lĩˈpaɾ/	[tɨˈtaː]	/Lat…Stop/	[Stop…stop]
	(d)	1;10.26	limão	lemon	/liˈmɐ̃w̃/	[miˈmɐ̃w̃]	/Lat…Nas/	[Nas…Nas]

B. ALTERNATIVE STRATEGIES AFFECTING FRICATIVES IN C1 – INÊS

Inês starts producing [C_{MoA}≠C_{MoA}] words containing fricatives in C2 at the age of 2;4, as exemplified in (a) and (b) below. However, in the period 2;4-2;5, the target words attempted containing fricatives in word-initial position are submitted to substitution patterns, where the fricative is replaced by a stop (see examples (c) and (d), below).

(283) Alternative strategies affecting /$C_{Fricative}$≠C/ sequences - Inês

		Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
Fric C2	(a)	2;4.18	café	coffee	/kɐˈfɛ/	[kɐˈfɛ]	/Stop…Fric/	[Stop…Fric]
	(b)	2;5.24	garfo	fork	/ˈgaɾfu/	[ˈgafu]	/Stop…Fric/	[Stop…Fric]
Fric C1	(c)	2;4.18	falta	lacks	/ˈfaɫtɐ/	[ˈpatɐ]	/Fric…Stop/	[Stop…Stop]
	(d)	2;5.24	senhor	man	/sɨˈɲoɾ/	[tiˈno]	/Fric…Nas/	[Stop…Nas]

The target combinations - /Fric…Stop/ and /Fric…Nas/ - affected in Inês' data, show that C1 fricatives are problematic for this child, independently of the MoA of the consonant in C2.

C. ALTERNATIVE STRATEGIES AFFECTING NASALS IN C1 – JOÃO

At 1;10, João starts producing C2 nasals in [C≠C] sequences (examples in (a) and (b), in (284), below). However, at the same age, word-initial nasals in [C≠C] sequences are replaced by stops, as illustrated in (c) and (d).

(284) Alternative strategies affecting /C_{Nasal}≠C/ sequences – João

		Age	Ortho	Gloss	Target	Output	Target MoA	Output MoA
Nas C2	(a)	1;10.26	perna	leg	/ˈpɛɾnɐ/	[ˈpɛmɐ]	/Stop…Nas/	[Stop…Nas]
	(b)	1;11.10	ténis	tennis	/ˈtɛniʃ/	[ˈtɛni]	/Stop…Nas/	[Stop…Nas]
Nas C1	(c)	1;10.26	mota	motorcycle	/ˈmɔtɐ/	[ˈpɔtɐ]	/Nas…Stop/	[Stop…Stop]
	(d)	1;10.26	Noddy	prop.noun	/ˈnɔdi/	[ˈdɔdi]	/Nas…Stop/	[Stop…Stop]
	(e)	1;10.26	maçã	apple	/mɐˈsɐ̃/	[tɐˈtɐ̃]	/Nas…Fric/	[Stop…Stop]

[68] Although accurate productions still coexist with substitutions by glides until 1;11.

Patterns affecting specific /C_{MoA}≠C_{MoA}/ combinations

Similarly to what has been described for the combination /Dor…Lab/ in Luma's data (see section 6.4.4), there are also some alternative strategies affecting MoA sequences that appear to be caused by combinatorial restrictions. The affected target patterns are mostly combinations of sonorants (nasals with liquids) or combinations of fricatives and sonorants, which are also amongst the last to be attempted and acquired (see section 6.5.1). These patterns are observed in the data of Inês, Joana and Luma, as will be shown below.

A. Inês

Inês acquires non-harmonic sequences with C1 laterals at 2;1 and with C2 fricatives at 2;4 (see examples in (285) below, in (a) and (b)). We would expect, then, the combinations /Lat…Fric/ to be produced accurately already at 2;4. However, this combination is submitted to substitutions at this age, as illustrated in (c).

(285) Combinatorial asymmetries: /Lat…Fric/ – Inês

	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	2;1.10	lobo	wolf	/ˈlobu/	[ˈlobu]	/<u>Lat</u>…Stop/	[Lat…Stop]
(b)	2;4.18	garfo	fork	/ˈgaɾfu/	[ˈgafu]	/Stop…<u>Fric</u>/	[Stop…Fric]
(c)	2;4.18	tira	take (it)	/ˈlɛvɐ/	[ˈlɛb]	/Lat…Fric/	[Lat…Stop]

As shown in appendix G, the percentage of accurate productions for targets /Lat…Stop/ is around or above 80% from 2;1 onwards. As for /Stop…Fric/, it is produced in a target-like fashion around 67% at 2;5. On the contrary, /Lat…Fric/ is systematically submitted to alternative strategies in the same time period (there are 10 attempts between 2;1 and 2;5, but none is produced accurately).

A similar pattern is observed in the way Inês copes with targets /Nas…Rhot/: at 1;8 she has acquired /C≠C/ combinations with nasals in word-initial position (example in (55), (a), below); at 1;10, she acquires C2 rhotics in the /Stop…Rhot/ pattern (example (b)), but, at 2;0, the target pattern /Nas…Rhot/ is still submitted to alternative strategies, in this case, deletion (example (c)).

(286) Combinatorial asymmetries: /Nas…Rhot/ – Inês

	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	1;8.2	manta	blanket	/ˈmɐ̃tɐ/	[ˈmatɐ]	/<u>Nas</u>…Stop/	[Nas…Stop]
(b)	1;10.20	tira	take (it)	/ˈtiɾɐ/	[ˈtiɾɐ]	/Stop…<u>Rhot</u>/	[Stop…Rhot]
(c)	2;0.11	nariz	nose	/nɐˈɾiʃ/	[ˈdiʃː]	/Nas…Rhot/	Deletion

As shown in appendix G, /Nas…Stop/ is accurately produced in 100% of the cases from 1;8 onwards in Inês' data. As for /Stop..Rhot/ it is produced in a target-like fashion in 71% of the cases at 1;10. The pattern /Nas…Rhot/, on the contrary, is infrequently attempted and no accurate production is observed in this period (there are 10 attempts, between 1;7 and 2;11, all rendered in alternative ways).

B. Joana

At the age of 2;10, Joana is already producing [C≠C] sequences with C1 fricatives and C2 laterals in [Fric…Stop] and [Stop…Lat] combinations (examples in (a) and (b), below). However, the target combination /Fric…Lat/ is submitted to alternative strategies (mostly substitution of the lateral by a glide) until the last session analyzed, at 4;0 (example (c) in (287)).

(287) Combinatorial asymmetries: /Fric…Lat/ – Joana

	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	2;2.19	saco	bag	/ˈsaku/	[ˈʃaku]	/Fric…Stop/	[Fric…Stop]
(b)	2;10.8	colo	lap	/ˈkɔlu/	[ˈkɔlu]	/Stop…Lat/	[Stop…Lat]
(c)	2;6-4;0	velas	candles	/ˈvɛlɐʃ/	[ˈvɛwɐʃ]	/Fric…Lat/	[Fric…Glide]

At 2;10, Joana produces [Fric…Stop] in a target-like fashion in 100% of the cases and [Stop…Lat] in 23% of the attempts. The target pattern /Fric…Lat/, however is never produced accurately in the same time-frame: all 9 attempts between 2,2 and 2;10 are submitted to alternative strategies (see appendix G).

A similar pattern was observed for targets /Nas…Lat/. At the age of 2;10, Joana is already producing non-harmonic sequences with C1 nasal ([Nas…Stop]) and sequences with C2 lateral ([Stop…Lat]) (examples in (288) (a) and (b)), but does not combine both (/Nas…Lat/) until the age of 3;3. Between 2;4 and 3;2, /Nas…Lat/ is rendered as [Nas…Glide] (example in (c), below).

(288) Combinatorial asymmetries: /Nas…Lat/ – Joana

	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	2;2.19	Necas	prop.noun	/ˈnɛkɐʃ/	[ˈnɛkɐs]	/Nas…Stop/	[Nas…Stop]
(b)	2;10.8	colo	lap	/ˈkɔlu/	[ˈkɔlu]	/Stop…Lat/	[Stop…Lat]
(c)	2;4-3;2	mola	spring	/ˈmɔlɐ/	[ˈmɔwɐ]	/Nas…Lat/	[Nas…Glide]

Another combinatorial restriction was observed in Joana's data: at the age of 3;3, this child has already acquired combinations with Nas in C1 ([Nas…Fric]) and combinations with Rhot in C2 [Fric…Rhot]) (examples in (289) (a) and (b)), but, at that same age, /Nas…Rhot/ targets are submitted to deletion (example (c)).

(289) Combinatorial asymmetries: /Nas…Rhot/ – Joana

	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	2;6.24	neve	snow	/ˈnɛvɨ/	[ˈnɛv]	/Nas…Fric/	[Nas…Fric]
(b)	3;3.23	fora	out	/ˈfɔɾɐ/	[ˈfɔɾɐ]	/Fric…Rhot/	[Fric…Rhot]
(c)	3;3.23	nariz	nose	/nɐˈɾiʃ/	[nɐˈiʃ]	/Nas…Rhot/	Deletion

There are only 8 attempts of /Nas…Rhot/ in Joana's data, between 2;2 and 3;6, all submitted to alternative strategies (see appendix G).

C. Luma

At 2;5.15, Luma produces accurate combinations with C1 fricatives ([Fric…Stop]) and combinations with C2 laterals ([Stop…Lat]) examples in (290) (a) and (b) below). However, at this same age, the target sequence /Fric…Lat/ is rendered in a substitution pattern, where the lateral is replaced by a nasal (example (c), in (290)).

(290) Combinatorial asymmetries: /Fric…Lat/ – Luma

	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	2;3.26	santo	saint	/ˈsɐ̃tu/	[ˈsʲɐ̃tu]	/Fric…Stop/	[Fric…Stop]
(b)	2;5.15	bola	ball	/ˈbɔlɐ/	[ˈbɔlɐ]	/Stop…Lat/	[Stop…Lat]
(c)	2;5.15	vela	candle	/ˈvɛlɐ/	[ˈvɛnɐ]	/Fric…Lat/	[Fric…Nas]

As shown in appendix G, Luma produces [Fric…Stop/ patterns in a target-like fashion in above 80% of the attempts from 2;3 onwards; as for /Stop…Lat/, it is produced accurately in 50% of the cases at 2;5. In this same session, however, /Fric…Lat/ is attempted twice, but rendered in alternative ways.

Another combination is problematic for Luma: at the age of 2;4.11, this child is already able to produce combinations with C1 nasals ([Nas…Stop]) in 64% of the cases and combinations with C2 fricatives ([Stop…Fric]) above 80% of the attempts but the three attempts of /Nas…Fric/ at that same age are rendered in a substitution pattern, where the nasal is replaced by a stop. These patterns are illustrated below.

(291) Combinatorial asymmetries: /Nas…Fric/ – Luma

	Age	Orthogr.	Gloss	Target	Output	Target MoA	Output MoA
(a)	2;4.11	nada	nothing	/ˈnadɐ/	[ˈnadɐ]	/Nas…Stop/	[Nas…Stop]
(b)	2;4.11	casa	house	/ˈkazɐ/	[kaʒɐ]	/Stop…Fric/	[Stop…Fric]
(c)	2;4.25	mocho	owl	/ˈmoʃu/	[ˈboʒuː]	/Nas…Fric/	[Stop…Fric]

In sum, target /C≠C/ sequences containing combinations of sonorants with fricatives (/Fric…Lat/, /Lat…Fric/, /Nas…Fric/) are problematic for three of the children studied (Inês, Joana, Luma); the combination of nasals with other sonorants also poses some problems: /Nas…Rhot/ (in Inês and Joana's data) and /Nas…Lat/ (in Joana's *corpus*).

6.6 Summary

The alternative strategies for /C_{PoA}≠C_{PoA}/ targets observed in the data of the five children obey to some general trends, summarized below.

As far as intake patterns are concerned, the following trends were observed:

(a) The earliest and more frequently attempted patterns are /Lab…Cor/ and /Dor…Cor/, which are also the first to be acquired, by most children.
(b) The latest and less frequently attempted patterns are /Cor…Dor/, /Lab…Dor/ and /Dor…Lab/, which tend to be the last combinations acquired.
(c) Except for Inês, children tend to avoid non-homorganic targets in the [C_{PoA}=C_{PoA}] stage. A sudden increase in the intake is observed, though, when the first [C_{PoA}≠C_{PoA}] production is acquired.
(d) Clara is a prime example of a selector; she tries to produce only three non-homorganic patterns, but renders them accurately at the first attempts.

Regarding the alternative output strategies that affect targets /C≠C/ in the [C_{PoA}=C_{PoA}] stage, it was shown that reduplication is the most frequent strategy. The output forms tend to be of the type [$C_iV_jC_iV_j$]; the reduplicated syllable is most frequently the target stressed one. There are also some cases of [C=C] outputs where the two syllables are no longer identical – [$C_iV_jC_iV_k$], particularly at later sessions.

As for the alternative output strategies that occur in the [C_{PoA}≠C_{PoA}] stage, three main types were observed:

(a) Strategies affecting non-acquired PoA features in both word-positions – mostly substitutions, where the targets tend to be dorsals (in João's data) or labial fricatives (mostly in Inês and João's data). The inserted PoA is most often Coronal.
(b) Strategies affecting non-acquired PoA features in a particular word-positions – mostly /C≠C/->[C≠C] patterns and metathesis - the most frequently affected feature is Labial, in C2 position.
(c) Strategies affecting specific PoA combinations. Both combinatorial and positional restrictions were observed in Luma's data, regarding the target combination /Dor…Lab/. The child has acquired [Dor…Cor] and [Cor…Lab] but /Dor…Lab/ targets are rendered as [Lab…Lab].

The alternative strategies for /C_{MoA}≠C_{MoA}/ targets observed in the data of the five children obey to some general trends, summarized below.

As far as intake patterns are concerned, the following trends were observed:

(a) The earliest and more frequently attempted patterns tend to be combinations of obstruents, combinations of stops and nasals and combinations of C1 stops with C2 liquids (/Stop…Lat/; /Stop…Rhot/). These combinations are also the first to be acquired in production, by most children.

(b) The later and less frequently attempted patterns tend to be combinations within sonorants (between nasals and liquids; between laterals and rhotics) and combinations of fricatives and sonorants. These patterns tend to be acquired later by all children.

(c) The number and variety of non-harmonic patterns attempted increases from the moment children enter the [$C_{MoA} \neq C_{MoA}$] stage.

Regarding the alternative strategies that affect targets /$C_{MoA} \neq C_{MoA}$/ in the [$C_{MoA} = C_{MoA}$] stage, reduplication is the most frequent strategy. The output forms tend to be of the type [$C_iV_jC_iV_j$]; the reduplicated syllable is most frequently the target stressed one. There are also some cases of [C=C] outputs where the two syllables are no longer identical – [$C_iV_jC_iV_k$], at later sessions.

As for the alternative output strategies that occur in the [$C_{MoA} \neq C_{MoA}$] stage, three main types were observed:

(a) Affecting non-acquired MoA in both word-positions, mostly substitutions of fricatives and liquids. The inserted MoA is most often a Stop. However, there are some cases of substitution of liquids by another sonorant (nasal or glide), particularly in C2 position.

(b) Affecting non-acquired MoA in a particular word-positions; the most frequently affected class is Lateral, in C1 position. The strategies used to cope with this positional asymmetry can be insertion of stop in C1 (substitution) or metathesis (occurs only in Inês' data). Other sounds are also affected: fricatives in C1 (Inês); nasals in C1 (João).

(c) Affecting specific MoA combinations; combinatorial restrictions were observed concerning two main types of [$C_{MoA} \neq C_{MoA}$] patterns: (i) combinations of nasals with other sonorants and (ii) combinations of fricatives and sonorants.

6.7 Discussion

Two main research questions underlie the current chapter: (i) what strategies Portuguese children recur to when coping with /C≠C/ targets; and (ii) what can those strategies tell us about children's lexical representations. In subsections A and B, we will discuss the main findings regarding the question given in (i). Based on those findings, we will present, in subsection C, a discussion on the nature of children's representations, throughout development (in [C=C] and [C≠C] stages).

One important aspect worth emphasizing here is that most of the alternative output forms observed for targets /C≠C/ do not result from combinatorial restrictions: they can result from several independent factors namely the late acquisition of some features in specific word positions (see sections A and B). However, there are, in fact, some alternative strategies that seem to be motivated by combinatorial restrictions (see section B).

A. THE [C=C] STAGE: LEXICAL SELECTION AND [C≠C]->[C=C] patterns

In sections 6.4 and 6.5, we observed that, in the period when no /C≠C/ pattern has yet been acquired, children either avoid non-harmonic targets or render the few patterns attempted in harmonic output forms (/C≠C/->[C=C]). We will discuss those three strategies in the following subsections.

(I) SELECTION STRATEGY

Children tend to avoid non-harmonic sequences in the [C=C] stage, particularly the ones that combine marked PoA or MoA. One of the children (Clara) is the prime example of lexical selection, as far as PoA is concerned: she attempts only three /C_{PoA}≠C_{PoA}/ patterns until the last session studied (at 1;10) and the three patterns are produced accurately at the first attempts. Clara does not attempt any other disyllabic /C_{PoA}≠C_{PoA}/ structure; it seems that this child selects only what she can produce, and avoids the patterns that are still problematic in her system.

The lexical selection strategy has often been reported in the literature on early development (Ferguson and Farwell, 1975; Kiparsky & Menn (1977); Stoel-Gammon & Cooper, 1984), as mentioned in section 6.1.5. The early predominance of [C=C] patterns in intake forms has been noticed, for instance, in Macken (1979); Levelt (1994) and Stoel-Gammon (2002). This strategy has often been viewed as a way of guaranteeing faithfulness: children select target words that comply with their early phonological ability.

According to Fikkert & Levelt (2008), the increase in children's intake forms (in size and variability) leads to the growth of the number of productions that deviate from the target structure. Portuguese children show a similar pattern: it is when the number of different /C≠C/ patterns increases in the intake (i.e. when the first non-harmonic patterns are acquired and children enter the [C≠C] stage) that the number and type of alternative strategies increases (see subsection B).

Still regarding the intake, within PoA patterns, the earliest and more frequently attempted sequences are /Lab…Cor/ and /Dor…Cor/ (see section 6.4.1). As for manner features, the sequences that are attempted earlier and more often tend to be combinations of stops and nasals, stops and fricatives or combinations of C1 stops with C2 liquids (see section 6.5.1). Both the PoA and the MoA sequences referred to above tend to be amongst the first [C≠C] patterns acquired in production. As already mentioned, this fact shows that children tend to attempt the forms they can already handle (see chapter 3, for similar findings). As for the non-harmonic patterns that are avoided in the first sessions, they tend to be combinations of marked features: Lab and Dor for place and Nas and Liq or Fric and Sonor, for manner.

Distribution of [C≠C] sequences: intake and adult speech

As mentioned in sections 6.4 and 6.5, the patterns that are attempted and acquired early tend also to be amongst the most frequently produced in the sample of EP adult speech (see section 6.3). As far as place feature patterns are concerned, [Lab…Cor] and [Dor…Cor] are the two most frequently produced in the adult sample: 36% and 23%, respectively (see table (244), section 6.3). As for manner features, the combinations of stops and nasals, stops and fricatives and C1 stops and C2 liquids are also the most often produced: [Nas…Stop] 23%; [Stop…Fric] 21%; [Stop…Nas] 15%; [Stop…Lat] 8% (see table (245), section 6.3).

In sum, the most frequent place and manner [C≠C] combinations in adult speech tend to be attempted and acquired early by the children studied. It thus seems that distributional properties of the input may be playing a role in the acquisition of [C≠C] sequences. Fikkert & Levelt (2008) report similar results in the acquisition of PoA in Dutch; according to these authors, [Lab…Cor] words are highly frequent in the input language and are also selected quite often by Dutch learners. Then, based on their intake patterns, children generalize that Labial has to be associated to word-initial position (see 6.1.2). Fikkert, Levelt & Van de Weijer (2002) further suggest that different distributions in input languages can lead to cross-linguistic differences in the type of constraints that emerge in the beginning of the [C≠C] stage: due to the lack of evidence for word-initial dorsals, Dutch children would generalize two types of constraints: [Lab and *[Dor, while English children would have both [Lab and [Dor (see section 6.1.2). In this line of though, then, EP data resembles English, since Portuguese children can produce [C≠C] sequences with both C1 Labial and C1 Dorsal.

It thus seems that, from the moment the first [C≠C] patterns are acquired, the relation between children's distributional patterns (intake and production) and the distribution in the input language is quite close. However, the nature of this relation is still not clear and needs to be further investigated (see section 6.8).

(II) THE /C≠C/->[C=C] PATTERNS

Within the [C=C] stage, two types of harmonic forms can be produced, for non-harmonic targets: [$C_iV_jC_iV_j$], which are interpreted as reduplications and [$C_iV_jC_iV_k$], which could be classified as CH-Like forms. We will explore both types of output forms separately.

Reduplication

Most of the /C≠C/->[C=C] patterns observed in the first sessions can be interpreted as reduplications, since they correspond to output [$C_iV_jC_iV_j$] sequences. The reduplicated syllable tends to be the target stressed syllable; in this respect, Portuguese children's data resemble acquisition patterns reported in other languages (Waterson, 1971; Ingram, 1979; Lléo, 1996).

As mentioned in section 6.1.1, some authors have suggested that reduplication can be viewed as a way for children to match the expected length of the word and, at the same time, comply with the requirement of PoA identity within the word (Lléo, 1996). Other studies argue that reduplications constitute a way of coping with multisyllabic target forms, whether motivated by the preference for such forms (Fee & Ingram, 1982) or by the avoidance of its complexity (Schwartz et al., 1980; see review in Klein, 2005). The discussion of these approaches would involve analyzing children's productions for targets words with different lengths (monosyllables, disyllables and polysyllables). This analysis is, however, beyond the scope of the current investigation. The findings that are relevant for the current discussion are that reduplication forms occur mostly at the [C=C] stage and that the produced syllable tends to be the target stressed one. The importance of the target stressed syllable for young learners is also evident in the patterns that will be discussed next.

CH-like patterns – /C≠C/->[$C_iV_jC_iV_k$]

Particularly at the later sessions within the [C≠C] stage, children produce some harmonic forms for targets /C≠C/ that could be interpreted as the outcome of an assimilation process between the two consonants of the word. In these cases, the [C=C] output forms present two different vowels and are not interpreted as reduplications. These cases involve more often place features. Some examples of these patterns are repeated in (292).

(292) Examples of non-reduplicated /C≠C/->[C=C] patterns in the [C_{PoA}=C_{PoA}] stage

	Child	Age	Orthogr.	Gloss	Target	Output	Target PoA	Output PoA
(a)	Inês	1;4.9	porta	door	/ˈpɔɾtɐ/	[pu̯ˈpɐː]	/Lab…Cor/	[Lab…Lab]
(b)	João	1;6.16	bola	ball	/ˈbɔlɐ/	[ˈbɐwɐ]	/Lab…Cor/	[Lab…Lab]
(c)	Luma	2;2.4	Pati	prop.noun	/paˈti/	[ˈtati]	/Lab…Cor/	[Cor…Cor]
(d)	Luma	2;2.22	bola	ball	/ˈbɔlɐ/	[poˈpɐ]	/Lab…Cor/	[Lab…Lab]
(e)	Luma	2;2.22	gato	cat	/ˈgatu/	[ˈtatu]	/Dor…Cor/	[Cor…Cor]

In the patterns illustrated above, it seems that (i) coronal consonants surface as labial in the presence of another labial consonant in the word (see examples in (a), (b), (d) in (292)) and (ii) labial or dorsal consonants become coronal in the presence of another coronal consonant in the word (see examples (c) and (e) in (292), respectively).

These cases could, at first sight, be classified as instances of consonant harmony. However, contrary to the most typical cases of CH reported in the literature (Smith, 1973; Pater & Werle, 2003, among others), there would be no fixed directionality in the process of assimilation: it can occur from left-to-right (in /Lab…Cor/->[Cor…Cor] and /Dor…Cor/->[Cor…Cor] patterns) or from right-to-left (in /Lab…Cor/->[Cor…Cor], see example (c) in (292)). Note also that the same target combination (/Lab…Cor/) can be rendered either as [Lab…Lab] or as [Cor…Cor], by the same child (Luma). To sum up, there is no clear pattern of assimilation in the hypothetical cases of CH mentioned above.

The CH-like forms mentioned above occur in a period where children are using the target stressed syllable as their main anchor of specification (stressed syllables tend to be reduplicated). If we look at the stressed syllable of the target words listed in (292), we can see that all of them (except for the word *gato*) display the same PoA as the one produced: the words *<u>po</u>rta*, *<u>bo</u>la*, which contain a labial consonant and a round (labial) vowel in the stressed syllable, are rendered as [Lab…Lab]; the word *pa<u>ti</u>*, which contains a coronal consonant and a front (coronal) vowel[69] in the target stressed syllable, is rendered as [Cor…Cor]. It thus seems that, in this initial stage, children are selecting the PoA of the stressed syllable (either from the vowel or from the consonant in onset) and assigning it to the whole word. This hypothesis would account for the fact that Luma produces *<u>bo</u>la* as [Lab…Lab] and *pa<u>ti</u>* as [Cor…Cor] and fits the hypotheses put forward at the end of chapter 4, about the initial holistic nature of children's lexical representations in the [C=C] stage.

Note, however, that Luma's production of the word *gato* (rendered as [Cor…Cor], see (292) (e) above) could not be accounted by the proposal outlined here, since the PoA produced (Coronal) is not part of the target stressed syllable. Note that, in

[69] See chapter 4, for a unified PoA classification of consonants and vowels.

chapter 3, we observed that Luma does not acquire the voiced dorsal stop until the last session studied, at 2;6. Even the voiceless dorsal [k] is only acquired at 2;3, when the child is already at the [C≠C] stage. It thus seems that the pattern /ˈgatu/->[ˈtatu] results from a substitution of the non-acquired dorsal stop by the default PoA coronal. It might be the case then, that when facing a target word where the onset in the stressed syllable is non-acquired and cannot provide the PoA specification, a default coronal is inserted.

Based on the alternative output forms observed in the [C=C] stage, the following general observations can be made: children pick up the target stressed syllable of the target words and (i) produce it, and reduplicate it in order to fit a multisyllabic pattern; (ii) pick the PoA specification of the stressed syllable (from the vowel or from the consonant) and assign it to the whole word. When the target stressed syllable is not able to provide a place specification (because the consonant in onset is not acquired yet), a default coronal is inserted.

B. THE [C≠C] STAGE: SEGMENTAL SUBSTITUTIONS AND METATHESIS

There are three main categories of alternative output forms in the [C≠C] stage: (i) resulting from substitutions of non-acquired PoA or MoA (in both positions); (ii) resulting from substitutions (or metathesis) of particular features, in specific word positions; (iii) resulting from substitutions (or metathesis) of features in specific [C≠C] combinations. Those categories will be discussed separately.

(I) SUBSTITUTIONS AFFECTING NON-ACQUIRED CONSONANTS IN BOTH WORD-POSITIONS

In the beginning of the [C≠C] stage, some combinations are not rendered accurately not because of the sequence itself but because they contain a PoA or MoA that are still not acquired. Those sounds are most often dorsals (particularly in João's data), fricatives and liquids, which are submitted to substitutions. Non-acquired PoA features are predominantly replaced by coronals, while non-acquired MoA are replaced by stops. This finding suggests that Coronal and Stop are the default place and manner features in these children's systems.

One interesting pattern was found regarding the production of labial fricatives, particularly in the data of Inês and João (see section 6.4.4); even though these two children had already acquired labial stops or nasals, they systematically replaced labial fricatives by coronals: /ˈveɾdɨ/->[ˈdedi] (Inês, 2;0); /ˈvakɐ/->[ˈtata](João, 1;10). The problem underlying these substitutions is the fact that fricatives are not acquired yet. However, since labial stops are already available in these children's systems, we would expect the substitution of labial fricatives by labial stops and not by coronals. This type of non-minimal alternative, where the changing of a problematic feature (or feature value) causes changes in features that are not problematic has been reported in the literature (Bernhardt & Stemberger, 1998; see chapter 3).

The influence of MoA on the substitution patterns for problematic PoA features has been reported in Dunphy (2006), on the basis of Dutch acquisition data. Similarly to the Portuguese children studied here, some of the Dutch learners also replaced labial fricatives by coronals (/ˈvoχəl/->[ˈtoχɔ], Jarmo, 2;0 in Dunphy, 2006) even though they had already acquired labial stops.

Another interesting substitution pattern observed concerns the substitution of liquids, per position; we observed that, while C1 liquids are most often replaced by stops (except of the pattern /l/->[n] in Luma's data), C2 liquids can be replaced by stops or by other sonorants, namely nasals and glides. It thus seems that there are word-position effects in the substitution patterns that affect liquids (see also chapter 3). The fact that sonorant substitutes appear most often in C2 position corroborated findings reported in other studies, where a strong affinity between sonorants and intervocalic position has been observed (Bernhardt & Stemberger, 1998; Stemberger & Bernhardt, 2001).

It thus seems that, as far as sonorants are concerned, C2 differs from C1. The intervocalic position seems to promote an earlier acquisition of sonorants in this position (see chapter 5) as well as a closer relation, in terms of sonority, between replaced and replacing consonants, in substitution patterns. However, the nature of C2 needs to be further explored, based on data on the development of liquids in coda position, thus being a topic for future research.

Overall, the alternative output forms described above do not tell us much about word-combinations: the substitution patterns described above are targeting features that are simply not acquired, independently of the word-combination they appear in.

(II) SUBSTITUTION AND METATHESIS AFFECTING FEATURES IN SPECIFIC WORD POSITIONS

Place feature patterns

The most frequent positional asymmetry found in [C_{PoA}≠C_{PoA}] patterns is the one that involves target /C≠C/ words with C2 labials, such as /Cor…<u>Lab</u>/ or /Dor…<u>Lab</u>/. It is particularly frequent in the data of Inês, Luma and João. It occurs in the beginning of the [C≠C] stage, when [Lab…Cor] patterns are already acquired, but patterns with labial in C2 (most frequently /Cor…Lab/) are submitted to alternative strategies. Two types of alternative strategies affect /Cor…Lab/ patterns: metathesis or /Cor…Lab/->[Lab…Lab].

Metathesis occurs mostly in the data of Inês. The most common alternative strategy across the three children is /Cor…Lab/->[Lab…Lab]. We will explore this pattern in further detail.

The /Cor….Lab/->[Lab…Lab] pattern

The /Cor…Lab/->[Lab…Lab] is a frequently observed pattern, cross-linguistically. It has been reported, among others, in French (Rose, 2000; Dos Santos, 2007); in English (Pater & Werle, 2003; Rose, 2000), and in Dutch (Levelt, 1994; Fikkert & Levelt, 2008; Levelt, to appear). Within these languages, several approaches have been proposed to account for the /Cor…Lab/>>[Lab…Lab] pattern. We will now discuss the adequacy of these proposals to account for this pattern in EP.

THE AGREE APPROACH

Assuming the approach proposed in Pater & Werle (2001, 2003), the three Portuguese children would produce /Cor…Lab/ targets as [Lab…Lab] due to a high-ranked constraint that would require the coronal consonant to assimilate to the labial consonant, in order do avoid non-homorganic sequences. However, this approach is not able to account for the metathesis patterns that affect the /Cor…Lab/ targets, during the same time period, in the data of Inês (see examples in (265)). This apparent labial harmony pattern cannot be the result of a pressure in the grammar for agreement between consonants; if that were the case, metathesis would not take place.

THE FOOT LICENSING APPROACH

According to Rose (2000), /Cor…Lab/->[Lab…Lab] patterns in French can be accounted for as the result of a high ranked licensing constraint that requires the coronal consonant to be licensed by the Head of the Foot, i.e., by the stressed syllable. This account is able to explain /Cor...Lab/->[Lab…Lab] patterns in iambic forms, which are the exclusive forms found in French.

However, in EP, we find /Cor…Lab/->[Lab…Lab] patterns affecting both trochees and iambs, as illustrated below.

(293) Examples of /Cor…Lab/->[Lab…Lab] patterns in EP acquisition data

		Child	Age	Orthogr.	Gloss	Target	Output	Production patterns	
Labial C2	(a)	Inês	1;8.2	chapéu	hat	/ʃɐˈpɛw/	[peˈbɛw]	/Cor…<u>Lab</u>/ >>	[Lab…Lab]
	(b)	Inês	1;9.19	roupa	clothes	/ˈʀopɐ/	[ˈbopɐ]	/Dor…<u>Lab</u>/ >>	[Lab…Lab]
	(c)	João	1;10.26	toma	take (it)	/ˈtɔmɐ/	[ˈpɔmɐ]	/Cor…<u>Lab</u>/ >>	[Lab…Lab]
	(d)	João	1;10.26	limão	lemon	/liˈmɐ̃w̃/	[miˈmɐ̃w̃]	/Cor…<u>Lab</u>/ >>	[Lab…Lab]
	(e)	Luma	2;4.11	toma	take (it)	/ˈtɔmɐ/	[ˈpɔmɐ]	/Cor…<u>Lab</u>/ >>	[Lab…Lab]
	(f)	Luma	2;4.25	nove	nine	/ˈnɔvɨ/	[ˈvov]	/Cor…<u>Lab</u>/ >>	[Lab…Lab]
	(g)	Luma	2;5.15	sofá	sofa	/suˈfa/	[fuˈfa]	/Cor…Lab/ >>	[Lab…Lab]
	(h)	Luma	2;5.15	chover	to rain	/ʃuˈveɾ/	[fuˈve]	/Cor…Lab/ >>	[Lab…Lab]

Trochees are more frequent, but this is most probably due to the high frequency of trochaic forms in the input.

To account for the patterns in trochees, like /ˈnɔvɨ/->[ˈvov], where the coronal consonant is at the stressed position and the labial at the unstressed, we would have to assume a Licensing constraint that requires labial to surface in the stressed syllable. On the contrary, in order to account for the pattern in iambs, like /suˈfa/->[fuˈfa], where the labial is at the stressed syllable and the coronal at the unstressed one, another Licensing constraint would have to be assumed, requiring coronal to surface at the stressed syllable. Thus, the same pattern /Cor…Lab/->[Lab…Lab] would require two markedness constraints, depending on the word shape - trochaic or iambic - the child is attempting.

THE ALIGNMENT APPROACH

The /Cor…Lab/->[Lab…Lab] pattern observed in EP is best captured by a constraint that requires the feature Labial to be assigned to the leftmost position within the word. Similar accounts have been proposed by Dos Santos (2007) for French and by Levelt (1994) and Fikkert & Levelt (2008) and Levelt (to appear) for Dutch. According to the latter authors, the constraint [Labial emerges in the child grammar at a given stage in the development of PoA feature representations, after the first non-homorganic productions appear in children's speech. These first non-homorganic productions are of the type [Lab…Cor]. In the intake, the first combinations are /Lab…Cor/, and are frequently attempted. The child overgeneralizes and assumes that all [C≠C] sequences with labial must have it in C1. At this time, any adult sequence that contains labial in C2 is rendered as [Lab…Lab].

In EP, the analysis of the intake showed that here too /Lab…Cor/ is not only amongst the first [C≠C] patterns attempted, but it is also the most frequently selected. Combinations with Labial in C2 are much less frequent, particularly in the first sessions. So, Portuguese children could also be overgeneralizing that Labial must be in C1. Further evidence for an alignment constraint that requires Labial to appear in C1 comes from the metathesis patterns that occur in Inês' data: /Cor…Lab/->[Lab…Cor]. In fact, it seems that Inês is also generalizing that dorsal must be assigned to C1: /Dor…Cor/ is also frequent in the intake; this generalization could account for the metathesis /Cor…Dor/->[Dor…Cor] that appears at the same period.

Manner feature patterns

The most common manner patterns affected by positional asymmetries across children are the ones that contain Lateral in C1 position, most often /Lat…Stop/

sequences. Most children acquire target /C≠C/ words with C2 laterals - mostly /Stop…Lat/ - early, while word-initial laterals in non-harmonic sequences are acquired later. The most frequent alternative strategy used is the substitution of the problematic feature in C1 by a stop: /Lat…Stop/->[Stop…Stop]. Is this pattern similar to the /Cor…Lab/->[Lab...Lab] patterns discussed above? Could we assume that children are dealing here with alignment constraints that required lateral to be aligned with C2? If that were the case, we would expect a pattern such as /Lat…Stop/->[Lat…Lat], where children would align Lateral with C2. But these patterns are not common in Portuguese children's productions. Children insert a default manner (stop) in C1, instead of the lateral. A default insertion, however, would not account for the /Cor…Lab/->[Lab…Lab] pattern, because if that would be the case, then the result would be /Cor…Lab/->[Cor…Cor].

It thus seems that children deal in different ways with positional asymmetries concerning place and those concerning manner feature specification; keeping the analysis within a constraint based approach, we could hypothesize that children are dealing with a high ranked alignment constraint on Lateral in C1 position. This alignment restriction, added to a low ranking of constraints against the insertion of default stops, would result in the /Lat…Stop/->[Stop…Stop] patterns observed in children's output forms.

(III) PATTERNS AFFECTING SPECIFIC FEATURE COMBINATIONS

As shown in sections 6.4.4 and 6.5.4, children tend to produce target combinations of marked place or manner features in alternative ways; those combinations include Labial and Dorsal, for PoA and Sonorant and Fricative, for manner. For instance, children may have already acquired /Fric….Stop/ and /Stop…Lat/, thus both fricatives and laterals are acquired in [C≠C] sequences, while at the same time a combination of both MoA, i.e. /Fric…Lat/, is rendered in an alternative way (see section 6.5.4). In these cases, the most common alternative strategy is substitution of one the consonants, mostly by a stop, or, in the case of sonorants in C2, by a glide or a nasal.

Note that the combinations of both labials and dorsals, on the one hand, and sonorants and fricatives on the other, tend also to be infrequent in the EP adult speech sample (see section 6.3). It appears that these combinations are marked both in the input language and in children's systems: they are attempted later and less often, and they are submitted to alternative strategies even though the individual features are already acquired.

This group of alternative strategies, affecting specific combinations, shows that the development of place and manner features at the [C≠C] stage is not completely independent of the unit word. The place or manner specification of one of the consonants in the word can influence the order of acquisition of [C≠C] sequences: if there is a coronal or a stop in the sequence, it tends to be acquired earlier than the combinations that include only marked features.

C. THE DEVELOPMENT OF CHILDREN'S LEXICAL AND OUTPUT REPRESENTATIONS: EVIDENCE FROM ALTERNATIVE STRATEGIES

In the [C=C] stage, two main strategies are used: lexical selection and reduplication of stressed syllables. Children tend to stay close to the feature make-up of the target stressed syllable.

In the [C≠C] stage, the alternative productions display a *more segmental nature*; they target specific place or manner features, either (i) because they are not acquired at all; (ii) because they are not acquired in a given word-position or (iii) because of combinatorial restrictions on marked features in [C≠C] sequences.

The strategies used in both stages corroborate the hypotheses put forward at the end of chapters 4 and 5:

- In the [C=C] stage, children's lexical representations are unsegmentalized. Initially the unit for specification is the whole word, only later there are separate C-slots. Children extract the feature specification of the consonant - or vowel, in the first sessions - of the target stressed syllable and assign it to a word-sized unit. The importance of the target stressed syllable is evident in the reduplication patterns that occur in this stage (see sections 6.4.1 and 6.5.1). This approach is also able to account for the /C≠C/->[C=C] cases that do not result in reduplications and could be interpreted as CH-like forms (see section B, above).
- In the [C≠C] stage, children's lexical representations become more detailed: C-slots become specifiable units (see chapter 5). The substitutions that affect specific MoA, such as /Fric…Nas/->[Stop…Nas], reflect this segmentalization: only the problematic consonant is affected and not the whole word. However, it seems that word-patterns are still playing a role: the positional and combinatorial asymmetries described show that the development of features can be influenced by the specific word-position and by the feature specification of the other consonant in the word. In summary, although lexical representations have become more detailed and adult-like, children's output representations still have to comply with specific types of positional and combinatorial restrictions.

6.8 Final remarks

In this chapter, it was shown that the alternative strategies children recur to when coping with target /C≠C/ place and manner feature combinations vary according to the developmental stage.

In the [C=C] production stage, children avoid non-harmonic patterns and render the few targets attempted in [C=C] forms. In the vast majority of cases, the harmonic forms produced are reduplications of the target stressed syllable. These alternative productions provide additional support for the hypothesis put forward in chapter 4, that children would be dealing with unsegmentalized representations at an early age and that they would be using the target stressed syllable as their main anchor of specification.

In the [C≠C] production stage, the number of attempts at non-harmonic forms increases and three main categories of alternative strategies appear: (i) substitutions of features that are not acquired in any position; (ii) substitutions or metathesis affecting specific features in specific positions in [C≠C] sequences and (iii) substitutions affecting combinations of marked features. These deviant output forms support the findings presented in chapter 5, where it was shown that the development of [C≠C] sequences is influenced by word-position and by C1-C2 interrelationships.

Another interesting finding presented in this chapter is that the order and frequency of selection of /C≠C/ words in children's vocabularies resembles the distribution of those sequences in a sample of EP adult speech. Similarly to what has been reported for the development of PoA in Dutch by Fikkert & Levelt (2008), we hypothesized that children may be overgeneralizing over their own lexicon and that alignment constraints such as align Labial with C1 would emerge from those generalizations. Being this the case then and assuming the possibility of the number of words stored in children's mental lexicon being much bigger than the set of words produced, another question arises: why would children generalize over a subset of the words in their lexicon? It might be the case that, if generalizations occur, they are constrained in some way in order to comply with children's phonological abilities. This issue needs to be further investigated, namely based on a larger set of data regarding adult speech, more specifically child directed speech. This way, a more reliable relation could be established between input and child data. In addition, the results observed in this chapter should be complemented with data on the development of monosyllables and polysyllables, as well as data on the development of consonants in coda position.

Chapter 7 - Conclusion

As referred to in chapter 1, two main goals underlie the current dissertation: (i) to provide information on the patterns of acquisition of the consonantal system in EP and (ii) to contribute to the discussion on the nature of Portuguese children's lexical and output representations. In order to achieve these goals, four main studies were carried out in this investigation: we analyzed the general order of acquisition of the consonantal inventory (chapter 3); we studied the relation between segmental development and the word (chapters 4 and 5) and we focused on the substitute forms children produce when attempting problematic target words (chapter 6).

The studies conducted in this dissertation were based on spontaneous longitudinal data of five children acquiring European Portuguese (EP) as their first language, between 0;11 and 4;10, approximately. Throughout the dissertation, acquisition patterns were compared with distributional data of EP adult language, on the basis of a sample of adult speech extracted from the corpus *Português Falado* (Instituto Camões/CLUL), in order to verify if the distribution of features in adult language could be related to the order of acquisition. Two software programs were used in the data analysis: *Phon* (Rose et al. 2006), for compilation of the data and queries related to acquisition data, and *FreP* (Frota, Vigário & Martins 2006), for the extraction of frequency information in the adult speech sample (see chapter 2).

In the following subsections (from I to V), we present a summary of the main findings and conclusions from chapters 3, 4, 5 and 6. The final remarks and the questions for future research are outlined in section VI.

I. General development of the consonantal system in EP

In *chapter 3*, we analyzed the order in which the five Portuguese children acquired the consonantal inventory of their language, focusing on place and manner features in non-branching onset position. In general terms, the data showed that Labial and Coronal [+ant] features tend to be acquired before Coronal [-ant] and Dorsal; as for manner, stops and nasals are the first to be acquired, followed by fricatives and, lastly, by liquids. Summarizing, Portuguese children tend to acquire place features from front to back (anterior >>non-anterior); as for manner, they prefer nasals and stops before any other consonantal class. These trends corroborate the results observed in the literature (Jakobson, 1941/68; Vihman, 1992; Lléo et al., 1996, Bernhardt & Stemberger, 1998, Lamprecht et al. 2004).

Also in chapter 3, it was shown that, besides being acquired early, coronal [+ant] and stops are also frequently used to replace consonants that are not part of children's early inventories. Based on these findings, we hypothesized that coronal [+ant] stops are unmarked in the five children's systems. These findings support, in part, the analysis proposed by Mateus & d' Andrade (2000) for the target language, who suggest that coronal [+ant] consonants are unmarked in the phonological system. Note that although the authors focus only on the PoA feature Coronal as the unmarked feature in the target system, acquisition data has shown that coronal [+ant] is only unmarked in the system if it is combined with the MoA features [-sonorant, -continuant]. In other words, only coronal stops are unmarked in the children's systems.

Another interesting finding regarding substitution patterns was that not all early-acquired features are equally prone to be used as substitutes. In fact, nasals and labials tend to be acquired early - in some cases, before coronal stops - but they are not frequently used as defaults. It thus seems that the early acquisition of a given feature does not necessarily imply a default status in children's systems, at least as far as substitution patterns are concerned.

Still in chapter 3, it was shown that word-position plays an important role in substitution patterns. For instance, intervocalic trills are more prone to surface as sonorants than C1 trills, which tend to be replaced by stops. Based on this finding, we hypothesized that the differences in the substitution patterns that affect the flap and the trill (the flap is more often replaced by sonorants than the trill) result from the distribution of these two rhotics in the word: an onset flap can only occur in intervocalic position (C2), while the trill can occur both in C2 and in word-initial position. From this perspective, the substitution patterns affecting the two rhotics can be explained based on word-position and not necessarily on sonority differences, as proposed by Miranda (1996; 2007) for BP. This issue needs to be further explored (see section VI).

II. The development of Portuguese children's early words

One of the main issues explored in this dissertation was the feature composition of children's early words, both in production and in the attempted forms. The main results of this analysis are summarized below.

- **Relation between the intake and the distributional properties of adult speech**

In chapter 3, we compared the feature composition of children's intake forms with the distribution of features in a sample of EP adult speech. It was shown that in the first sessions (i) there is a high degree of variation in the number of times a given feature is attempted by a child, from one recording to the next; (ii) in general, the frequency of selection differs substantially from the distribution of features in adult speech. For instance, children tend to select labials more often than coronals, although Coronal is the most frequently produced place feature in adult speech. As for manner, young learners select nasals and stops more often than any other feature, although fricatives outrank nasals in the adult speech sample studied.

As referred to in chapter 3, early intake patterns (between the ages of 0;11 and 1;8, approximately) are very idiosyncratic and the set of words attempted is, of course, very limited at this age. Similarities between children's data and distributional patterns in adult speech tend not to be found in these early attempted words. A similar discrepancy was reported in Dos Santos, (2007), for French and in Levelt & van Oostendorp (2007) and Fikkert & Levelt (2008), for Dutch.

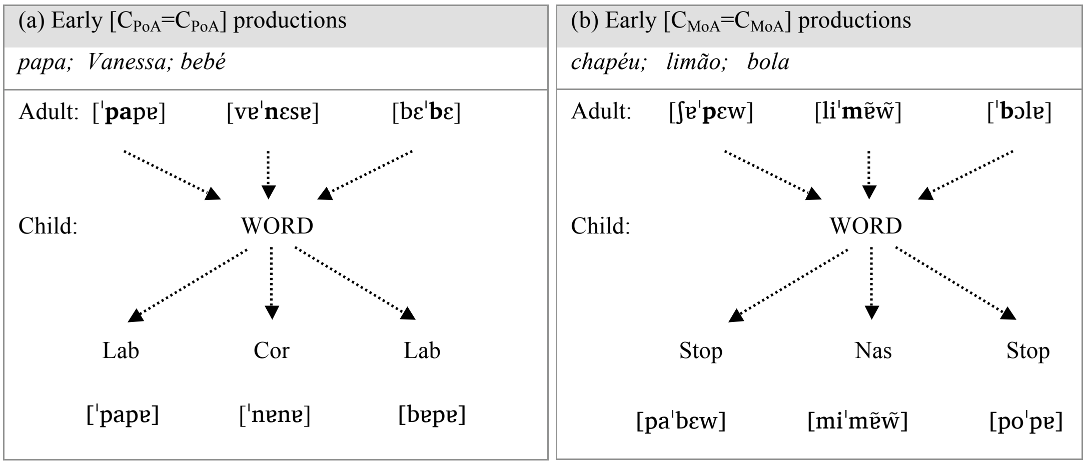
The idiosyncrasy of early words was attested not only in the intake patterns but also in the output forms, as summarized below.

- **An initial [C=C] output stage**

In chapter 4, it was shown that the five EP children studied in this project go through an initial harmonic output stage, affecting both place and manner features. In this respect, EP developmental patterns resemble the findings reported in the acquisition of other languages, namely English (Stoel-Gammon, 2002); Dutch (Levelt, 1994; Langeslag, 2007; Fikkert & Levelt, 2008), Spanish (Macken, 1979); German and French (Altvater-Mackensen, dos Santos & Fikkert, 2008; Altvater-Mackensen & Fikkert (2009).

Throughout the [C=C] output stage, the place or manner specification of the consonants produced in the harmonic forms frequently coincides with the PoA or MoA of the consonant in the onset of the target stressed syllable, independently of word-position. Examples are words like /ˈb̲ɔlɐ/ produced as [poˈpɐ], /ʃɐˈp̲ɛw/ as [paˈbɛw] or /liˈm̲ɐ̃w̃/ as [miˈmɐ̃w̃]. We hypothesized that children select the place or manner specification of the consonant in the target stressed syllable and assign it to the unit word, similarly to what is proposed by Levelt (1994), Fikkert & Levelt (2008) and Levelt (to appear) for Dutch. This procedure is illustrated in (294).

(294) Place and manner feature specification at the word level – early stages



As shown in chapter 4, whenever the consonant in the target stressed syllable had not been mastered yet a default insertion took place, resulting in [Cor…Cor] or [Stop…Stop] output forms. These patterns provide further support for the hypothesis that Coronal ([+ant]) and Stop are unmarked in these children's systems, appearing by default to replace non-acquired sounds.

As for vowels in these early words, they tend to be low or central; [$C_iV_iC_iV_i$] forms, where vowels and consonants share PoA specification, are not as common in EP as in Dutch acquisition data. In chapter 4, we hypothesized that this difference could result from the fact that vowels are less salient to EP learners than to Dutch children, because of the reduction processes that affect vowels in EP (see chapter 4).

III. The development of [C≠C] output forms: positional and combinatorial effects

The data of the five Portuguese children showed that non-harmonic combinations of place and manner features ([C≠C]) are not available from the onset of speech production and are acquired gradually. As far as [C_{PoA}≠C_{PoA}] patterns are concerned, it was shown that two combinations are amongst the first to be acquired: [Lab…Cor] and [Dor…Cor]. As for the development of [C_{MoA}≠C_{MoA}] patterns, we observed that, in general, the first sequences acquired contain a stop in one of the word-positions, while the patterns acquired later tend to be combinations within sonorants or combinations of fricatives with sonorants.

In chapter 5, it was shown that PoA and MoA features in [C≠C] patterns tend to be acquired first in one specific position and only later in the other. For instance, Labial and Dorsal are first acquired in C1 and only later in C2; liquids, on the contrary, are first acquired in C2 and only later in C1. This gradual acquisition results in positional asymmetries in children's productions, for instance, they produce [Lab…Cor] accurately but not [Cor…Lab] or [Dor…Lab].

Another important finding presented in chapter 5 was that a given feature in a particular position could be systematically replaced in [C≠C] forms while it could at the same time be accurately produced in [C=C] or CV/CVV forms. For instance, it was shown that, at the same time a child omitted C1 laterals in [Lat…Stop] combinations (*wolf* /ˈlobu/->[ˈobu] Luma, 2;6) she was already producing accurate CV forms with word-initial laterals (*lake* /ˈlagu/->[ˈlaː] Luma, 2;4). This finding suggests that non-harmonic sequences play a role in the acquisition of features per position: a given feature may be acquired in word-initial position but only if it is not part of a [C≠C] sequence. Thus, as claimed by Langeslag (2007), the study of the acquisition of features must focus both on the development per position and on the interactions that take place between word-positions. Additional evidence for this interaction can be found in the fact that children avoid combinations of marked features, such as [Lab...Dor] and [Fric…Lat]. This delay in attempting and acquiring marked combinations can also be related to the distribution of these combinations in EP adult speech, as shown below.

- **Relation between the acquisition of [C≠C] forms and adult speech**

In chapter 5, we compared the order of acquisition of [C≠C] patterns with the distribution of those forms in a sample of EP adult speech. A strong correlation was found between both sets of data: (i) the two first acquired PoA combinations, [Lab…Cor] and [Dor…Cor], are also the two most frequently produced combinations in the sample of EP adult speech; (ii) the most frequently produced [C_{MoA}≠C_{MoA}] forms in adult speech, [Nas….Stop], [Stop….Nas], [Stop…Fric], [Stop…Lat], are amongst the first to be acquired. On the contrary, infrequent patterns in adult speech, such as [Fric…Liq] or [Liq…Fric] tend to be acquired late. In summary, marked combinations in adult speech tend to be marked also in children's speech.

Thus, the hypothesis put forward by Fikkert, Levelt & Van de Weijer (2002), that the order of acquisition of [C≠C] patterns can be related to the distribution of features in the input languages, seems to find further support in the EP acquisition data. The distributional properties of the input could also account for the fact that [C≠C] combinations with word-initial dorsals are less problematic for EP children than for Dutch learners (see chapter 4).

IV. The development of alternative output forms

In chapter 6, it was shown that the alternative forms children produce vary according to the developmental stage.

In the early [C=C] stage, children avoid non-harmonic patterns and render the few targets attempted as [C=C] forms. In the vast majority of cases, the harmonic forms produced are reduplications of the target stressed syllable. These output forms provide additional support for the hypothesis put forward in chapter 4, that children are dealing with a WORD representation at an early age and that they use the target stressed syllable as their main anchor for feature specification.

In the [C≠C] stage, the number of attempts at non-harmonic forms increases and three main categories of alternative productions appear: (i) substitutions of features that are not acquired in any position; (ii) substitutions or metathesis affecting specific features in specific positions in [C≠C] sequences and (iii) substitutions affecting combinations of marked features. These repairs support the findings presented in chapter 5, where it was shown that the development of [C≠C] sequences is influenced by word-position and by C1-C2 interrelationships.

V. Children's lexical and output representations throughout development

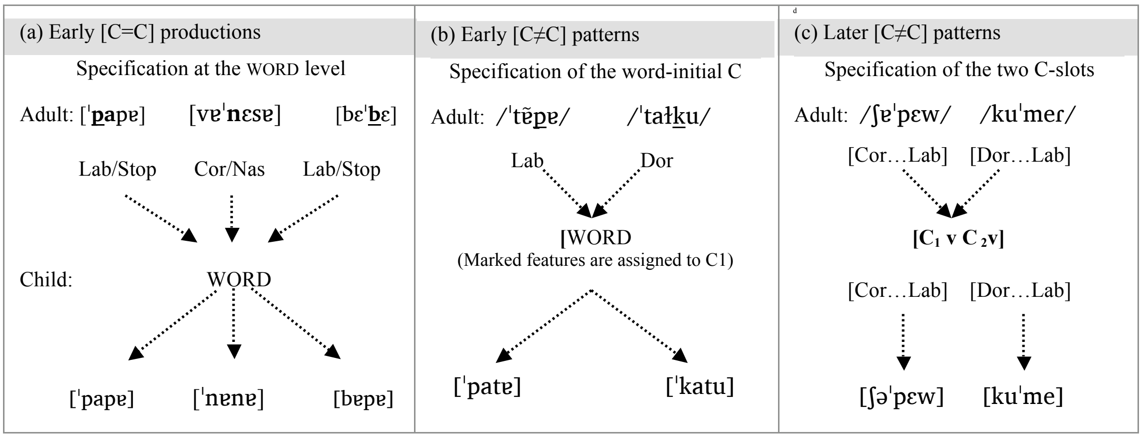
The findings presented in the current dissertation provide insight into the development of children's lexical and output representations; those insights are summarized below.

The [C=C] output stage explored in chapter 4 leads us to hypothesize that EP children go through an initial stage where one single feature (PoA and MoA) is assigned to the word, resulting in [C=C] forms. During this period, children do not distinguish between word positions in their lexical representations, since those representations are unsegmentalized (see (294), above).

A few months later, when [C≠C] patterns start being acquired, it becomes clear that children's representations have become more detailed. In chapter 5, we hypothesized that children start the process of acquisition of [C≠C] forms by assigning feature specification to C1 only, and leave C2 unspecified, resulting in combinations such as [Lab…Cor] and [Dor…Cor], where C2 is filled with the default PoA Coronal. At this stage, C2 is still not available as a separately specifiable unit in the children's lexical representations. Levelt (1994) and Langeslag (2007) have proposed a similar approach to the development of place and manner features in Dutch. At a later development stage, combinations with marked features in C2 start being acquired. At this point, C2 appears to be already available for feature assignment.

In (295) we illustrate the children's lexical representations at the three developmental stages outlined above: (295.a) represents the WORD stage, (295.b) illustrates the specification of C1 ([WORD) and (295.c) represents the stage where both consonants in the word can be independently specified (C_1vC_2v) .

(295) Gradual development of children's lexical representations



Overall, we found evidence that supports the following developments in children's lexical representations: WORD >> [word >> CVCV. However, the intermediate stage ([WORD) does not occur for MoA patterns, in the data of two children. This difference may result from individual variation or from an overlap of two developmental periods. Alternatively, it might result from different representations for place and for manner specification. This issue needs to be further investigated on the basis of more data, namely on the development of polysyllabic forms.

To summarize, based on the acquisition patterns observed, our proposal is that young learners' lexical representations are child-specific and unsegmentalized to a high degree in the early stages. Segmentalization takes place in a gradual fashion: vowels first, then the word-initial consonant and, finally all the c-slots in the word (see representations in (295)). In this respect, EP data supports the proposals for the acquisition of Dutch presented in Fikkert & Levelt (2008), for PoA and by Langeslag (2007) for MoA. Under this perspective, the early alternative output forms studied do not derive from processes that shape output forms, but are the natural outcome of developing representations (Fikkert, 2007; Levelt, to appear).

Another important finding presented in this dissertation is that, when the segments in the lexical representations are already separately specifiable (see representation in (c), in (295)), children's output forms are constrained by both positional and combinatorial restrictions: some features are acquired first in one position (C1 or C2) and only later in the other and some combinations of features are more problematic than others (see chapters 5 and 6). At this stage, children's underlying representations are more adult-like, but the output forms still have to comply with certain regularities, resulting in deviant productions.

VI. Final remarks and topics for future research

The current investigation has contributed to filling the gap in the knowledge of how EP children acquire the segmental system of their language. In general, EP acquisition patterns are similar to the ones observed in other languages. Some differences, however, were found; for instance, similarly to English but contrary to Dutch (Fikkert, Levelt & Van de Weijer, 2002), EP children do not show constraints on word-initial dorsals in [C≠C] sequences; also contrary to Dutch, EP learners show a clear preference for low or central vowels in early output forms. These differences can result from characteristics of the target language, namely the distribution of feature patterns, like the fact that [Dor…Cor] patterns appear to be relatively frequent in adult speech, and the lower saliency of vowels in the input, due to processes to which these segments are submitted in EP.

One of the crucial findings of this investigation is the fact that the unit of specification of place and manner features is, at the beginning of meaningful speech, larger than the segment. This initial suprassegmental specification underlies the five children's productions until at least the age of 2;1, resulting in [C=C] or [C≠C_{Cor}] output forms. The nature of the unit WORD needs, however, to be further investigated, since, in a very early stage, that unit could be equaled to a syllable, which is reduplicated (/buˈnɛkɐ/ -> [ɲɛˈɲɛ]) and to higher prosodic domains.

Throughout this dissertation, it was shown that the process of segmental acquisition is influenced by several variables, namely the unit of specification, the word-position, the interaction between features within the word and the distributional properties of the input. Still, other variables need to be investigated, namely syllable constituency (onset *vs* coda; branching onset vs non-branching), stress position and word-extension (development in monosyllables *vs* disyllables *vs* polisyllables).

The relation between acquisition data and the properties of EP adult speech also needs to be further studied, on the basis of a larger sample of data. In addition, information is needed on EP Child Directed Speech. Ideally, the analysis of the acquisition data of a given child should be complemented with speech data of the adults that surround him/her. Based on this type of data, the inferences about the relation between both systems would be more consistent and reliable.

Given the importance of acquisition data not only to linguistic theory but also to language teaching and clinical phonology, the study of how children acquire the phonology of their language should have an important place in linguistic studies. However, up until now this has not been the case for EP, as far as segmental acquisition is concerned. One of the main goals of this dissertation was to contribute to filling the gap in the knowledge of how EP children acquire the consonantal system of their language. This goal has been attained, since detailed information has been provided on the acquisition patterns of five typically developing Portuguese children. Specifically, the knowledge of the patterns that characterize the acquisition of place and manner features in words – the fact that the initial unit for feature specification appears to be the word, that development depends on the word-position in later developmental stages, and that feature co-occurrence restrictions play a role - constitutes crucial information for other linguistic-related fields, like education and speech therapy. As far as education is concerned, the knowledge of how the consonantal system is acquired in EP can play a key role, for instance, in the construction of teaching exercises, particularly for non-native children acquiring EP as a second language. In the clinical field, several studies on children who present deviant phonological acquisition patterns have shown that information on typical segmental acquisition is crucial as a basis for the construction of diagnosis and therapeutic instruments (in PB, see, for instance, Mota, 1996; Késke-Soares, 2001; Lazzarotto, 2005; Duarte, 2006; Lazzarotto-Volcão, 2009).

As usual in scientific studies, some of the questions that have arisen throughout this dissertation remain unanswered; hopefully, those questions will constitute the basis for future research and will allow for a more in-depth knowledge on the way Portuguese children acquire the phonological system of their native language.

References

Allen, G., & Hawkins, S. (1978). The development of phonological rhythm. In A. Bell, & J. B. Hooper (Eds.), *Syllables and segments*. Amsterdam: North-Holland.

Altvater-Mackensen, N., & Fikkert, P. (2009). Comparing the acquisition of segmental contrast in Dutch and German. Talk given at the workshop *Complexity, Typology and Acquisition*. May 27-28, Lyon, France.

Altvater-Mackensen, N., Dos Santos, C., & Fikkert, P. (2008). A cross-linguistic perspective on the role of prosodic structure in the acquisition of manner of articulation features. Talk given at the *16th Manchester Phonology Meeting*. May 22-24, Manchester, UK.

d'Andrade, E. (1994). *Temas de Fonologia*. Lisboa: Colibri.

d'Andrade, E., & Kihm, A. (1987). Fonologia auto-segmental e nasais em Português. *Actas do III Encontro da Associação Portuguesa de Linguística*. Lisboa: APL.

Andrade, E., & Rodrigues, C. (1999). Das escolas e das culturas: história de uma sequência consonântica. *Actas do XIV Encontro da Associação Portuguesa de Linguística 1*, pp. 117-133. APL/Colibri.

Archangeli, D. (1984). *Underspecification in Yawelmani phonology and morphology*. Doctoral dissertation: MIT. New York: Garland Press.

Archibald, J. (1995). *Phonological Acquisition and Phonological Theory*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Bacelar do Nascimento, M.F., Pereira, L. A. S., & Saramago, J. (2000). Portuguese Corpora at CLUL. In *Second International Conference on Language Resources and Evaluation Proceedings*, Volume II. Athens.

Battistella, E. (1996). *The Logic of Markedness*. USA: Oxford University Press.

Beers, M. (1995). *The phonology of normally developing and language impaired children.* Doctoral Dissertation. IFOTT, University of Amsterdam, the Netherlands.

Beers, M. (1996). Acquisition of Dutch phonological contrasts within the framework of feature geometry theory. In B. Bernhardt, J. Gilbert, & D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press.

Bernhardt, B. (1990). *Application of nonlinear phonological theory to intervention with six phonologically disordered children*. Unpublished PhD thesis, University of British Columbia.

Bernhardt, B. (1992). Developmental implications of nonlinear phonological theory. *Clinical Linguistics & Phonetics*, *6*, pp. 259-281.

Bernhardt, B., & Stemberger, J. (1998). *Handbook of phonological development from the* *perspective of constraint-based nonlinear phonology*. San Diego: Academic Press.

Bernhardt, B., & Stemberger, J. (2002). Intervocalic consonants in the speech of children with phonological disorders. *Clinical Linguistics and Phonetics 16(3),* pp. 199-214.

Bernhardt, B., & Stoel-Gammon, C. (1994). Nonlinear phonology: introduction and clinical application. *Journal of Speech and Hearing Research, 37*, pp. 123-143.

Blodgett, E., & Miller, V. (1989). *Easy Does It For Phonology*. *A complete program to remediate phonological disorders in young children*. USA: Linguisystem.

Boersma, P., & Levelt, C. (2004). Optimality Theory and Phonological Acquisition. *Annual Review of Language Acquisition 3*, pp. 1-50.

Bonet, E., & Mascaró, J. (1996). On the representation of contrasting rhotics. Unpublished ms. Universidade Autónoma de Barcelona.

Bonet, E., & Mascaró, J. (1997). On the representation of contrasting rhotics. In F. Martínez Gil, & A. Morales Front (Eds.) *Issues in the Phonology and Morphology of the Major Iberian Languages*. Washington, DC: GUP.

Bonillha, G. (2005). *Aquisição Fonológica de Português Brasileiro: uma abordagem conexionista da teoria da otimidade*. Tese de doutoramento. Pontifícia Universidade Católica do Rio Grande do Sul. Porto Alegre.

Boysson-Bardies, B., Vihman, M., Roug-Hellichius, L., Durand, C., Landberg, I., & Arao, F. (1992). Material evidence of infant selection from the target language: a cross-linguistic phonetic study. In C. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.*)* *Phonological development: models, research, implications*. Timonium, Maryland: York Press.

Brown, C., & Matthews, J. (1997). The role of feature geometry in the development of phonemic contrasts. In S. Hannahs, & M. Young-Scholten (Eds.), *Focus on Phonological Acquisition*. Durham: John Benjamins Publishers.

Chomsky, N. (1981). *Lectures on Government and Binding*. Dordrecht: Foris.

Clements, N. (1985). The geometry of phonological features. *Phonology Yearbook*, *2*, pp. 223-252.

Chomsky N. (1986). Knowledge of Language. Its Nature, Origin and Use. New York: Praeger.

Chomsky, N., & Halle, M. (1968). *The Sound Pattern of English*. Massachusetts: MIT Press.

Clements, N. (2001). Representational economy in constraint-based phonology. In T. Hall. (Ed.) *Distinctive Feature Theory*. Berlin: Mouton de Gruyter.

Clements, N. (2009). The Role of Features in Phonological Inventories. In E. Raimy & C. Cairns (Eds.). *Contemporary Views on Architecture and Representations in Phonology*, pp. 19-68. Cambridge: MIT Press. Published in 2005 in

<http://www.nickclements.free.fr>.

Clements, G., & Hume, E. (1995). The internal organization of speech sounds. In J. Goldsmith (Ed.), *The Handbook of Phonological Theory*. Cambridge: Blackwell Pub.

Compton, A. J., & Streeter, M. (1977). Child phonology: data collection and preliminary analyses. *Papers and Reports on Child Language Development 7*. Stanford, CA: Stanford University Press.

Costa, T., & Freitas, M. J. (2003). Obstruções na aquisição. A propósito da natureza dos estádios iniciais no desenvolvimento segmental. *Actas do XVIII Encontro Nacional da Associação Portuguesa de Linguística*. Lisboa: APL.

Dinnsen, D. (1992). Variation in developing and fully developed phonologies. In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.) *Phonological Development: Models, Research, Implications*, pp. 191-210. Timonium, MD: York Press.

Dinnsen, D. (1996a). Context-sensitive underspecification and the acquisition of a phonemic contrast. *Journal of Child Language 23,* pp. 31-35.

Dinnsen, D. (1996b). Context effects in the acquisition of fricatives. In B. Bernhardt, J. Gilbert, & D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press.

Dinnsen, D., Chin., Elbert, M., & Powell, T. (1990). Some constraints on functionally disordered phonologies: phonetic inventories and phonotactic. *Journal of Speech and Hearing Research,* v.33, pp. 28-37.

Dresher, B. & Hulst, H. (1995). Global determinacy and learnability in phonology. In J. Archibald (Ed.), *Phonological Acquisition and Phonological Theory*. Hillsdale: Lawrence Erlbaum Associates.

Dunphy, C. (2006). *Another perspective on Consonant Harmony in Dutch*. M.A. thesis. Department of Linguistics. Memorial University of Newfoundland.

Echols, C., & Newport, E. (1992). The role of stress and position in determining first words. *Language Acquisition* 2 *(3)*, pp. 189-220.

Edwards, M.L. (1996). Word position effects in the production of fricatives. In B. Bernhardt, J. Gilbert, & D. Ingram (Eds.), *Proceedings of the UBC international conference on phonological acquisition.* Somerville, MA: Cascadilla Press.

Edwards, J., Beckman, M., & Munson, B. (2004). The interaction between vocabulary size and phonotactic probability effects on children's production accuracy and fluency in nonword repetition. *Journal of Speech, Language and Hearing Research, 47*, pp. 421-436.

Fee, J. (1995). Segments and Syllables in Early Language Acquisition. In J. Archibald (Ed.), *Phonological Acquisition and Phonological Theory*. Hillsdale: Lawrence

Erlbaum Associates.

Fee, J., & Ingram, D. (1982). Reduplication as a strategy of phonological development. *Journal of Child Language, 9*, pp. 41-54.

Feest, S. van der (2007). *Building a phonological lexicon*. PhD. Thesis. Radboud University of Nijmegen.

Feest, S. van der, & Fikkert, P. (2005). Segmental detail in children's early lexical representations. Pr*oceedings of the ISCA Workshop on Plasticity in Speech Perception*. University College London.

Ferguson, C. (1979). Phonology as an Individual Access System: Some Data from Language Acquisition. In C. Fillmore et al. (Eds.) *Individual Differences in Language Ability and Language Behavior.* New York: Academic Press.

Ferguson, C., & Farwell, C. (1975). Words and sounds in early language acquisition. *Language, 51*, pp. 419-439.

Ferguson, C., & Garnica, O. (1975). Theories of phonological development. In E. H. Lenneberg & E. Lenneberg (Eds.), *Foundations of language development*, pp. 153–180. Volume 1. New York: Academic Press.

Ferguson, C. & Macken, M. (1983). The role of play in phonological development. In N. Keith (Ed.) *Children's Language. Vol. 4*, pp. 231-245. New Jersey, London: Lawrence Erlbaum Associates.

Fikkert, P. (1994). *On the Acquisition of Prosodic Structure*. Dordrecht: HIL.

Fikkert, P. (2005a). Getting sounds structures in mind. Acquisition bridging linguistics and psychology? In A. Cutler (Ed.) *Twenty-First Century Psycholinguistics: Four Cornerstones.* Lawrence Erlbaum Associates.

Fikkert, P. (2005b). From phonetic categories to phonological features specification: Acquiring the European Portuguese vowel system. *Lingue e Linguaggio 4(2)*, pp. 263-280.

Fikkert, P. (2007). Acquiring phonology. In P. de Lacy (Ed.), *Handbook of phonological theory*. Cambridge, MA: Cambridge University Press.

Fikkert, P., & Freitas, M. J. (2006). Allophony and allomorphy cue phonological development: Evidence from the European Portuguese vowel system. *Journal of Catalan Linguistics 5*, pp. 83–108.

Fikkert, P., & Levelt, C. (2008). How does place fall into place? The lexicon and emergent constraints in the developing phonological grammar. In P. Avery, B. Elan Dresher, & K. Rice (Eds.), *Contrast in phonology: Perception and Acquisition*. Berlin: Mouton.

Fikkert, P., Levelt, C., & van de Weijer, J. (2002). Input, intake and phonological development; the case of consonant harmony. Talk given at GALA, Utrecht.

Fischer, C., Church, B., & Chambers, K. (2004). Learning to identify spoken words. In D. G. Hall & S. R. Waxman (Eds.), *Weaving a lexicon*, pp. 3–40. Cambridge, MA: The MIT Press.

Freitas, G. (2004). Sobre a aquisição das plosivas e nasais. In R. Lamprecht, G. Bonilha, G. Freitas, C. Matzenauer, C. Mezzomo, C. Oliveira & L. Ribas, *Aquisição Fonológica do Português, perfil de desenvolvimento e subsídios para a terapia*. São Paulo: Artmed.

Freitas, M. J. (1997). *Aquisição da Estrutura Silábica do Português Europeu*. Dissertação de Doutoramento. Faculdade de Letras da Universidade de Lisboa.

Freitas, M. J. (2003). O ponto de articulação das laterais em Ataque simples na aquisição do Português Europeu. In M.E. Soares (Ed.) *Anais do II Congresso Internacional da ABRALIN*. Fortaleza: ABRALIN.

Frota, S., & Vigário, M. (2007) FreP - Automatic extraction of phonological frequency patterns and applications to language acquisition. Talk given at *GALA 2007 Satellite Workshop Tools for Phonological Databases: FreP, Phon, and PhonBank*. UAB, Spain.

Frota, S., Vigário, M., & Martins, F. (2006) FreP: an electronic tool for extracting frequency information of phonological units from Portuguese written text. *Proceedings of the 5th International Conference on Language Resources and Evaluation*, Genoa, May 2006.

Frota, S., Vigário, M., Martins, F., & Cruz, M. (to appear). Th*e FrePOP (Frequency of Phonological Objects in Portuguese) Database*. Laboratório de Fonética da FLUL.

Gierut, J. (1986). Sound change: A phonemic split in a misarticulating child. *Applied Psycholinguistics*, 7, pp. 57-68.

Gierut, J. (1992). The conditions and course of clinically-induced phonological change. *Journal of Speech and Hearing Research.* v. 35, pp. 1049-1063.

Goad, H. (1996). Consonant harmony in child language: evidence against coronal underspecification. In B. Bernhardt, J. Gilbert e D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press.

Goad, H. (1997). Consonant harmony in child language: an optimality-theoretic account. In S. J. Hannahs, & M. Young-Scholten (Eds.) *Focus on ORAB Phonological Acquisition*, pp. 113-142. Amsterdam: John Benjamins.

Goldsmith, J. (1990). *Autosegmental and Metrical Phonology*. Oxford: Blackwell.

Goldsmith, J. (1995). Phonological Theory. In J. Goldsmith (Ed.), *The Handbook of Phonological Theory*. Cambridge: Blackwell Pub.

Goodluck, H. (1991). *Language Acquisition*. Oxford: Blackwell Pub.

Hall, C. J. (1988). Integrating diachronic and processing principles in explaining the suffixing preference. In A. Hawkins (Ed.). *Explaining Language Universals*. Oxford: Blackwell.

Hall, C. J. (1992). *Morphology and mind: a unified approach to explanation in linguistics*. New York: Routledge.

Hall, T. (2001). Phonological representations and phonetic implementation of distinctive features. In T. Hall. (Ed.) *Distinctive Feature Theory*. Berlim: Mouton de Gruyter.

Hansson, G. (2001). *Theoretical and Typological Issues in Consonant Harmony*. Doctoral dissertation, University of California, Berkeley, CA.

Hawkins. L. A & Cutler, A. (1988). Psycholinguistic factors in morphological asymmetry. In A. Hawkins (Ed.). *Explaining Language Universals*. Oxford: Blackwell.

Ingram, D. (1986). Phonological development. In P. Fletcher & M. Garman (Eds.) *Language Acquisition*. Cambridge: CUP.

Ingram, D. (1974). Phonological rules in young children. *Journal of Child Language*, *1*, pp. 49–64.

Ingram, D. (1979). Phonological patterns in the speech of young children. In P. Fletcher & M. Garman (Eds.) *Language acquisition,* pp. 133-49. Cambridge: Cambridge University Press.

Ingram, D. (1989). *First Language Acquisition*. *Method, Description and Explanation*. Cambridge: Cambridge University Press.

Ingram, D. (1996). Some observations on feature assignment. In B. Bernhardt, J. Gilbert & D. Ingram (Eds), *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press.

Ingram, D., Christensen, L., Veach, L., & Webster, B. (1980). The acquisition of word-initial fricatives and affricates in English by children between 2 and 6 years. In G. H. Yeni-Komshian, J. F. Kavanagh & C. A. Ferguson (Eds.) *Child phonology,* Vol. 1, pp. 169-92. New York: Academic Press.

Inkelas, S. & Rose, Y. (2003). Velar Fronting Revisited. *Proceedings of the 26th Annual Boston University Conference on Language Development*, Somerville, MA.

Iverson, G. & Wheeler, D. (1987). Hierarchical structures in child phonology. *Lingua 73*, pp. 243-257.

Jaeger, J. (1997). How to say 'Grandma' and 'Grandpa': a case study in early phonological development. *First Language*, *17*(1), pp. 1-29.

Jakobson, R. (1941/68). *Child Language, Aphasia and Phonological Universals.* The Hague: Mouton.

Jakobson, R., Fant, G., & Halle, M. (1952). *Preliminaries to Speech Analysis*. Cambridge, Massachusetts: MIT Press.

Jusczyk, P., Luce, P., & Charles-Luce, J. (1994). Infants' sensitivity to phonotactic patterns in the native language. *Journal of Memory and Language 33*, pp. 630-645.

Kager, R., Pater, J., & Zonneveld, W. (2004). *Constraints in Phonological Acquisition* (Eds.) Cambridge: Cambridge University Press.

Kehoe, M., & Lléo, C. (2002). Intervocalic consonants in the acquisition of German: onsets, codas or something else? *Clinical Linguistics & Phonetics*, vol. 16, no. 3.

Kenstowicz, M. (1994). *Phonology in Generative Grammar*. Cambridge, MA: Blackwell.

Kiparsky, P. (1982). From Cyclic Phonology to Lexical Phonology. In H. van der Hulst & N. Smith (Eds.), *The structure of phonological representations*. Vol 1, pp.131-175. Dordrecht: Foris.

Kiparsky, P., & Menn, L. (1977). On the acquisition of phonology. In *Language Learning and Thought*, pp. 47–78. New York: Academic Press.

Klein, H. (2005). Reduplication revisited: Functions, Constraints, Repairs and Clinical Implications. *American Journal of Speech- Language Pathology*. Vol. 14, pp. 71-83.

Ladefoged, P., & Maddieson, I. (1996). *The Sounds of the World's Languages*. Oxford: Blackwell Publishers.

Lahiri, A. & Evers, V. (1991). Palatalization and coronality. In C. Paradis & J. F. Prunet (Eds.), *The special status of coronals*, pp. 79-100. San Diego: Academic Press.

Lamprecht, R. (1990). *Perfil da Aquisição Normal da Fonologia do Português - descrição longitudinal de 12 crianças: 2:9 a 5:5*. Tese de doutorado. Porto Alegre: PUCRS.

Lamprecht, R. (1999). Desvios Fonológicos: evolução nas pesquisas, conhecimento atual e implicações dos estudos em Fonologia Clínica. In R. Lamprecht (Org.), *Aquisição da Linguagem - Questões e análises*. Porto Alegre: EDIPUCRS.

Lamprecht, R., Bonilha, G., Freitas, G., Matzenauer, C., Mezzomo, C., Oliveira, C., & Ribas, L. (2004). *Aquisição fonológica do Português. Perfil de desenvolvimento e subsídios para terapia*. Porto Alegre: Artmed.

Langeslag, J. (2007). *As to the Manner Born*. M.A. Thesis. Radboud University. Nijmegen.

Lazzarotto-Volcão, C. (2009). Modelo padrão de aquisição de contrastes: uma proposta de avaliação e classificação dos desvios fonológicos. PhD dissertation. Universidade Católica de Pelotas.

Levelt, C. (1994). *On the acquisition of place*. HIL dissertations in Linguistics 8, The Hague: HAG.

Levelt, C. (1996). Consonant-vowel interactions in child language. In B. Bernhardt, J. Gilbert & D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press.

Levelt, C. (to appear). Consonant Harmony in child language. In M. van Oostendorp, C. Ewen, E. Hume & K. Rice (Eds.). *The Blackwell Companion to Phonology*. Blackwell Publishing ltd.

Levelt, C., & van de Vijver, R. (2004). Syllable types in cross-linguistic and developmental grammars. In R. Kager, W. Zonneveld, J. Pater (Eds.), *Fixing Priorities: Constraints in Phonological Acquisition,* Cambridge: Cambridge University Press.

Levelt, C., & Oostendorp, M. (2007). Feature co-occurrence constraints in L1 acquisition. In B. Los, & M., Koppen (Eds.), *Linguistics in The Netherlands*, pp. 162-172. Amsterdam: John Benjamins Publishing Company.

Lléo, C. (1990). Homonymy and reduplication revisited: On the extended availability of two strategies in phonological acquisition. *Journal of Child Language 17*, pp. 267-278.

Lléo, C. (1996a) To spread or not to spread: different styles in the acquisition of Spanish phonology. In B. Bernhardt, J. Gilbert & D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition,* pp. 215-228. Somerville: Cascadilla Press.

Lléo, C. (1996b). Early phonological acquisition of German and Spanish: A reinterpretation of the continuity issue within the Principles and Parameters model. In C.E. Johnson & J.H.V. Gilbert (Eds.), *Children's Language, Volume 9*, pp.11-31. Hillsdale: Lawrence Erlbaum Associates.

Macken, M. (1979). Developmental reorganization of phonology: A hierarchy of basic units of acquisition*. Lingua, 49,* pp. 11-49.

Macken, M. (1995). Phonological Acquisition. In J. Goldsmith (Ed.), *The Handbook of Phonological Theory*. Cambridge: Blackwell Pub.

Macken, M. (1996). Prosodic Constraints on features. In B. Bernhardt, J. Gilbert & D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press.

MacNeilage, P., & Davis, B. (2000). Origin of the internal structure of word forms. *Science*, 288, pp. 527–531.

MacWhinney, B. (2000). *The CHILDES project: tools for analyzing talk*. Volume 1: Transcription format and programs. Volume 2: The database. Lawrence Erlbaum.

Mateus, M.H. (1975). *Aspectos da Fonologia Portuguesa*. Lisboa: INIC.

Mateus, M.H. (1997). Redundâncias lexicais e subespecificação: o sistema do português. In *Actas do XII Encontro Nacional da Associação Portuguesa de Linguística*. Lisboa: APL.

Mateus, M.H., & d'Andrade, E. (2000). *The Phonology of Portuguese*. Oxford: University

Press.
Mateus, M.H., Falé, I., & Freitas, M.J. (2005). *Fonética e Fonologia do Português*. Lisboa: Universidade Aberta.
Matzenauer[70], C. (1990). *Aquisição da Fonologia do Português. Estabelecimento de padrões com base em traços distintivos*. Dissertação de doutoramento apresentada à PUCRS. Porto Alegre: PUCRS.
Matzenauer, C. (1993). A análise da fonologia da criança através de traços distintivos. *Letras de Hoje, n.º 92*. Porto Alegre: PUCRS.
Matzenauer, C. (1994). A Geometria de Traços na representação das palatais na aquisição do português. *Letras de Hoje.* , v.29, n.4, pp.159-167. Porto Alegre
Matzenauer, C. (1995). Sobre a descrição de desvios fonológicos e de fenómenos da aquisição da fonologia. In *Letras de Hoje*, *n.º 4*. Porto Alegre: PUCRS.
Matzenauer, C. (1996). Relações Implicacionais na Aquisição da Fonologia. In *Letras de Hoje, nº 104*. Porto Alegre: PUCRS.
Matzenauer, C. (2001a). A construção da fonologia no processo de aquisição da língua. In Matzenauer, C. (Org.) *Aquisição da Língua Materna e da Língua Estrangeira*. Pelotas: EDUCAT.
Matzenauer, C. (2001b). A aquisição de segmentos do português e o pé métrico. In R. Lamprecht & S. Menuzzi, *Letras de Hoje*. Porto Alegre: PUCRS.
Matzenauer, C., & Bonilha, J. (2003). *Aquisição da Fonologia e Teoria da Otimidade*. Pelotas: EDUCAT.
McCarthy, J. (2004), (Ed.). *Optimality Theory in Phonology: A Reader*. USA: Blackwell.
McCarthy, J., & Prince, A. (1993). *Prosodic Morphology I: Constraint Interaction and Satisfaction*. ms. University of Massachusetts, Amherst and Rutgers University.
McDonough, J. & Myers, S. (1991). *Consonant harmony and planar segregation in child language.* UCLA and University of Texas, Austin.
Menn, L. (1971). Phonological rules in beginning speech. *Lingua*, 26, pp. 225–241.
Menn, L. (1978). Phonological units in beginning speech. In A. Bell & J. B. Hooper (Eds.), *Syllables and Segments*., pp. 157–172. New York: Elsevier-North Holland.
Menn, L., & Stoel-Gammon, C. (1995). Phonological development. In P. Fletcher, B. MacWhinney (Eds.), *The Handbook of Child Language*. USA: Blackwell.
Mezzomo, C. (2007). O uso de estratégias de reparo como indício do conhecimento fonológico da criança. In G. Bonilha & M. Keske-Soares (Org.), *Estudos em Aquisição Fonológica, pp.* 65-79. Santa Maria: PPGL Editores.
Mezzomo, C. L. & Ribas, L. P. (2004). Sobre a aquisição das líquidas. In R. Lamprecht et

[70] Until 2000, this author published as Hernandorena, C.

al., *Aquisição fonológica do português: perfil de desenvolvimento e subsídios para terapia*, pp. 95-112. Porto Alegre: Artmed.

Miranda, A. (1996). *A Aquisição do 'r': uma contribuição à discussão sobre seu status fonológico*. Dissertação de mestrado apresentada à PUCRS, Porto Alegre.

Miranda, A. (2007). As róticas no sistema do português brasileiro e na aquisição da linguagem. In G. Bonilha & M. Keske-Soares (Org.), *Estudos em Aquisição Fonológica, pp.* 25-46. Santa Maria: PPGL Editores.

Monnin, J., Loevenbruck, H., & Beckman, M. E. (2007). The influence of frequency on word-initial obstruent acquisition in Hexagonal French. *Proceedings of the XVIth International Congress of Phonetic Sciences,* 6-10 August , Saarbruecken.

Morrisette, M. L., Dinnsen, D. A., & Gierut, J. A. (2003). A reconceptualization of markedness based on acquisition of place features. Talk given at the *Symposium on Research in Child Language Disorders*, Madison.

Moskowitz, A. J. (1973). The acquisition of phonology and syntax: A preliminary study. In J. Hintikka *et al*. (Eds.), *Approaches to natural language : proceedings of the 1970 Stanford Workshop on Grammar and Semantics*, pp. 48–84. Dordrecht: Reidel Publ.

Mota, H. B. (1996). *Aquisição segmental do Português: um modelo implicacional de complexidade de traços*. Tese de Doutoramento. Pontifícia Universidade Católica do Rio Grande do Sul. Porto Alegre.

Mota, H. B. (2007). Modelo implicacional de complexidade de traços – os caminhos na aquisição segmental do português. In G. Bonilha, & M. Keske-Soares (Orgs.) *Estudos em aquisição fonológica*, vol. 1. Santa Maria: UFSM, PPGL-Editores.

Oliveira, C. (2004). Sobre a aquisição das fricativas. In R. Lamprecht. (Org.). *Aquisição fonológica do português - perfil de desenvolvimento e subsídios para terapia*, pp. 83-94. Porto Alegre: Artmed editora.

Oliveira, C. (2007). Aquisição do r-fraco no português brasileiro e no espanhol: um estudo comparativo. In G. Bonilha & M. Keske-Soares (Org.), *Estudos em Aquisição Fonológica, pp.* 47-64. Santa Maria: PPGL Editores.

Ota, M. (2006). Input frequency and word truncation in child Japanese: Structural and lexical effects. *Language and Speech, 49*, pp. 261-295.

Paradis, C., & Prunet, J. (1991). *Phonetics and Phonology: The Special Status of Coronals.* New York: Academic Press.

Pater, J. (1997). Minimal violation and phonological development. *Language Acquisition 6*: pp. 201–253.

Pater, J. (2002). Form and Substance in Phonological Development. In L. Mikkelson & C. Potts, (Eds.), *WCCFL 21 Proceedings*, pp. 348-372. Somerville: Cascadilla Press.

Pater, J., & Werle, A. (2001). Typology and variation in child consonant harmony. In C. Féry, A. Green & R. van de Vijver, *Proceedings of HILP 5*, pp. 119-139. Potsdam: University of Potsdam.

Pater, J. & Werle, A. (2003). Direction of assimilation in child consonant harmony. *Canadian Journal of Linguistics/Revue canadienne de linguistique, 48(3/4)*.

Prince, A., & Smolensky, P. (1993). *Optimality Theory: constraint interaction in generative grammar*. [ROA 537-0802]. Published 2004 by Blackwell.

Prince, A., & Smolensky, P. (2004). *Optimality theory*. Oxford: Blackwell. [Available on Rutgers Optimality Archive as ROA-537].

Rangel, G.A. (1998). Os diferentes caminhos percorridos na aquisição da fonologia do português. *Letras de Hoje*, pp. 133-140 Porto Alegre, vol. 33.

Rice, K. & Avery, P. (1995). Variability in a deterministic model of language acquisition: a theory of segmental elaboration. In J. Archibald (Ed.), *Phonological Acquisition and Phonological Theory*. Hillsdale: Lawrence Erlbaum Associates.

Robb, M. P., & Bleile, K. M. (1994). Consonant inventories of young children from 8 to 25 months. *Clinical Linguistics and Phonetics, 8,* pp. 295-320.

Rose, Y. (2000). *Headedness and Prosodic Licensing in the L1 Acquisition of Phonology*. Ph.D dissertation. McGill University.

Rose, Y., MacWhinney, B., Byrne, R., Hedlund, G., Maddocks, K., O'Brien, P., & Wareham, T. (2006). Introducing *Phon*: A Software Solution for the Study of Phonological Acquisition. In D. Bamman, T. Magnitskaia, & C. Zaller (Eds.), *Proceedings of the 30th Annual Boston University Conference on Language Development*, pp. 489-500. Somerville, MA: Cascadilla Press.

Saffran, J., Newport, E., & Aslin, R. (1996). Word segmentation: the role of distributional cues. *Journal of Memory and Language, 35*, pp. 606-621.

Sagey, E. (1986). *The Representation of Features and Relations in Non-Linear Phonology*. Ph.D. Dissertation, MIT.

Dos Santos, C. (2007). *Développement phonologique en français langue maternelle. Une étude de cas*. Ph.D dissertation. Université Lumière Lyon 2.

Schwartz, R., Laurence L., Wilcox, M.J., & Folger, M. K. (1980). Again and Again: Reduplication in child phonology. *Journal of Child Language, 7*, pp. 75-87.

Selkirk, E. (1984). On the Major Class Features and Syllable Theory. In M. Aronoff & R. Oehrle (Eds.), *Language and Sound Structure*. Cambridge, MA: MIT Press.

Smith, N. V. (1973). *The Acquisition of Phonology, a Case Study*. Cambridge: Cambridge University Press.

Smith, N.V. (1975). Universal tendencies in the child's acquisition of phonology. In N.

O'Connor (Ed.), *Language, Cognitive Deficits and Retardation*. Reprinted in B. Lust & C. Foley (2004) (Eds.). *First Language Acquisition: The Essential Readings*, pp. 294-306. Oxford: Blackwell.

Soares, M. (2001). Um modelo de terapia para crianças com desvios fonológicos: a hierarquia implicacional dos traços distintivos. In Matzenauer, C. (Org.). *Aquisição da Língua Materna e da Língua Estrangeira*. Pelotas: EDUCAT

Sosa, A. V., & Stoel-Gammon, C. (2006). Patterns of intra-word phonological variability during the second year of life. *Journal of Child Language 33*, pp. 31–50.

Spencer, A. (1986). Towards a theory of phonological development. *Lingua 68*, pp. 3–38.

Stampe, D. (1973). *A dissertation on natural phonology*. Ph.D. dissertation. University of Chicago [Published by Garland Press, New York, 1979].

Stampe, D. 1969. The acquisition of phonetic representation. *CLS* 5, pp. 443-453.

Stemberger, J.P., & Bernhardt, B.H. (2001). U-shaped learning in language acquisition, and restrictions on error correction. Poster presented at the *2001 Biennial Meeting of the Society for Research in Child development,* April 22. ROA-472.

Stemberger, J. P. & Stoel-Gammon, C. (1991). The underspecification of coronal: evidence from language acquisition and performance errors. In C. Paradis & J. F. Prunet (Eds.), *The special status of coronals: internal and external evidence. Phonetics and Phonology* 2, pp. 181-199. San Diego, CA: Academic Press.

Steriade, D. (1995). Underspecification and Markedness. In J. Goldsmith (Ed.), *The Handbook of Phonological Theory*. Cambridge: Blackwell Pub.

Stoel-Gammon, C., (1993). Phonological characteristics of children's first words: the earliest stages. Symposium with B. Bernhardt, U. Bertolini and L. Leonard, *Sixth International Congress for the Study of Child Language*, July, Trieste, Italy.

Stoel-Gammon, C. (1994). Measuring phonology in babble and speech. *Clin Commun Disord*. Mar;4(1), pp.1-11.

Stoel-Gammon, C. (1996). On the acquisition of velars in English. In B. Bernhardt, J. Gilbert & D. Ingram (Eds.) *Proceedings of the UBC international conference on phonological acquisition*, pp. 201-214. Somerville, MA: Cascadilla Press.

Stoel-Gammon, C. (1998). Sounds and words in early language acquisition: the relationship between lexical and phonological development. In R. Paul (Ed.) *Exploring the Speech-Language Connection*, pp. 25-52. Baltimore: Paul H. Brookes Publishing Co.

Stoel-Gammon, C. (2001). Transcribing the speech of young children. *Topics in Language Disorders*, *21*, pp. 12-21.

Stoel-Gammon, C. (2002). Intervocalic consonants in the speech of typically developing children: emergence and early use. *Clinical Linguistics & Phonetics*, vol. 16, no. 3, pp. 155- 168.

Stoel-Gammon, C., &. Dunn, C. (1985). *Normal and Disordered Phonology in Children*. Austin, TX: Pro-Ed.

Stoel-Gammon, C. & Stemberger, J.P. (1994). Consonant harmony and phonological underspecification in child speech. In M. Yavaş (Ed.), *First and second language phonology*, pp. 63-80. San Diego: Singular Press.

Storkel, H. L. (2001). Learning new words: Phonotactic probability in language development. *Journal of Speech Language and Hearing Research, 44(6)*, pp. 1321-1337.

Storkel, H. L., & Morrisette, M. L. (2002). The lexicon and phonology: Interactions in language acquisition. *Language, Speech, and Hearing Services in Schools, 33*, pp. 22-35.

Velleman, S. (1996). Metathesis Highlights Feature-by-position constraints. In B. H. Bernhardt, J. Gilbert & D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press.

Vihman, M. (1978). Consonant Harmony: Its Scope and Function in Child Language. *Universals of Human Language 2: Phonology*. In J. H. Greenberg (Ed.), pp. 281-334. Stanford: Stanford University Press.

Vihman, M. (1992). Early syllables and the construction of phonology. In C. Ferguson, L. Menn & C. Stoel-Gammon (Eds.), *Phonological development: models, research, implications*. Timonium, MD: York Press.

Vodopivec, S. (2004). *The influence of phonotactic probability on consonant acquisition.* B.A. honor's thesis. Department of Speech and Hearing Science, Ohio State University.

Waterson, N. (1971). Child phonology: A prosodic view. *Journal of Linguistics, 7(2),* pp. 179-211.

Weijer, J. van de (1999). *Language input for word discovery*. PhD dissertation, Nijmegen University, Nijmegen, The Netherlands.

Yavas, M. (Ed.) (1991). *Phonological Disorders in Children*. London: Routledge.

Yavas, M., & Lamprecht, R. (1988). Processes and Intelligibility in Disordered Phonology. *Clinical Linguistics and Phonetics*, *2(4)*, pp. 329-345.

Zamuner, T., Gerken, L. A., & Hammond, M. (2004). Phonotactic probabilities in young children's speech productions. *Journal of Child Language, 31*, pp. 515-536.