HEADEDNESS AND PROSODIC LICENSING IN THE L1 ACQUISITION OF PHONOLOGY

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À Éliane…

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Abstract

With the emergence of Optimality Theory, where the burden of explanation is placed almost entirely on constraints, we have observed in the phonological literature a de-emphasis on the role of structural relationships that hold within and across segments. In this thesis, counter to the current trend, I argue that the most explanatory approach to phonological processes requires reference to highly-articulated representations. I explore a number of phenomena found in the first language acquisition of Québec French and argue that these phenomena are best captured in an analysis based on structurally-defined markedness, headedness in constituent structure, and relationships between segmental features and their prosodic licensors.

I demonstrate that headedness in constituent structure must be assigned to both input and output forms. In order to encode the dependency relations between input and output representations, I appeal to faithfulness constraints referring specifically to constituent heads. Output representations are regulated by markedness constraints governing complexity within constituents, as well as by licensing relationships that hold between segmental features and different levels of prosodic representation.

At all stages in the development of syllable structure and complex segments, when more than one option is available for the representation of a target string, children select the unmarked option, consistent with the long-held view that early grammars reflect what is unmarked. When input complex structures are reduced in children's outputs, reduction operates in order to ensure faithfulness to the content of prosodic and segmental heads. Finally, in the discussion of consonant harmony, where the French data are supplemented by examples from English, I propose that consonant harmony results from a licensing relation between segmental features and the head of the foot. The differences in foot structure between French and English enable us to account for the contrasts observed between learners of the two languages.

Résumé

Depuis l'émergence de la théorie de l'optimalité, où les explications sont basées presque exclusivement sur les contraintes, le rôle que jouent les relations structurales dans l'explication de processus phonologiques a été de beaucoup réduit. Dans cette thèse, à l'encontre du courant actuel, je défends que l'approche la plus explicative doit être basée sur des représentations hautement articulées. J'examine plusieurs phénomènes observés dans l'acquisition du français québécois, langue maternelle, et je soutiens que la meilleure approche doit être basée sur les notions de marque, définie de manière structurale, de tête de constituent, et sur les relations entre traits segmentaux et légitimateurs prosodiques.

Je démontre que les têtes de constituants doivent être assignées à la fois dans les représentations sous-jacentes et de surface. Pour rendre compte des relations de dépendance entre formes sous-jacentes et de surface, je fais appel à des contraintes de fidélité faisant référence aux têtes de constituants. Les formes de surface sont régies par des contraintes de marque, ainsi que par des relations de légitimation qui prennent place entre traits segmentaux et différents paliers de représentation prosodique.

À tous les stades de développement de la structure syllabique et des segments complexes, lorsque plus d'une option est possible pour la représentation d'une suite segmentale cible, les enfants sélectionnent l'option de défaut, conformément avec le point de vue traditionnel selon lequel la grammaire de l'enfant reflète le non-marqué. Lorsqu'une structure complexe cible est réduite par l'enfant, la réduction s'opère de manière à préserver les têtes syllabiques et segmentales sous-jacentes. Finalement, en ce qui a trait à l'harmonie consonantique, pour laquelle les données du français sont comparées avec des exemples de l'anglais, je propose que ce processus résulte d'une relation de légitimation entre traits segmentaux et la tête du pied prosodique. Les différences entre la structure du pied en français et en anglais permettent d'expliquer les contrastes observés dans les grammaires des apprenants des deux langues.

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Chapter 1

INTRODUCTION

1.0 Introduction

In standard generative phonology (*The Sound Pattern of Englis*h; Chomsky and Halle 1968), phonological behaviour was primarily captured through rules. During the late 1970s, with the emergence of ‘non-linear phonology’, highly-articulated representations were proposed, and a move towards the integration of phonological constraints was observed. Since then, constraints have become central to most frameworks, particularly in Optimality Theory (OT; e.g. Prince and Smolensky 1993, McCarthy and Prince 1993a), where rules have been abandoned altogether. Within OT, the framework adopted in this thesis, the burden of explanation is placed almost entirely on constraints. A consequence of this move has been a de-emphasis on the structural relations that hold within and across segments.

In this thesis, I argue, using data from first language (L1) acquisition, that the most explanatory approach to phonology is one which is based primarily on highly-articulated representations and headedness in constituent structure, which are encoded in both input (underlying) and output (surface) forms. In order to express the dependency relations that hold between input and output representations, I appeal to faithfulness constraints referring specifically to constituent heads. Output representations are regulated by markedness constraints governing complexity within constituents, as well as the licensing relationships that hold between segmental features and different levels of prosodic representation.

The present chapter is organized as follows. In section 1.1, I describe the empirical base which constitutes the foundation of this thesis. It consists primarily of two previously unpublished longitudinal corpora on the L1 acquisition of Québec French, which will be supplemented with two published sources on the L1 acquisition of English. In section

1.1.1, I discuss the methodology used for the gathering, transcription, and organization of the French data. In order to better situate the ensuing discussion and analyses, central differences between Québec French and European French are also discussed in this section. In section 1.1.2, I report on the methodologies used in the data collection for the two English corpora. In light of the methodological issues introduced by both sets of data, I will discuss whether child language production data is a viable source of evidence to inform the nature of the acquisition process, taking Hale and Reiss (1998) as a starting point, in section 1.2. In section 1.3, I present an overview of the patterns to be analysed in the subsequent chapters. Concluding remarks are offered in section 1.4.

1.1 The empirical base

In this section, I describe the corpora of data which will be used in this thesis. The main set of data consists of two studies of the acquisition of Québec French. These data will constitute the basis for a comparative investigation on prosodic and segmental aspects of the acquisition of French, which are offered in chapters 3 and 5, respectively. In chapter 4, I propose a cross-linguistic investigation of consonant harmony, a process of feature sharing between two consonants at a distance (e.g. *duck* → [gʌk]). I will compare the data from one of the French-learning children, Clara,[1] with those from two English-learning children, Amahl (Smith 1973) and Trevor (Pater 1996, 1997; Trevor's data originally come from a diary study by A. J. Compton described in Compton and Streeter 1977). I will now turn to address some aspects of the methodologies employed in the French and English studies, which are discussed in turn in the next subsections.

1.1.1 The primary French data

The methodology used for the gathering and sampling of the French data described in this section was elaborated within the *Acquisition of phonology research project*, which

1. Of the two French-learning children, only Clara displays systematic patterns of consonant harmony.

took place under an FCAR grant to H. Goad at McGill University. Part of the funding also came from the *Harmony research project*, funded by a SSHRC grant to G. Piggott and H. Goad. During the tenure of these projects, three French and two English children were studied for a period of one to two years each.

In this thesis, I introduce the first results of this enterprise, focusing on longitudinal data from two of the French-learning children, Clara and Théo. Because of the time required for data extraction, transcription and analysis, only the data from these two children were available at the time when this thesis was written. As mentioned above, these two corpora will be compared extensively in two chapters. In chapter 3, I will study the development of Clara's and Théo's syllable structure. In chapter 5, I will investigate the patterns from these two children concerning the development of the French rhotic [ʁ].

Clara is a learner of Québec French spoken in the Québec City region. She has a brother who is five years and four months older than her. Her data were collected over a period of one and a half years, starting at the child's age of 1;00.28 until age 2;07.19.[2] During this period, 34 recording sessions took place. The first sessions have only a few words, which are in fact Clara's first words. A breakdown of the sessions and the number of tokens gathered at each of these sessions is given in (1).

2. Throughout the thesis, the format Y;MM.DD will be used to encode the children's respective ages at the different developmental stages observed.

(1) Clara: Breakdown of the recording sessions

Session	Age	Tokens	Session	Age	Tokens	Session	Age	Tokens
1	1;00.28	3	13	1;05.18	41	25	2;02.06	128
2	1;01.08	3	14	1;06.22	41	26	2;02.20	38
3	1;02.18	5	15	1;07.06	39	27	2;03.05	143
4	1;03.07	14	16	1;07.27	110	28	2;03.15	62
5	1;03.08	9	17	1;09.01	110	29	2;03.19	115
6	1;03.16	21	18	1;09.29	87	30	2;05.10	80
7	1;03.23	24	19	1;10.04	103	31	2;05.25	128
8	1;04.07	79	20	1;10.10	72	32	2;06.05	81
9	1;04.14	47	21	1;11.06	85	33	2;06.28	101
10	1;04.15	15	22	1;11.21	108	34	2;07.19	114
11	1;04.17	5	23	2;00.02	124			
12	1;05.05	47	24	2;01.05	86			

The second French-learning child, Théo, is a learner of Québec French typically spoken in the Bas-St-Laurent region, situated on the south shore of the St-Laurent river, between the Québec City area and the Gaspesian peninsula (see next subsection for a comparison of the two children’s dialects). Théo has two older sisters and a younger one. The former are roughly four and five years older than him, respectively; the latter is one year and three months younger. The data collection for Théo was done over a period of two years and two months, from age 1;10.27 to 4;00.00. A total of 45 recording sessions took place. Although the recording sessions started at an age which may seem rather old, the starting age corresponds to the time when Théo was producing his first words other than the canonical *mama* / *papa*. A breakdown of the sessions and their corresponding numbers of tokens is given in (2).

(2) Théo: Breakdown of the recording sessions

Session	Age	Tokens	Session	Age	Tokens	Session	Age	Tokens
1	1;10.27	14	16	2;06.30	174	31	3;02.23	97
2	1;11.10	20	17	2;07.06	91	32	3;03.18	116
3	1;11.24	14	18	2;07.13	47	33	3;04.00	156
4	2;00.06	10	19	2;07.22	135	34	3;04.19	125
5	2;00.21	22	20	2;08.05	243	35	3;05.06	136
6	2;01.19	18	21	2;08.22	151	36	3;05.26	82
7	2;02.02	32	22	2;09.12	87	37	3;06.13	84
8	2;02.16	32	23	2;10.05	168	38	3;07.06	189
9	2;03.06	50	24	2;10.24	156	39	3;07.27	141
10	2;03.20	48	25	2;11.23	132	40	3;08.19	133
11	2;04.06	59	26	2;11.29	40	41	3;09.15	195
12	2;04.28	79	27	3;00.07	111	42	3;10.03	357
13	2;05.11	74	28	3;00.23	119	43	3;10.26	186
14	2;05.29	81	29	3;01.18	135	44	3;11.10	49
15	2;06.12	152	30	3;02.07	121	45	4;00.00	157

The target Québec French dialects of these two children are very similar. Before I introduce the relevant facts, I will first provide some details about the essential phonological differences that exist between Québec French and European French. In light of this, I will address the differences between the two Québec French dialects under investigation in this thesis.

1.1.1.1 Québec versus European French

Québec and European French have similar phonemic inventories. With one difference in the vowels, as noted, the system which holds for the two dialects is given in (3).

(3) French phonemic inventory (Casagrande 1984)

a) Consonant inventory

	Labial	Coronal		Dorsal	Uvular
		+ant.	-ant.		
Stops	p, b	t, d		k, g	
Fricatives	f, v	s, z	ʃ, ʒ		
Nasals	m	n	ɲ		
Liquids		l			ʁ

b) Vocoid inventory

	Coronal	Coronal-Labial		Labial
Vowels	i	y		u
	e	ø		o
	ɛ, ɛ̃	œ, œ̃[a]	(ə)	ɔ, ɔ̃
			a, ɑ̃	
Glides	j	ɥ		w

a. The contrast between [ɛ̃ ~ œ̃] has disappeared in many varieties of European French but remains in Québec French.

The two dialects differ in some assimilatory behaviours, the surface realization of vowels, and the shape of right-edge clusters. I will discuss these differences in turn. First, in Québec French, the coronal stops ([t, d]) are affricated ([t͜s, d͜z]) before high front vocoids ([i, y, j, ɥ]; e.g. *petit* /pəti/ → [pət͜si] 'small'). This allophonic variation does not occur in the European dialects usually described in the literature (e.g. Casagrande 1984) nor in the general reference works on French (e.g. *Petit Robert* dictionaries).

Second, as described in detail in Dumas (1981) and Charette (1991), Québec French vowels tend to be lengthened and / or diphthongized when they appear in an open syllable, but never when they are followed by a rhymal consonant.[3] For example, vowel

3. As will be discussed in section 2.2.7, word-final consonants in French are considered to be syllabified outside the rhyme, as onsets of empty-headed syllables, following, e.g. Kaye (1990), Kaye, Lowenstamm, and Vergnaud (1990), Charette (1991), Dell (1995). This assumption will find independent support in the French data to be analysed in chapter 3. (One exception, Clara's [ʁ], will be discussed in chapter 5.)

lengthening / diphthongization is possible in words like *rêve* [ʁɛːv] / [ʁaɪv] ‘(a) dream’ and *rêver* [ʁɛːve] / [ʁaɪve] ‘(to) dream’, but not in words like *perdu* [pɛʁd͜zy] (*[pɛːʁd͜zy] / *[paɪʁd͜zy]) ‘lost’ or *perdre* [pɛʁd] (*[pɛːʁd] / *[paɪʁd]) ‘(to) lose’. Notice from this last example that word-final obstruent-liquid clusters tend to be reduced to obstruents in Québec French ([pɛʁd], *[pɛʁdʁ]). The word-final [ʁ] deletion found in this context contrasts with European French, in which these clusters are usually fully realized ([pɛʁdʁ]).

In Québec French, high vowels undergo laxing in surface closed syllables and in word-final position when followed by a single consonant. For example, while /i/ is tense in *paniquer* [panike] ‘(to) panic’, it is realized as lax in *panique* [panɪk] ‘panic’. Laxing is not found in the varieties of European French usually described in the literature.

Finally, in some southern dialects of European French, word-final consonants, as well as falling and rising sonority clusters are regularly followed by a schwa (e.g. *raquette* [ʁaˈkɛt(ə)] ‘racket’; *ferme* [fɛʁm(ə)] ‘farm’; *perdre* [pɛʁdʁ(ə)] ‘(to) lose’). Optional schwa epenthesis is generally not found in Québec French, apart from situations where each syllable of a word is pronounced in isolation.

The different characteristics of the Québec French dialects under investigation such as those described above will be reflected in the target forms provided throughout the thesis. The principal differences between Clara’s and Théo’s target dialects, which differ only slightly from one another, are described in the next subsection.

1.1.1.2 Clara’s versus Théo’s dialects of Québec French

Apart from some remote regional varieties (spoken in, e.g. Abitibi, Beauce, Saguenay, Lac-St-Jean, or Gaspésie), Québec French is usually divided into two main dialect areas by a vertical isogloss between Montréal and Québec City. For the sake of discussion, I will refer to these dialects as the western dialect and the eastern dialect, respectively.[4] The distinction between the two dialects is noticeable in the realization of both consonants and vowels. Regarding vowel quality, lexical variation is found in words like *poteau* ‘post’ and *photo* ‘photograph’ which are pronounced as [po̱to] and [fo̱to] in the western dialect but as [pɔ̱to] and [fɔ̱to] in the eastern dialect. This distinction is specific to some lexical items only, as other words such as *émotion* [emɔ̱sjɔ̃] ‘emotion’ are pronounced with [ɔ] in both dialects. The [o / ɔ] contrast between the two dialects is not observed among in the front counterparts of these vowels ([e / ɛ]).

Another typical distinction between the western and eastern dialects regards diphthongization. As mentioned above, Québec French vowels tend to be lengthened / diphthongized in open syllables. Diphthongization is more commonly found in the western dialect than in the eastern dialect (e.g. *arrête* ‘stop’ is pronounced [aʁa̱ɪ̱t / ara̱ɪ̱t] in the western dialect and usually as [aʁɛ̱ː̱t] in the eastern dialect).

Finally, the [ʁ / r] variation observed above in *arrête* in the western dialect constitutes the only distinction between the two dialects in the realization of consonants. While the rhotic /r/ is consistently realized as uvular ([ʁ]) in the eastern dialect, it is often realized as apical ([r]) in the western dialect.[5, 6] Notice, finally, that in all dialects that select [ʁ], when this consonant is preceded by a voiceless obstruent in branching onsets, it is realized as a voiceless uvular fricative (e.g. *trop* /tʁ̱o/ → [tχo] ‘too much’).

Regarding the central aspects of this thesis, which concentrates on the realization of consonants, Clara’s and Théo’s target dialects are for all intents and purposes identical. As mentioned above, Clara is from Québec City and is thus a learner of the eastern dialect.

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4. This distinction oversimplifies the actual distribution of the phenomena discussed below. Other sociolinguistic factors (e.g. socioeconomic status, education, age) must be taken into consideration to attain a more accurate description of the facts.
5. This distinction, very noticeable among older speakers, seems to be disappearing in younger speakers, who tend to adopt the uvular variant.
6. This observation holds true of the native vocabulary of Québec French. In loanwords, especially in English loanwords adapted in Québec French, Paradis and C. Lebel (1994) and Paradis and É. Lebel (1997) report that some English sounds (e.g. [ɹ]) tend to be imported with their foreign phonetic shape. This tendency is more generally observed in the Montréal area than in the Québec City area. Since the vast majority of words found in the French corpora used in this thesis come from the native vocabulary, this issue will not be discussed further.

The same holds true of Théo, with the difference that his family, who originates from Bas St-Laurent, now lives in a Montréal suburb. One effect of this is that some of Théo's vowels are more diphthongized than Clara's. However, since neither the acquisition of vowels nor the development of diphthongization is addressed in this thesis, and since both children have the uvular [ʁ] as their target rhotic, the data from the two corpora are comparable. For this reason, throughout the thesis, unless indicated otherwise, the term 'French' will refer to the characteristics of Québec French shared by Clara and Théo.

1.1.1.3 Data gathering and sampling methodology

Both of the French children were recorded in their homes, in a naturalistic setting, generally in the absence of their siblings. The recording sessions were done approximately every second week (or somewhat less frequently, depending on circumstances). This relatively high frequency of sampling provides us with a fairly detailed characterization of each developmental stage, as well as with a good approximation regarding the points in time when the different stages occurred for each child.

Clara was recorded by her mother, a specialist in sociolinguistics. Théo was recorded by a female native French-speaking linguistics graduate student from McGill with whom he had a familial relationship, in the presence of his mother. The two children were recorded, mainly while looking at picture books or playing with toys, on TDK SA90 tapes using an analogue recording machine Marantz PMD221 with a multidirectional table-top microphone SoundGrabber P2M-12-SG. The microphone was placed on a foamy cushion on the floor (in order to reduce interfering noise coming from the child's or the toys' movements), usually between the child and the interviewer, as near to the child as possible. After the first few minutes of each interview, the microphone did not cause any distraction, as the child was more interested in the more colourful books and toys than in this black — and arguably boring — device.

During the recording sessions, the interviewer concentrated on two main points. On the one hand, she encouraged spontaneous word production by the child, in order to avoid a speech sample consisting of repeated words which may overestimate the child's abilities.[7] Also, in conversation with the child, the interviewer repeated the child's words, in order to facilitate subsequent word identification for data extraction and transcription (see below). This was performed very naturally; indeed, this type of back channel (follow-up of the conversation through repetition) usually takes place in the conversations one has with a two-year-old child. The recording sessions lasted approximately 20-45 minutes, with a few of them extending to over an hour, depending on the child's mood. In cases where a session was considered too short, the next interview was usually conducted within a short period of time, in order to ensure that the corpus was representative.

The tapes were digitized using SoundEdit™ 16v2 in 16 bit sample size at a sample rate of 22.050 kHz. The tokens extracted from the tapes were labelled and later imported into a computerized database specifically designed for transcription, coding, and compilation. Most of the tokens are single words or short phrases (two to three words). However, to avoid losing phrasal contextual information, some tokens were extracted in larger segments, especially those from later recording sessions, when the children were producing longer sentences.

I programmed the database where the sampled data are stored using the FileMaker™ Pro development software. The database is divided into several sections. I will briefly discuss some of these sections here, in order to give the reader a better sense of the overall organization of the program.

The first section, illustrated in (4) with a screen shot of one of Théo's records, contains information relative to each recording session, e.g. date of the session, child's age, type of session (book or game), type of output (spontaneous speech or repetition), its

7. Word production types (repetition versus spontaneous speech) were coded accordingly, as will be discussed in the next subsection.

location on the original tape, and, most importantly, the sound produced by the child. This sound, available directly in the database for each token recorded, allows the user of the database to hear the child’s output as often as desired, and with the same quality as mentioned above (16 bit at 22.050 kHz), simply by clicking onto the ‘Sound’ field. I will come back to this below, where I discuss the advantages of this technique.

(4) Database’s session information

Child's name:	Théo	**Record number:**	0033		
Date:	05/11/1996	**Session type:**	Book		
Child's age:	1;11.10	**Response type:**	Spontaneous Speech		
Sound:		**Tape number:**	1b	**Counter:**	209

The second section of the database contains information relevant to the token contained in each record, as we can see in (5). The first field in that section contains the utterance written orthographically. The two other fields contain the adult’s and the child’s surface representations for this utterance, respectively.

(5) Utterance and transcription fields[8]

Utterance:	encore
Adult SR:	[ɑ̃kɔʁ]
Child SR:	[ɑˈka]

All tokens were phonetically transcribed by a trained linguist at either the undergraduate or graduate level at McGill who was a native speaker of the target language. The transcriptions were made in the narrowest possible fashion, using Grado Labs SR60

8. Stress is not encoded in the ‘Adult SR’ field, for two reasons. First, stress is predictable in French, as it always falls on the last vowel of the word. Also, the encoding of stress requires the addition of a diacritic in the transcription field, which has the effect of making the search of cross-syllabic strings of sounds more difficult. However, stress was transcribed for the children’s outputs, in order to verify their consistency with the target forms.

headphones and following the transcription principles of the International Phonetic Association supplemented by additional symbols for sounds unique to child language. Each transcription appearing in these fields was subsequently verified by at least one independent transcriber. In cases where the two transcribers were in disagreement on some aspect of a given word, the point of contention was discussed until agreement was reached. A third transcriber also occasionally intervened in the discussions.

The database also contains a number of fields which are used for data coding and analysis. For the purposes of this thesis, each token was coded for consonantal type (e.g. obstruent, nasal, [l], [ʁ], etc.) in each possible syllable position, as well as for consonant harmony alternations.

Apart from its convenient graphical user-interface, this database offers a number of advantages. The best of all is the fact that, as mentioned above, it provides direct and unlimited access to the digitized child's output. This feature facilitates transcription as well as post hoc verification. Conventional transcription methods, using either tape player or transcriber devices, require the transcriber to rewind, locate and replay each token being transcribed. Also, any subsequent retrieval of a particular token word on a tape represents a fairly cumbersome task, which is avoided in a database like the one described here. Finally, coding can be refined at will, and the digitized audio data can be exported and used for subsequent phonetic analysis.

The methodology used in this research has shortcomings, however. The biggest problems come from the recording methodology. First, despite the relatively good acuity of the table-top multidirectional microphone used during the interviews, a directional, wireless lapel microphone attached to the child's clothing would have rendered a better signal with less interference from surrounding noise. Also, digital recording would have provided us with a better quality sound output. However, because of the prohibitive cost of this more sophisticated equipment at the time the research was conducted, we had to resort to the equipment described above. Despite the limitations inherent in the methodology used, however, the overall setup of our study provides us with reliable primary data which are stored in an integrated database that, we believe, constitutes a very useful organizational and analytical tool.

1.1.1.4 Contributions from the French data

As mentioned in the introduction, the French data set consists of two previously unpublished longitudinal studies on the acquisition of Québec French, from Clara and Théo. They constitute a nice addition to the empirical base currently available in the literature. The patterns found in both Clara's and Théo's forms, which will be compared in chapters 3 and 5, provide us with a fairly detailed picture of a number of processes observed in the acquisition of Québec French. Of course, it is impossible that a look at two children is sufficient to provide us with all of the patterns that could possibly be found in children acquiring French. Nevertheless, this study constitutes a step in the right direction.

A comparison between the patterns found in the French data with those found in other languages will permit us to shed new light on some issues that pertain to the role of constituent structure in children's early grammars. Indeed, the Québec French data investigated in this thesis provide evidence for iambic (right-headed) foot construction in child language. This contrasts with the evidence currently available in the literature, which comes primarily from Dutch and English, i.e. two languages with trochaic feet. The evidence for iambic footing in the two French-learning children will shed new light on a long-standing debate about the role of a potential trochaic bias in early acquisition (see section 2.2.2). The contrast between iambic French and trochaic languages will be at the core of the arguments in chapters 3 and 4. As we will see, different patterns are predicted from left- versus right-headed foot construction; the different predictions will be verified in a number of developmental patterns (syllable truncation, consonant epenthesis, and consonant harmony). A comparison between French and the trochaic languages mentioned above will thus reveal the importance of cross-linguistic investigation for our understanding of alternations typically found in the L1 literature. Finally, from a segmental point of view, the study of the acquisition of French [ʁ] will reveal an interesting problem regarding feature specification and syllabification in child language, as we will see in chapter 5. All of these patterns are outlined in more detail in section 1.3 below.

In the next section, I turn to describe the data from the two English children which will be used in the investigation of consonant harmony in chapter 4.

1.1.2 The English children

In chapter 4, I will compare the consonant harmony patterns found in French- and English-learning children. The former data will come from Clara for, as mentioned above, consonant harmony is not attested in Théo's outputs. The latter will come from two English-learning children, Amahl (Smith 1973) and Trevor (Pater 1996, 1997; original data from a diary study by A. J. Compton described in Compton and Streeter 1977).

Although the researchers who gathered the data from Amahl and Trevor could not benefit from the type of technology used for the French corpora described above, the methodologies which were adopted for the elaboration of these two early English corpora were very rigorous. Concerning Amahl's data, which constitute, to date, the most comprehensive resource available on child phonology in the public domain,[9] despite the relative rarity of recording machines at the time he conducted his research (in the late 1960s), Smith, who personally collected the data from his son, occasionally recorded sessions with Amahl, allowing for the verification of at least a portion of the corpus. Furthermore, Smith's transcriptions are very narrow and thus demonstrate his concern with providing as much phonetic detail as possible about Amahl's outputs. Regarding Trevor's

9. Bernhardt and Stemberger (1998) provide a survey of the patterns observed in the literature on phonological development. However, as most of their example sets are not cast in their developmental context, it is difficult to undertake complete analyses from these data. Diary corpora such as the one provided by Smith (1973) do not present such a limitation. See, also, Ingram (1989) for an excellent overview of the studies of child language since the nineteenth century.

data, sporadic recordings were also performed for parts of the corpus, the transcriptions of which revealed overall high accuracy with the data transcribed directly from the child's non-recorded productions. Thus, as pointed out by Pater (1996, 1997) concerning Trevor's data, "we can have a reasonable degree of confidence in the accuracy of the transcriptions" (Pater 1997: 214). Finally, it must be pointed out that the consonant harmony processes analysed in chapter 4, for which most of the data from Amahl and Trevor are used, involve only major place of articulation features (Labial, Coronal, Dorsal), which are relatively easy to perceive. For this reason, the validity of the data from these two children should not raise further concerns.

Keeping this last point in mind, we will now turn to some empirical concerns, as well as some more general views, expressed by Hale and Reiss (1998) regarding the value of child language data.

1.2 On Hale and Reiss' (1998) arguments against child phonology

In their provocative paper on first language acquisition, Hale and Reiss (1998) cast doubt on (a) the quality of the evidence commonly used in the field of phonological acquisition, as well as on (b) the validity of child phonology as system-based. I will address these two issues in turn in the next subsections.

1.2.1 Quality of the data used in studies on child language

Part of Hale and Reiss' (1998) position against the study of child language from *production* data concerns the quality of the data used in many studies. In short, Hale and Reiss argue that any account of child language based primarily on children's productions is undermined by the fact that the data found in the L1 literature are questionable in some respects (e.g. absence of systematic recordings, or of double verification of the transcriptions).

While acquisitionists readily acknowledge that the study of child language has inherent limitations which may make certain claims difficult to assess, some points need to be mentioned regarding Hale and Reiss' criticisms. Firstly, it is striking that in study after study, the same processes are found among children, within and across developmental stages, no matter what language is being acquired. Given their robustness, these general patterns constitute evidence that contributes to our understanding of language acquisition.

Secondly, while some studies, especially older ones, may not provide us with perfectly accurate transcriptions of some aspects of the child's outputs, these studies still contain very compelling evidence on broader details such as, for example, place of articulation. If one acknowledges the methodological shortcomings inherent to each study, and limits the number and type of claims that can be made accordingly, the study of these data remains perfectly well motivated.

Hale and Reiss (1998) also point out that "transcriptions of child speech are rife with inaccuracy" (Hale and Reiss 1998: 669). It is decidedly true that transcription of child language represents a very difficult task, given the fact that the transcriber must cope with sounds which do not always exist in the target language. However, doing child transcriptions is, in a way, no different from undertaking field work on a new language. In both cases, the sounds and combinations of sounds that are transcribed are filtered through the transcriber's perceptual system. Thus, abandoning the study of child language on these grounds would also imply rejecting much of the evidence presently available to linguists. This holds especially true of data from extinct languages for which no recordings exist, or historical reconstructions, despite the importance of this evidence for our understanding of linguistic systems and for the elaboration of linguistic theory. It seems highly unlikely that any linguist who has had the opportunity of doing fieldwork or working directly with informants would accept such a move! Moreover, given the methodology and setup of the database used for the French data analysed in this thesis, where the more difficult utterances could be heard and verified at will in order to attain the most accurate transcriptions possible, the empirical limitations suggested by Hale and Reiss regarding child language find very limited support.

In the next subsection, I discuss the second point of contention raised by Hale and Reiss (1998), namely their view that child productions are not system-based but, rather, are the result of non-linguistic factors.

1.2.2 The systemic basis of child language

Hale and Reiss (1998) defend the position that all of the mismatches observed between children's and target outputs result from performance-based misarticulations. They thus reject the idea that non-target-like outputs are system-based. Further, they argue that child language is plagued with misarticulations which provide us with no indication of what the underlying system is. Indeed, Hale and Reiss suggest that patterns regularly observed in some children's forms such as consonant harmony consist of "*systematic* misarticulations" (Hale and Reiss 1998: 668; emphasis original), thereby reducing most of child phonology to non-linguistic factors.

Hale and Reiss' conclusion is too radical. First of all, as mentioned above, the systematicity of the patterns observed within one child's outputs correlates with what is found in many other children, from several target languages (see, e.g. Ingram 1974a and Bernhardt and Stemberger 1998 for an overview of the patterns observed across languages). This cross-linguistic regularity considerably narrows the range of what is actually observed, as compared to what one would expect if the patterns were not constrained by the children's grammars. This point will be better demonstrated in chapter 4 where a cross-linguistic account of consonant harmony is provided. A process such as consonant harmony — if outside the system — should not be delimited by formal constraints on prosodic structure. However, as we will see in that chapter, any analysis of the French data from Clara must make reference to the child's foot structure — hence the organization of her grammar — in order to correctly account for the alternations observed.

Thus, Clara’s ‘systematic misarticulations’, as Hale and Reiss would label them, will be shown to result from her grammar’s systemic requirements.

Regarding the range of variation observed in child language, Hale and Reiss (1998) cite an example of extreme variability found in the pronunciation of the word *pen* by a 15-month-old child in a 30-minute time period as follows: [mã^{ə}], [ṽ], [dɛ^{dn}], [hɪn], [^{m}bõ], [p^{h}ɪn], [t^{h}n̩t^{h}n̩t^{h}n̩], [ba^{h}], [dhauɴ] (original data from Ferguson 1986; see, also, Faber and Best 1994). As concerns the present study, like many others, only the outputs for which the target (adult) word could be unambiguously identified were kept in the database, which is hardly the case for outputs such as [ṽ] and [ba^{h}] reported above. A number of scholars have addressed the issue of variability in L1 acquisition, for example, Velten (1943), Ferguson and Farwell (1975), Macken (1980), Macken and Ferguson (1983), Schwartz (1988), and, more recently, Brown and Matthews (1993, 1997), Rice and Avery (1995), Rice (1996a,b), and Jongstra (2000). While different points are focussed on in each of these studies, one consensus emerges: variation is not random. For example, at the level of the segment, Rice and Avery (1995) and Rice (1996a,b) propose a model of acquisition whereby variability decreases as a function of the number of segmental contrasts that are acquired by the child (see, also, Brown and Matthews 1993, 1997). Their model makes interesting predictions regarding (a) what yields variability (absence of the projection of features encoding phonemic contrasts) and (b) how variability should decrease (through the development of contrasts). Furthermore, Jongstra (2000), who has conducted a cross-sectional study of left-edge cluster reduction based on data from 11 Dutch-learning children, reports that, within individuals, variation in the cluster reduction strategies used by each child is very limited indeed, especially when the data are divided into periods of acquisition, each reflecting a different developmental stage. We can thus conclude that the example provided by Hale and Reiss (1998) constitutes an extreme case which can hardly be compared with the data sets used elsewhere in the L1 literature.

Drawing a parallel between child and adult language, Bernhardt and Stemberger (1998) also build an argument against Hale and Reiss' (1998) position. They suggest that Hale and Reiss' proposal "is equally applicable to adult speech: alternations could be due to alterations by the motor system" (Bernhardt and Stemberger 1998: 25). Bernhardt and Stemberger further argue that if the processes found in child phonology can be reduced to low-level phonetic considerations only, then the processes observed in adult phonology should be analysed in the same way. Such a position is rejected by Bernhardt and Stemberger (1998).

Consistent with Bernhardt and Stemberger's view, I maintain the position that alternations found in adult languages can only be analysed through an abstract organization of the grammar at segmental and prosodic levels of representation. The same holds true of child language. For example, Goad and Rose (2000, to appear) demonstrate that some cluster reduction patterns observed cross-linguistically can only be analysed with reference to structurally-defined prosodic heads, as no phonetic approach permits an adequate account of these patterns. In the same vein, as already mentioned, I argue in chapter 4 that consonant harmony patterns cannot be accounted for on phonetic grounds only; rather, only an approach based on hierarchically organized prosodic constituents can capture the patterns observed in the children's outputs as well as for contrastive behaviour observed between children. Moreover, throughout the thesis, all of the constraints used in the analysis of the children's patterns are independently supported in the literature on adult language, further demonstrating the parallel that exists between adult and child phonological systems. This parallelism will be further supported in chapter 3 where I show that, at each developmental stage in the acquisition of syllable structure, both Clara and Théo resemble at least one adult language. Levelt, Schiller, and Levelt (2000) reach similar conclusions in their investigation of the acquisition of syllable structure by 12 Dutch-learning children.

In the next section, I present an overview of the patterns described and analysed in chapters 3 to 5. As we will see, the current proposal adopts a system-based view of child language, contra Hale and Reiss (1998).

1.3 Overview of the patterns studied in the thesis

In chapter 2, which is devoted to an outline of the theoretical background and assumptions adopted in this thesis, I will discuss several patterns found in adult languages. These patterns will serve two main purposes. On the one hand, in cases where more than one option is available for representing a given segmental string, I will discuss typological evidence in order to determine which option constitutes the unmarked one, i.e. the option that must be entertained first by the learner. As we will see in subsequent chapters, the children will always conform to the default options determined through these typological investigations. On the other hand, adult languages will constitute independent motivation for the constraints that will be at the core of the analyses of the developmental patterns proposed in chapters 3 to 5. Specifically, I will focus on faithfulness constraints referring to heads of constituent structure (MAXHEAD), as well as licensing constraints expressing relations between features and their prosodic licensors (LICENSE). MAXHEAD, which will enable us to make predictions about which input segment or Root node survives at stages where complex input structures are not tolerated by the children's grammars, will be motivated at three levels of representation, namely, the foot, the onset, and the segment. Motivation for the former two will come from the southeastern dialect of Brazilian Portuguese; motivation for the latter will be based on patterns of rising diphthong reduction attested in French loanwords in Fula. LICENSE, which will be central to the analysis of assimilation patterns in child language (consonant harmony and place assimilation in branching onsets) will be motivated from vowel harmony systems found in dialects of European Spanish.

In chapter 3, I will propose a longitudinal comparative study of the acquisition of French prosodic structure, based on Clara's and Théo's data. The account will focus on the acquisition of complex syllabic constituents (branching onsets, branching rhymes), as well as on the acquisition of word-final consonants and rising diphthongs.

We will see that the syllable structure of the two children, starting from an unmarked consonant-vowel (CV) shape at the initial state, becomes progressively more marked. Acquisition of the various branching constituents will be achieved independently, supporting the view that different markedness constraints govern the realization of each syllable constituent.

Regarding the acquisition of word-final consonants, I will argue, in line with Piggott (1999), which is based on adult languages, and Goad and Brannen (2000), which is based primarily on L1 acquisition data, that, in the unmarked case, a word-final consonant must be represented as the onset of an empty-headed syllable (see section 2.2.7) rather than as the second member of a branching rhyme (coda). This account will be supported on empirical grounds by the fact that word-final consonants and word-internal (true) codas are acquired at different points in time.[10]

I will also demonstrate that branching onsets and rising diphthongs, despite the fact that they are both contained in consonant+sonorant+vowel sequences, are acquired independently of each other. This will provide support for the view that glide-vowel sequences in CGV strings are, in the unmarked case, represented as monopositional complex vowels (see, on this, section 2.2.5).

Finally, a positional faithfulness pattern will be observed in the acquisition of branching onsets. Complexity within the onset constituent emerges in stressed syllables before it emerges in unstressed syllables. In order to account for this pattern, I will appeal to a segmental faithfulness constraint referring specifically to the head of the foot, i.e. the

10. This generalization holds true of all of the consonants with the exception of Clara's [ʁ], whose segmental representation, devoid of place specifications, yields a different syllabification, as I will argue for in chapter 5 (see below as well).

stressed syllable. Regarding this pattern, I will also demonstrate on empirical grounds that while the emergence of branching onsets is subject to this particular faithfulness constraint, rising diphthongs are not and cannot be, because rising diphthongs do not involve complexity within the onset constituent. This will further support the current position that the two strings involve different structures.

The combination of the various phenomena mentioned above will support the view adopted in this thesis that an approach which refers to highly articulated prosodic representations is necessary to enable us to make strong predictions regarding the developmental patterns observed in child language.

In chapter 4, I turn to consonant harmony. The analysis will be based on interacting sets of constraints which make direct reference to the licensing of segmental features at the level of foot structure. Clara's consonant harmony patterns will be compared with those found in the data from Amahl and Trevor, which show similar patterns with one noticeable exception: while word-final consonants undergo consonant harmony in both English children's outputs, Clara's word-final consonants escape consonant harmony (e.g. Amahl's *duck* [d̲ʌk] → [g̊ʌk] versus Clara's *dame* [d̲am] → [dam], *[bam] 'lady'). This last example contrasts with Clara's *debout* [d̲əbu] → [bɑˈbu] 'standing', where regressive labial assimilation is observed. Moreover, in CVC [Coronal…Dorsal] words parallel to English *duck*, a metathesis process is observed in Clara's data (e.g. *sac* [s̲ak̲] → [katʃ]).

A unified analysis of the differences observed between the French and English data will be proposed, based on (a) licensing relationships between place features and different levels of prosodic representation, and on (b) a structural difference that exists at the level of foot structure between the two languages. I will argue that Clara's word-final consonants escape consonant harmony because they are licensed outside the foot, directly by the prosodic word, contrary to final consonants in English, which are licensed within the foot. While input word-final dorsal consonants are not subject to consonant harmony in French, they still cannot appear in this position. I will argue that metathesis constitutes a last-resort option for ensuring faithfulness to both Coronal and Dorsal in [Coronal…Dorsal] CVC words. In short, the burden of explanation in chapter 4 will be placed on prosodic constituency, as in chapter 3, as well as, crucially, on licensing relationships which take place within constituents.

In chapter 5, I will turn to processes observed in the development of the French rhotic [ʁ], for which Clara and Théo display contrasting patterns. Two patterns will be discussed as concerns the development of Clara's [ʁ]. Firstly, when it appears in the head position of the onset constituent, Clara's [ʁ] takes on the place specification of another consonant in the word, similar to the consonant harmony patterns described above (e.g. *robe* [ʁ̲ɔb] → [wɔb] 'dress' and *rouge* [ʁ̲ʊʒ] → [jʊʃ] 'red'). During the same period of acquisition, however, [ʁ] can surface as target-like in the dependent position of a branching onset (e.g. *citrouille* [sit̲χ̲ʊj] → [θəˈtχuːj] 'pumpkin').

Secondly, contrary to all of the other word-final consonants, which are syllabified as onsets of empty-headed syllables, we will see that Clara's [ʁ] is syllabified word-finally in coda position. This proposal will be empirically supported by two observations. First, word-final [ʁ] emerges at the same time as word-internal codas and crucially later than other word-final consonants, which are onsets of empty-headed syllables. Second, a pattern of vowel lengthening concomitant with word-final [ʁ] deletion is found, which finds no correlate when word-final consonants other than [ʁ] are deleted: this will support the rhymal status of Clara's word-final [ʁ].

With regard to the development of [ʁ], Théo differs from Clara in two ways. First, while Clara's [ʁ] *undergoes* assimilation in onset heads, Théo's [ʁ] *triggers* assimilation; in branching onsets, Théo's input Coronal-[ʁ] branching onsets are realized as Dorsal-[ʁ/χ] in output forms (e.g. *train* [t̲χ̲ɛ̃] → [kχɛ] 'train'). Also, while Clara's word-final [ʁ] is syllabified in coda position, Théo's word-final [ʁ] emerges at the same time as his other word-final consonants, as the onset of an empty-headed syllable.

Assuming that [ʁ] is inherently placeless in French, as has been argued for several other languages, I will propose that Clara's representation for [ʁ] is target-like, i.e. placeless. Théo, by contrast, who is mislead by the uvularity of target [ʁ], incorrectly assigns a Dorsal specification to this consonant.

I will argue that both of the observations made above for Clara's [ʁ] can be related to the placelessness of this consonant. Placeless [ʁ] will violate the requirements of a constraint demanding all output consonants to bear place specifications when they appear in head position (HEADPLACE; see section 5.2.2.1). The place feature assimilation that is observed in *robe* and *rouge* (realized as [wɔb] and [jʊʃ], respectively) will result from this. Furthermore, since target [ʁ] in branching onsets appears in a dependent position, it can surface as placeless since HEADPLACE is not concerned with dependent positions. In order to explain why Clara's word-final [ʁ] is syllabified in coda position instead of as the onset of an empty-headed syllable, I will appeal to markedness (see section 2.2.7) and hypothesize that, in the unmarked case, while word-final consonants specified for place features are syllabified as onsets of empty-headed syllables, word-final placeless consonants are syllabified in coda position. By treating word-final placeless [ʁ] as a coda, Clara will reflect the unmarked option.

I will explain Théo's assimilation pattern as a consequence of the proposal that he represents [ʁ] as Dorsal. I will appeal to a licensing constraint demanding that Dorsal (a marked feature) be licensed by a head. The combination of these two factors will provide us with an explanation for the assimilation pattern observed in Théo's branching onsets. Finally, since Théo's [ʁ] is specified for Dorsal place, its syllabification in word-final position as the onset of an empty-headed syllable will also reflect the unmarked option.

1.4 Concluding remarks

In this introductory chapter, I have discussed a number of issues related to the data which will be analysed in subsequent chapters. I first outlined the methodology used in the collection of the French data introduced in this thesis, as well as the techniques developed for encoding these data into a computerized database. I then discussed aspects of the English data which will be used in the cross-linguistic account of consonant harmony developed in chapter 4.

I addressed next some of the conceptual and methodological issues raised by Hale and Reiss (1998), who take a position against any approach to child phonology based primarily on children's productions. I argued that the concerns raised by Hale and Reiss (1998) find no legitimate support for the type of data used in this thesis; the potential limitations of the data under investigation are, in essential respects, comparable to studies based on field work.

Finally, I provided an overview of the patterns and of some of the issues that will be discussed in the following chapters. As we saw from this summary, all of the developmental issues tackled in this thesis will be approached from a structural perspective. Based on highly-articulated representations, I will appeal to (a) faithfulness constraints referring to material contained in constituent heads, (b) markedness constraints regulating constituent-internal complexity, as well as (c) feature licensing constraints targeting specific levels of prosodic structure.

We will now proceed to the chapter devoted to the theoretical background and assumptions adopted in this thesis.

Chapter 2

THEORETICAL BACKGROUND AND ASSUMPTIONS

2.0 Introduction

In this chapter, I outline the theoretical background and assumptions necessary before a satisfactory account of the developmental patterns overviewed in the previous chapter can be provided. As we will see, much importance will be attributed to theories of representation, which are at the core of the arguments proposed in the subsequent chapters. All aspects of the representations to be discussed below are assumed to be available to the child, provided by Universal Grammar (henceforth, UG), which constitutes the cornerstone of Generative Grammar, the general framework adopted in this thesis. I will also appeal to phonological constraints, which are assumed to be part of the UG endowment as well, in order to regulate both the type of structures allowed in surface representations (markedness constraints), and the input-output mapping between these representations (faithfulness constraints). As I will demonstrate in subsequent chapters, this approach will permit us to regulate the shape of representations in output forms for each developmental stage, as well as to make strong predictions about the developmental patterns observed across stages.

I will now proceed to a more detailed description of the different theories to be used in the next chapters. In each of the sections below, I will discuss the positions adopted in light of acquisition patterns, in order to anticipate the analyses that will follow in subsequent chapters.

The chapter is organized as follows. In section 2.1, I discuss the theory of segmental representation used in the analysis. This is followed, in section 2.2, by the representations which hold at the level of prosodic structure. As mentioned above, both segmental and prosodic representations will be regulated by a set of constraints. The constraints used in this thesis are formalized within Optimality Theory (e.g. Prince and Smolensky 1993).

This framework is introduced in section 2.3, where I also define the general constraints used in the following chapters. Finally, in section 2.4, I discuss the positions assumed regarding child language and phonological development, namely, the continuity assumption (Pinker 1984), the initial state of the grammar, as well as the shape of the inputs in child grammar, i.e. the representations stored in the child’s lexicon.

2.1 Segmental representation

Although I will focus primarily on prosodic aspects of the developmental patterns discussed in this thesis, I will on occasion refer to the featural organization of the segments involved. This especially holds true of chapter 5, where I will discuss the variability observed between Clara and Théo in the development of the rhotic [ʁ].

As a consequence of the emergence of Optimality Theory (described in detail in section 2.3), theories of segmental representation, and especially Feature Geometry (e.g. Clements 1985, Sagey 1986, Halle 1992, Clements and Hume 1995), have lost much of the importance attributed to them with the emergence of non-linear phonology (e.g. Goldsmith 1976, Clements 1976). Many of the alternations that were formerly explained through the hierarchical organization of features are now formalized in terms of constraint interaction, without regard to segment-internal structure at all, or in frameworks such as Feature Class Theory (Padgett 1995).[1]

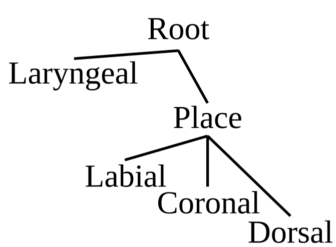
Despite this trend, I maintain the view that features are hierarchically organized in representations. The problem with approaches such as Feature Class Theory is that by encoding *all* feature geometric relations in terms of constraints, some robust generalizations, which are consistently observed throughout the literature on Feature Geometry, are lost.[2] More specifically, while it is true that the various geometries proposed vary in their details, certain relations like, for example, the presence of the organizing

1. See, e.g. Parkinson and Cahill (1997) for a critique of Padgett (1995).
2. I owe this observation to H. Goad.

nodes Place and Laryngeal as constituents under Root, as well as the presence of the features Labial, Coronal, and Dorsal as constituents under Place (see the representation in (1)), appear throughout the literature. Encoding these non-commutable aspects of segmental representation in terms of constraints is akin to throwing the baby out with the bath water.

I claim that while some aspects of segmental representation may vary across spoken languages and, as such, are preferably encoded through violable constraints, other aspects are inalterable and, thus, should be encoded via fixed representations, in terms of a feature geometry. For the aspects of development that are essential to this thesis, I will assume the somewhat simplified geometry in (1).[3] This model is adopted as it encodes the properties discussed earlier which recur in all geometries found in the literature.

(1) Feature geometry (simplified)



In brief, this geometry posits that segments are composed of a Root node which directly dominates two organizing nodes, namely, Laryngeal and Place. The first captures laryngeal specifications such as voicing. The second node organizes specifications relative to place of articulation. Regarding Place specifications, the division into the three major place features, Labial, Coronal, and Dorsal, will prove to be of relevance in chapters 4 and 5, where the analysis of the patterns observed focuses on the constraints which regulate the

3. Note that the model adopted in (1) serves for illustrative purposes only. The analyses proposed in the next chapters do not depend crucially on this particular feature geometry.

realization of these features in different prosodic environments. Finally, I also assume that features are monovalent although nothing rests on this.

In section 2.2.8, I will discuss how segmental information is anchored to prosodic representations. In order to cast this discussion in its broader context, I will first present the theory of prosodic representation which is assumed throughout the thesis. The constraints that act on both segmental and prosodic representations are introduced later, in section 2.3, concurrently with the discussion of the constraint-based framework adopted.

2.2 Prosodic representation

2.2.1 Prosodic hierarchy

In this thesis, I integrate a set of theories on prosodic representation which takes as its starting point the view that constituents are organized into a prosodic hierarchy, as illustrated in (2).

(2) Prosodic hierarchy[4] (e.g. Selkirk 1980a,b, McCarthy and Prince 1986)

Prosodic word (PWd)
|
Foot (Ft)
|
Syllable (σ)
|
(Syllable subconstituents)
|
Timing unit (X)

I will discuss in separate sections below the representations I assume for the internal organization of two constituents dominated by the prosodic word, namely, the foot and the syllable. I will then turn to the level of the timing unit (or X slot), which constitutes the lowest level of organization in the prosodic hierarchy. Before I elaborate on these different

4. Timing units (X) are used instead of moras (μ) in the prosodic hierarchy in (2), mainly because I assume the Onset-Rhyme theory of syllabification (see section 2.2.3 for details) rather than Moraic Theory (Hyman 1985, McCarthy and Prince 1986, Hayes 1989).

levels of representation, I will introduce, in the next subsections, a few assumptions related to prosodic structure and the relations that take place within the prosodic hierarchy.

2.2.1.1 Prosodic licensing

In order to constrain how segmental information is incorporated into the prosodic hierarchy in (2), I adopt Itô's (1986) Licensing principle, defined in (3).

(3) Licensing principle (Itô 1986: 2)
All phonological units must be licensed, i.e. belong to higher prosodic structure

According to this principle, in order to be implemented on the surface, melodic material must be licensed by some constituent within the prosodic hierarchy. Material that is not licensed is subject to deletion.

Licensing relationships are expressed in the literature as dependency conditions which make the presence of one unit (e.g. constituent, segment or feature) conditional on the presence of another unit.[5] According to Itô (1986), the distribution of features in surface representations is determined by relationships that apply between them and a given prosodic category, the licensor. Such relationships are observed in languages like Lardil, where restrictions on coda position can be found. As we can see in the examples in (4), codas in this language are limited to coronal consonants, (4a), and homorganic nasals, (4b).

(4) Restrictions in coda in Lardil (Itô 1986; original source: Wilkinson 1986)
a) Coronals

[kar̲.mu]	'bone'
[yar̲.put]	'snake, bird'
[rel̲.ka]	'head'

5. Such dependency relations are not restricted to the theory of Prosodic Phonology. Similar relations are discussed in the literature on Dependency Phonology (e.g., Anderson and Ewen 1987; Durand 1990) and Government Phonology (e.g. Kaye, Lowenstamm, and Vergnaud 1985, 1990; Harris 1990).

b) Homorganic nasals

[kuŋ̲.ka]	‘groin’	(*[kum.ka])
[kan̲.tu]	‘blood’	(*[kaŋ.tu])
[ŋam̲.pit]	‘humpy’	(*[ŋaŋ.pit])

In order to account for the restrictions on place of articulation observed in (4), Itô proposes that marked place features can appear in coda only when they are licensed by the following onset, following the Coda condition in (5).

(5) Coda condition (Itô 1986)
The coda cannot license (non-coronal) place features

This is illustrated in (6). As we can see, the presence of a (non-coronal) place feature is only possible when this articulator is shared with the licensor of this feature, the following onset, as in (6a). As illustrated in (6b), a coda place feature which is not licensed by an onset is not allowed in Lardil.

(6) Coda licensing in Lardil
a) Well-formed b) Ill-formed

The alternations observed in Lardil clearly show that the presence of a feature in a weak syllabic position, the coda, is conditional on its realization in a strong syllabic position, the onset, which is the licensor of this feature. The fact that a position that *bears* a feature is not necessarily the position that *licenses* it constitutes the cause of the feature sharing observed in the examples in (4b).

Most scholars accept an analysis akin to (6) in order to account for coda restrictions across languages. This proposal has been extended to other contexts where asymmetrical distributions of features are observed. For example, Beckman (1995, 1997) explains the distribution of mid vowels in Shona verbs through a faithfulness constraint referring specifically to a prosodically strong position, the first syllable of the word. In brief, Shona mid vowels may appear in verbal suffixes only when their height specifications are realized (licensed) by the initial syllable of the verbal root (#CeCe; *#CaCe, *#CiCe). Similarly, in his investigation of a number of harmony systems observed across languages, Piggott (1996, 1997, 2000) argues that the feature sharing observed in these systems is caused by licensing. He proposes that harmony results from licensing relations that take place between a feature (the harmonic feature) and the prosodic licensor of this feature, i.e. the head of a given prosodic category (e.g. syllable, foot, prosodic word). In the field of child phonology, Goad (2000), who follows Piggott's (1996, 1997, 2000) proposal that licensing is the central source of harmony systems, argues that consonant harmony is driven by licensing relationships. (The analysis proposed in chapter 4 follows the spirit of Goad's (2000) proposal, although it is quite different in its implementation.[6]) Finally, as mentioned above (section 1.3), the assimilation pattern found in Théo's Coronal-[ʁ] branching onsets will also be analysed through licensing: the feature Dorsal must be licensed by the head of the onset constituent.

2.2.1.2 Binarity

In subsequent sections, I describe in more detail the different levels of constituency within the prosodic hierarchy. As we will see, each constituent may or may not branch. In branching constituents, maximal binarity is assumed, following the theorem proposed by

6. Both Goad (2000) and the current proposal constitute extensions of Piggott's contribution to the theory of licensing.

Kaye (1990), which is given in (7). (On maximal binarity of constituents, see also Kenstowicz 1994 and Hayes 1995, among others.)

(7) Maximal binarity
All prosodic constituents are maximally binary

Kaye (1990), as well as other proponents of Government Phonology (e.g. Kaye, Lowenstamm, and Vergnaud 1985, 1990, Harris 1990, Charette 1991), argue for strict binarity of all prosodic constituents (below the foot). The position taken in this thesis is somewhat less rigid. I do assume binarity in the sense that a given constituent *x* cannot immediately dominate more than two instances of *y*. However, as will be discussed in section 2.2.6, simultaneous binary branching of the rhyme and the nucleus which creates ternary rhymes will be permitted in the marked case, a possibility which is ruled out under a strict interpretation of Government Phonology (but see Harris 1994).

2.2.1.3 Headedness

I also assume that head-dependency relationships hold at every level of constituent structure. As we will see in section 2.2.5, I assume that headedness holds not only at the level of prosodic structure but also at some levels of segment structure, more specifically between the two Root nodes of input rising diphthongs, which are argued to be monopositional complex vowels.

The notion of headedness, which is accepted by most — if not all — phonologists, refers to a formal relation that holds between the elements appearing in a given structure. In non-branching configurations, headedness is trivially assigned to the only member of the structure. In branching configurations, one of the elements, the head, has primacy over the other, the dependent. Head-dependent asymmetries are reflected in distributional freedom: the head has a freer distribution than its dependent (Harris 1994: 149). Distributional freedom is a consequence of the fact that heads can license more material than dependents. This has consequences for the way that processes such as cluster reduction and assimilation are manifested: these processes apply in a way that ensures that faithfulness to input heads is satisfied, and that the distribution of features satisfies head-dependency relations in the output.

These relationships will be exemplified in the subsequent chapters, where, as implied above, I refer to headedness at both the prosodic and segmental levels of representation in order to express the developmental patterns observed in the data under investigation. As we will see, these relationships enable us to make strong predictions concerning the reduction patterns observed in the acquisition of target complex structures (both segmental and syllabic), as well as in assimilation processes, which will be found in the patterns of consonant harmony discussed in chapter 4 and in Théo’s Coronal-[ʁ] branching onsets in chapter 5.

2.2.1.4 Locality

Finally, I assume that relationships that take place within any category of the prosodic hierarchy are subject to the Locality condition. The definition of Locality that I adopt, which is in the spirit of Itô (1986) as well as Kaye (1990) and Kaye, Lowenstamm, and Vergnaud (1990), is given in (8).

(8) Locality
A relation is bound within the domain delimited by the highest category to which it refers

According to the definition in (8), a licensing relationship referring to a given domain (e.g. the foot, the onset) will never extend beyond that domain.

I will appeal to the Locality condition in the analysis of the consonant harmony patterns explored in chapter 4. As we will see, consonant harmony will be analysed as a licensing relation that refers specifically to the foot. Because Locality determines the domain in which a relation (like assimilation) holds, consonants that are licensed outside of this constituent will escape consonant harmony (see section 4.3.4). Also, in chapter 5, I will analyse an assimilation process that applies exclusively within branching onsets through a licensing constraint which refers specifically to this constituent. Here again, Locality will prevent assimilation from applying outside the licensing domain defined by the onset licensing constraint.[7]

I will now turn to a description of the different levels of prosodic constituency which I will refer to in the analyses proposed in subsequent chapters.

2.2.2 Foot structure

According to the prosodic hierarchy in (2), syllables are organized into feet. Foot construction involves maximally binary groupings either at the level of the syllable or at the level of the syllable rhyme (mora), in quantity sensitive stress systems (Hayes 1995). According to Fikkert (1994) and Demuth (1996b), however, feet found in early acquisition are always quantity insensitive, even in languages which show quantity sensitivity (e.g. Dutch and English). Thus, I will restrict the discussion to syllabic (quantity insensitive) foot construction.

According to Hayes (1995), two types of syllabic feet can be found across languages: left- and right-headed (labelled ‘trochee’ and ‘iamb’, respectively). These two foot types are represented in (9).

7. The view of Locality adopted here is similar to constituent government as posited within Government Phonology (e.g. Kaye 1990, Kaye, Lowenstamm, and Vergnaud 1990). In order to formalize the relationship illustrated in (6), it is necessary to posit cross-constituent licensing between two positions which belong to different syllables. In the analyses proposed in subsequent chapters, I will refer only to licensing relationships that hold within constituents.

(9) Trochaic and iambic feet (after Hayes 1995: 71; heads are underlined)

a) Trochee (left-headed) b) Iamb (right-headed)

Because of the fact that trochaic languages are more frequent than iambic languages, the theory of foot structure detailed in Hayes (1995) contains a markedness component which predicts that a bias towards the trochaic foot shape should be found in child language. Compatible with Hayes' (1995) view, some researchers have proposed that such a bias exists on the basis of children's early word shapes (e.g. Allen and Hawkins 1978, 1980, Gerken 1991, 1994, Fikkert 1994).[8] However, this position has been challenged by other researchers such as Demuth (1995, 1996a), Demuth and Fee (1995), and Paradis, Petitclerc, and Genesee (1997), who argue against a universal bias towards trochaic footing. For example, based on observations about early word shapes, Demuth (1995) suggests that children could initially be agnostic to language-specific details about foot structure.

Based on experimental results, Jusczyk, Cutler, and Redanz (1993), and Morgan and Saffran (1995) demonstrate that children are more sensitive to the predominant stress patterns of the target language even during the period of babbling which predates the first words. However, the evidence provided by these scholars comes essentially from English, a language which has a trochaic system. In fact, the majority of English nouns are bisyllabic with initial stress,[9] compatible with the representation in (9a). Therefore, no

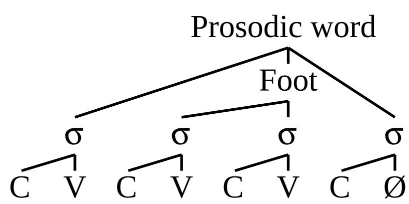
8. Notice that Fikkert, whose claim is based on children learning trochaic languages only, adds a provision to her position, that "patterns of children learning a language with iambic feet would be revealing" (Fikkert 1994: 192).

9. Although this holds true of most bisyllabic nouns, the English facts are obviously more complicated than implied in the text. For example, in longer nouns, stress falls on the antepenultimate syllable when the penult is light (e.g. análysis, Cánada, América).

firm conclusion regarding the validity of a trochaic bias in child language can be made from these studies.

With regard to stress patterns, French words consistently display word-final stress (e.g. Tranel 1981, Dell 1984, Charette 1991). It is actually quite difficult to find formal accounts of stress in French in general and, especially, in Québec French. Regarding this dialect, Charette (1991) provides the clearest proposal, which, for the matters important to this thesis, goes as follows: (a) a right-dominant foot is projected from the last vowel of the word, (b) an empty nucleus cannot be the head of a metrical foot,[10] and (c) all the nuclei of the word which remain metrically unorganized are incorporated into the level of the prosodic word (after Charette 1991: 146).[11] This proposal is illustrated in (10).

(10) French foot structure



For all intents and purposes, French thus constitutes the mirror image of the left-dominant foot shape found in English nouns. There are some additional complications concerning the prosodification of word-final consonants which will be addressed in section 2.2.7.2.

Regarding foot shape in English- and French-learning children, Paradis (2000) sheds new light on the trochaic bias issue discussed above. In an experiment on truncation patterns in English-learning, French-learning, as well as in English-French bilingual two-year-old children, Paradis demonstrates that French children follow an iambic 'template' (e.g. WWWS → WS).[12] Notice that this pattern is expected since when building binary

10. Onsets of empty-headed syllables will be addressed in section 2.2.7.
11. See, also, Paradis and Deshaies (1990) and Scullen (1993) for additional discussion.
12. W(eak) = unstressed syllable; S(trong) = stressed syllable. All stimuli were nonce words.

syllabic feet, a word-final stressed syllable forces, in essence, iambic foot construction. More interestingly, when facing WSWS words, the English-French bilinguals show a greater tendency to build WS (iambic) words than the English-only children, who generally produce a SW (trochaic) word.[13] The effect found with the English-French bilinguals appears to be the result of an iambic bias caused by exposure to French.

In order to reconcile the French facts with the universal trochaic bias suggested by Hayes (1995) and others cited above, I accept that there is a trochaic bias at the earliest stage, but that it disappears quickly in languages where the child is exposed to evidence in favour of iambic footing. Such an early mastery of the target language's foot shape presumably results from the fact that, in foot construction, the structural head corresponds to the phonetic head (the most salient syllable); as a result, children have plenty of evidence in order to determine the right- versus left-headed foot shape of the language they are acquiring.

Following from this hypothesis, at the stage where the first words are produced by the child, the predominant stress pattern of the target language (e.g. left- versus right-headed feet) is already acquired, consistent with the findings of Jusczyk, Cutler, and Redanz (1993), and Morgan and Saffran (1995). This hypothesis is also consistent with the standard position in the generative literature that the child can only use positive evidence to acquire the grammar of his/her language:[14] despite the trochaic bias provided to the

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13. Note that, on the one hand, W<u>SW</u>S $\rightarrow$ SW requires deletion of the word-final syllable, counter to what is regularly observed in the truncation patterns of English-learning children (e.g. Smith 1973, Allen and Hawkins 1978, Ingram 1978, Echols and Newport 1992, Echols 1993, Fikkert 1994, Gerken 1994, Wijnen, Krikhaar, and den Os 1994, Demuth and Fee 1995, Demuth 1996b, Pater 1996, 1997, Curtin 1999). On the other hand, WS<u>WS</u> $\rightarrow$ SW requires stress shift, a process which is rarely found in child language; it is sometimes observed for words showing stress patterns that depart from the regular pattern of the target language (Fikkert 1994: 200-201). Therefore, the stimuli of the WSWS shape favour iambic footing for those children who have had exposure to words of this shape. Despite this problem, the different behaviour observed between the monolingual English-learning children versus the English-French bilinguals reveals the influence of the French iambic system on the latter.
14. This issue is further discussed in section 2.4.

French child by UG, positive evidence in favour of a different foot construction yields patterns such as the ones found in Paradis (2000).

In light of the results from Paradis (2000) — English children = trochaic; French children = iambic — and those references which showed sensitivity to foot structure during babbling, I propose that English- and French-learning children exploit different foot types, i.e. the trochee and the iamb, respectively, as illustrated in (11).

(11) English and French foot structure (heads are underlined)

a) English (left-headed) b) French (right-headed)

A comparison of English and French early outputs provides additional support for this hypothesis. As reported by a number of scholars (see references in footnote #13), at the stage where bisyllabic words are possible in early English grammars, initial syllables in the exceptional English words — those that, contrary to the regular pattern, display final stress — tend to undergo deletion, as we can observe in (12a) from Pater (1997). Notice that, at equivalent ages, faithfulness is observed for both input syllables when the word is stressed on the initial syllable, as evidenced by the following data from Trevor: *tickle* [gɪgʊ], 1;07.28; *jacket* [gækɪt], 1;04.09-1;10.11 (data from Pater 1997: 235-236).[15] In contrast to the English pattern, French early CVCV words, which always bear final stress, are realized without initial syllable deletion in the children's outputs, as we can see in (12b).[16]

15. Unfortunately, Pater does not provide a systematic comparison between stress-initial and stress-final bisyllabic words. These examples are taken from the data he uses to illustrate Trevor's consonant harmony alternations. For the point being discussed here, however, only the preservation versus deletion of initial syllables in stress-initial and stress-final bisyllabic words is relevant. For similar data in Dutch, another trochaic language, see Fikkert (1994).

(12) Difference between English and French in early stress-final CVCV words

a) English early stress-final words: initial syllable deletion (Pater 1997: 217-218)

Word	Child's output	Child's name	Age
again	[gɛn]	Julia	1;10.01-2;01.24
	[gɛ]	Sean	2;05.21
	[gɛn]		2;07.11
apart	[part]	Trevor	1;09.29
behind	[haind]	Derek	2;03.04
	[haiːn]	Trevor	2;00.08-2;02.15
balloon	[bun]	Derek	2;02.25-2;04.26
	[bʊn]	Julia	1;09.18-1;10.23
	[bum]	Sean	1;04.27-1;06.25
	[buːm]	Trevor	1;04.27-1;06.25

b) French early stress-final words: no initial syllable deletion

Word	Target form	Child's output	Child's name	Age	Gloss
maman	[maˈmɑ̃]	[məˈmæ]	Clara	1;00.28	'mom'
		[mɔˈmaː]	Théo	2;02.16	
papa	[paˈpa]	[paˈpæ]	Clara	1;03.07	'dad'
		[bəˈba]	Théo	1;11.10	
dedans	[dəˈdɑ̃]	[daˈdæ]	Clara	1;03.16	'inside'
		[tœˈtɑ̃]	Théo	2;11.23	
sandale	[sɑ̃ˈdal]	[θaˈðæ]	Clara	1;04.14	'sandal'
Gaspard	[gasˈpɑʁ]	[pəˈpæː]	Clara	1;03.07	'Gaspard'
bébé	[beˈbe]	[beˈbeː]	Clara	1;03.23	'baby'
		[pəˈpe]	Théo	1;11.24	
capable	[kaˈpab]	[kœˈpa]	Théo	2;01.19	'able to'
encore	[ɑ̃ˈkɔʁ]	[aˈka]	Théo	1;10.27	'again'

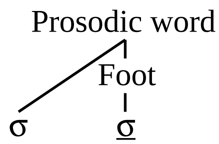
This distinction between English and French can be straightforwardly explained through the difference between these two languages' foot structures as posited in (11). At the stage we are concerned with, syllables prosodified outside the foot cannot be preserved

16. One exception to this pattern is found in Clara's early vowel-initial words, which display deletion. As we will see in section 3.1.1.1, this pattern is explained through (a) a constraint against onsetless syllables and (b) the absence of consonantal epenthesis.

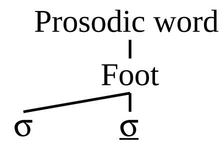
in output forms. The initial syllable in English stress-final bisyllabic words is left unfooted, as illustrated in (13a). Consequently, this syllable is deleted from the output.

(13) English and French foot structure in stress-initial bisyllabic words

a) English: word-initial syllable unfooted



b) French: word-initial syllable footed



In contrast to this, the initial syllable of French bisyllabic words is contained within the foot, as we can see in (13b). This syllable can thus be preserved in the output, along with the second (stressed) syllable of the input.[17]

We have thus seen that different foot shape in the two languages have consequences for preservation of initial unstressed syllables. In chapter 4, I will provide more evidence in favour of the claim that English and French children exploit different foot shapes. As we will see, different patterns of consonant harmony found between the two languages reflect the dichotomy in foot headedness illustrated in (11). This distinction between the English and French foot shapes will have important consequences for the way that final consonants are linked to prosodic structure. However, it would be premature to tackle this issue at this point, since the status of word-final consonants has not yet been discussed. I will thus defer any further elaboration on this topic to section 2.2.7.2 below, after the syllabification of word-final consonants has been addressed.

A final issue concerns the question of whether codas contribute to syllable weight in (at least some) French-learning children. This appears to be very improbable. First, as mentioned earlier, regarding languages that display quantity-sensitivity such as Dutch, Fikkert (1994) demonstrates that, at the initial state, Dutch-learning children abide by a

17. A similar explanation will be proposed in chapter 3 in order to explain contrasting faithfulness patterns between Dutch and French vowel-initial words.

quantity insensitive foot (for similar evidence from English-learning children, see Demuth and Fee 1995). Given this evidence, it can be concluded that, despite the fact that many languages have quantity sensitive systems (e.g. Hayes 1995), quantity sensitivity does not represent the unmarked case, i.e. the first option available to the child. Concerning French, given that codas are found relatively rarely in stressed syllables, and that there are no alternating stress patterns in this language, the child starting with a quantity-insensitive system is faced with no positive evidence for quantity sensitivity. Therefore, the learner of French should never develop quantity sensitivity. This conclusion is supported by both Clara's and Théo's data.

In the next section, I turn to the issues pertaining to the syllable and its subconstituents.

2.2.3 Syllable structure

Throughout the thesis, I will assume a version of syllable structure which recognizes an internal organization of the syllable along the lines of, e.g. Pike and Pike (1947), Fudge (1969), Halle and Vergnaud (1978), McCarthy (1979), and Selkirk (1982), among others. Although the proposals of these scholars vary in their details, they generally recognize a hierarchical organization whereby the syllable consists of a head constituent, the rhyme, and a non-head constituent, the onset. The rhyme dominates another constituent, the nucleus, within which the segment that constitutes the syllable head (usually a vowel) is syllabified. This basic syllable is represented in (14). The parentheses around the onset indicate that this constituent is optional, as opposed to the nucleus and the rhyme, which are assumed to be obligatory constituents.

(14) Syllable

σ

(Onset) Rhyme

Nucleus

Notice as well that, following Kaye (1990) and Kaye, Lowenstamm, and Vergnaud (1990), I reject the coda as a constituent of the syllable. Coda consonants are instead syllabified as post-nuclear consonants, i.e. in the dependent position of the rhyme, as we will see in more detail in section 2.2.6.

Syllables without onsets are relatively more marked than syllables containing an onset. This claim is supported on typological grounds. For example, Clements and Keyser (1983), Prince and Smolensky (1993), and Blevins (1995: 217), who follow the earlier work of Jakobson (1962), report that while all languages have CV syllables, a number of languages do not allow for vowel-initial syllables. This relative markedness is also reflected in the acquisition literature. For example, Fikkert (1994: 57-58) has observed that many Dutch-learning children initially allow only for CV syllables before they allow for the vowel-initial syllables found in Dutch. In section 3.1, I will discuss this pattern in more detail. I will also provide additional evidence for obligatory onsets at the initial state from Clara's data.

In the next subsections, I discuss in more detail the three subconstituents of the syllable, namely, the onset, rhyme, and nucleus, as well as the headedness relationships that take place within these constituents. Given the familiarity that most readers will have with English, I will illustrate the discussion of French syllable structure with a comparison of the main similarities and differences that it has with English.[18]

18. Notice that the comparison of the two languages provided below is far from exhaustive. The discussion focuses on those differences that are relevant for the issues addressed in this thesis. For a thorough description of French and English, the reader is invited to consult the references provided.

2.2.4 Onset

Following the theorem given in (7) above, I assume that the onset is a maximally binary constituent. In singleton onsets, the head trivially corresponds to the only segment of the constituent. In branching onsets, the head of the constituent universally corresponds to the left member of the cluster (e.g. Kaye, Lowenstamm, and Vergnaud 1990), as represented in (15).

(15) Representations for possible onsets (heads are underlined)

a) Singleton Onset

Onset

$\underline{\text{X}}$

b) Branching Onset

Onset

$\underline{\text{X}}$ X

French, like English, allows for branching onsets. However, these two languages have different phonotactic restrictions regarding the melodic content that they allow in branching onsets. For example, English disallows voiced fricatives in head position (*[vr]) while French allows them in words like *vrille* [vʁɪj] ‘spin’. Conversely, English allows for [ʃr] branching onsets (e.g. *shred*), a possibility which is not attested in French. Also, while in English the glide [w] is syllabified as the second member of a branching onset (Davis and Hammond 1995) along with the liquids ([l, r]), French only allows for liquids ([l, ʁ]) in this position (Kaye and Lowenstamm 1984).[19] Thus, every French glide ([j, ɥ, w]) found in an input consonant-glide-vowel sequence (henceforth, CGV; e.g. *pois* [pwa] ‘pea’) is syllabified as the first member of a light rising diphthong (see next section). The same holds true of the glide [j] in English which, in contrast to [w], is syllabified as the second member of a branching onset.[20]

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19. Although the French rhotic /ʁ/ is realized as a uvular fricative when preceded by a voiceless obstruent in branching onsets (as mentioned in section 1.1.1.2), this consonant patterns as a liquid, along with the lateral /l/.

20. The peculiarity of English CGV sequences is discussed in more detail in the next section.

The acquisition of branching onsets in French will be discussed in depth in section 3.4. As we will see, branching onsets which appear in stressed syllables in the input emerge before those appearing in unstressed syllables. In order to account for this asymmetry, I will appeal to a specific faithfulness constraint which refers to the head of the foot.

2.2.5 The status of rising diphthongs

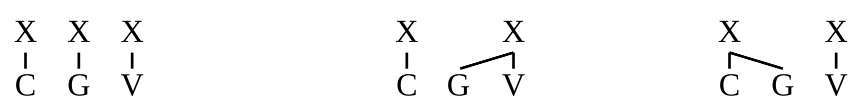
In this section, I discuss the representation of rising diphthongs, i.e. nuclear glide-vowel (GV) sequences. As we will see, I defend the position that the unmarked interpretation for GV is that both the glide and the vowel are represented as a complex nuclear vowel anchored to a unique timing position, following Rose (1999a,b, to appear).

2.2.5.1 Typology

In theory, there are three different ways of representing a surface CGV sequence, as expressed in (16).

(16) Possible representations for surface CGV sequences

a) Three distinct segments b) Complex vowel c) Secondarily-articulated C



The first option, in (16a), is that CGV is represented as a sequence of three distinct segments, each of which is licensed by its own timing position, that is, a configuration which is identical to that for a branching onset (cf. (15b)) followed by a singleton nucleus. The second option, in (16b), is that the sequence consists of a consonant followed by a monopositional complex vowel. Finally, the last option, in (16c), is that CG is realized as a complex (secondarily-articulated) consonant followed by a vowel. As more than one option for the representation of a CGV string is available across languages, in order to determine which option the child will first entertain, i.e. what the default option offered by UG is, it is necessary to investigate the relative markedness of each of these options.

The argument presented in this section is taken from Rose (1999a,b, to appear), who demonstrates that when the monopositional rising diphthong representation in (16b) is assumed as the universal default option in the study of loanword adaptation, correct predictions regarding Root node preservation versus deletion patterns can be obtained.

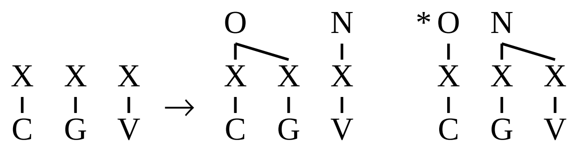
In order to tease apart (16a) and (16b), Rose (to appear) examined the syllabification of CGV clusters across languages, based on the claim that the different relationships that hold between the melodic and timing tiers should lead to different syllabifications.

Firstly, scholars such as Hayes (1985), Hyman (1985), and Schane (1987) argue that true rising diphthongs, i.e. nuclear GV sequences, are monopositional. This analysis is also supported in Kaye and Lowenstamm (1984). Furthermore, Schane (1987) reports that only falling diphthongs count as two positions in languages that treat long vowels and diphthongs as quantitatively equal. As a consequence, (16a), on the one hand, must lead to a CG.V[21] syllabification as represented in (17a), since syllabifying this configuration as C.GV would lead to a bipositional rising diphthong, a configuration which appears to be impossible across languages. Notice as well that given that branching nuclei are universally left-headed (see section 2.2.6), a bipositional rising diphthong, which should be right-headed, would be interpreted incorrectly. On the other hand, (16b) can only be syllabified as C.GV, since the two positions available in this configuration must be syllabified as an onset-nucleus sequence, as depicted in (17b).

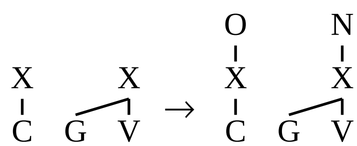
21. A dot (.) indicates the boundary between two syllable constituents.

(17) Syllabification of segmental sequences containing glides

a) Branching onset syllabification



b) Rising diphthong syllabification



In order to disentangle these possibilities, Rose (to appear) performed a typological survey comparing (17a) and (17b). Importantly, this survey only includes languages that allow for branching onsets in order to ascertain that the syllabification of CGV sequences found in these languages does not depend on the absence of a possible CCV syllable shape, but solely on the language-specific selection for CG.V or C.GV syllabification. For example, in languages like Korean and Japanese, which allow for CGV but not for CLV sequences, CGV sequences are not syllabified as branching onsets. For this reason, languages such as these were not included in the survey.

The results of the survey are reported in (18). We can see in this table that, in languages that have CGV clusters, the C.GV syllabification appears to be favoured by far. Apart from the West Germanic languages Frisian and Dutch, which allow for (17a), and (American) English, which allows for both options, all of the languages surveyed syllabify the glide as the first member of a nuclear diphthong.

(18) Syllabification of CGV clusters cross-linguistically (Rose, to appear)

Language	Family	C.GV	CG.V	Reference
Frisian	W. Germanic		√	Booij (1989)
Dutch	W. Germanic		√	Booij (1983)
(American) English	W. Germanic	√	√	Davis and Hammond (1995)
Old English	W. Germanic	√		Suzuki (1982)
Slovak	Slavic	√		Kenstowicz and Rubach (1987)
French	Romance	√		Kaye and Lowenstamm (1984)
Spanish	Romance	√		Harris (1983), Carreira (1992)
Italian	Romance	√		Marotta (1988)
Imyan Tehit	Indo-Pacific	√		Hesse (1995)

From this survey, it can be concluded that the monopositional rising diphthong option in (16b) is less marked than (16a).[22]

The next step consists of teasing apart (16b) and (16c). As noted in Rose (to appear), the typological evidence for (16c) is very difficult to determine because of the controversial status of some secondarily-articulated consonants. In order to achieve this goal, Rose assembled a series of observations about the restrictions that apply to secondary articulations (about, for example, the fact that secondarily-articulated consonants are found in a minority of languages within which their distribution is also very limited; based on Maddieson 1984: 38 and Ladefoged and Maddieson 1996: 355). From these observations, Rose concludes that (16b) is the universally unmarked option for the interpretation of CGV sequences. This will then be the first option entertained by the child encountering a CGV string (see further section 2.2.5.2).

Following from this conclusion, I assume the representation for rising diphthongs as illustrated in (19). It consists of a single timing unit which licenses the two parts of the

22. Rose (to appear) acknowledges that cross-linguistic frequency does not always translate into unmarked status. For example, it is possible that there exist more languages with codas or branching onsets than languages without such constituents, despite the fact that CV syllables represent the unmarked syllable shape. Nevertheless, although such surveys should not be taken as definitive, they still provide us with a useful measure of relative markedness.

diphthong (see, e.g. Kaye and Lowenstamm 1984, Hyman 1985, Schane 1987). I also assume, following Rose (1999a), that rising diphthongs are right-headed complex segments, i.e. the segmental head of the structure is the surface vowel, as mentioned above. This vocoid enjoys the freest distribution, since it is not restricted to the class of high vocoids, as opposed to the surface glide.

(19) Representation of a rising diphthong

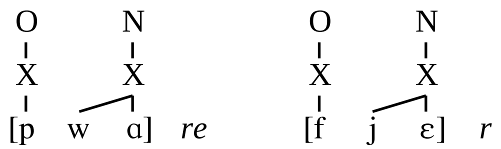
$$\begin{array}{cc} & X \\ G & \underline{V} \end{array}$$

Note in this context that I adopt the standard view that there is no featural difference between glides (e.g. [j]) and corresponding high vowels (e.g. [i]), and that whether the phonetic realization is a glide or a vowel is driven by syllabification (e.g. Jakobson, Fant, and Halle 1952, Clements and Keyser 1983, Levin 1985, Kaye and Lowenstamm 1984, Ladefoged and Maddieson 1996).

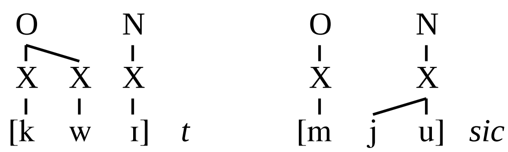
The difference in the syllabification of CGV clusters in French and English is illustrated in (20), with the French words *poire* [pwɑʁ] ‘pear’ and *fier* [fjɛʁ] ‘proud’, and the English words *quit* and *music*.

(20) Syllabification of CGV sequences in French and English

a) French C*w*V = C*j*V



b) English C*w*V ≠ C*j*V[23]



2.2.5.2 Consequences for acquisition

Given the current position, French, which syllabifies GV sequences as rising diphthongs, reflects the unmarked case. Thus, a French-learning child will not have to learn how to syllabify target rising diphthongs; only mastery of complexity at the level of segmental organization will be necessary in order to correctly realize rising diphthongs in output forms. As we will see in chapter 3, the developmental patterns displayed by both Clara and Théo provide strong support for the position adopted here.

The current proposal also implies that English children, whose target grammar shows the unmarked option for C*j*V sequences but not for C*w*V, will have to determine the possibilities for C*w*V from the phonotactics of the target language. Without developing a fully fleshed out argument on this issue, I suggest that the English child will initially wrongly syllabify the two GV sequences in the same fashion, i.e. as nuclear diphthongs, according to the default option, and that the adult structure for C*w*V will only be attained in the course of later development, once the distributional facts have been understood.[24]

23. Notice that the [u] of *music* is actually long. This, however, does not affect the analysis of the GV part.

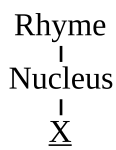
24. The investigation of this issue lies beyond the scope of this thesis and is left for further research.

2.2.6 Nucleus and rhyme

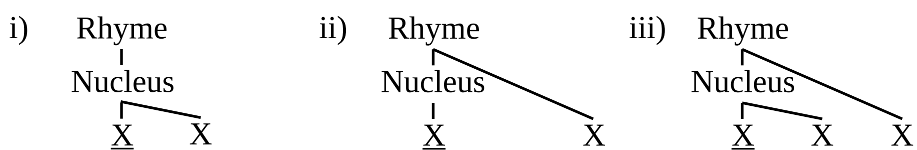
As mentioned above in section 2.2.3, the syllable is organized around a syllable head, the vowel, which projects two levels of constituency: the nucleus and the rhyme. Both of these constituents may or may not branch. When the nucleus does not branch, the head is trivially assigned to the only member of the constituent, as in (21a). When it branches, the constituent is left-headed (e.g. Levin 1985, Kaye, Lowenstamm, and Vergnaud 1990, Harris 1994, 1997), as represented in the schema in (21bi).

(21) Representations for nuclei and rhymes (heads are underlined)

a) Non-branching nucleus / rhyme



b) Branching nucleus / rhyme



Like the nucleus, the rhyme, i.e. the second level of projection of the syllable head, may or may not branch. When only one segment is present in the rhyme, it must be part of the nucleus ((21a); cf. Kaye 1992). When two segments are present in the rhyme, different syllabification options are available. As depicted in (21b), the structure may branch at the level of the nucleus ((21bi)) or at the level of the rhyme ((21bii)). I will refer to the second member of a branching rhyme as a ‘coda’, although, as can be seen, I do not assume that the coda is a formal constituent of the syllable (see, earlier, section 2.2.3). If the rhyme contains three segments, branching occurs at both levels, as illustrated in (21biii). Notice that this last option is cross-linguistically marked. The relative markedness of ternary rhymes provides support for strict binarity, at least as the unmarked option (see references in section 2.2.1.2 above).

French differs from languages like English in the types of segments which can appear in nuclear position; while French only allows for vowels in the nucleus, English also allows for sonorant consonants within this constituent, in words like *letter* [lɛtr̩] and *button* [bʌtn̩]). As concerns branching, both branching nuclei and branching rhymes are possible in French as in English; long vowels are found, as are codas. These options will be detailed below.

Québec French, contrary to languages like English, has very few underlying long vowels. It also differs from Continental French, where most dialects have lost vowel length contrasts altogether in the course of their evolution. In Québec French, long vowels are restricted to a handful of words and vowels only (e.g. *pâte* /pɑːt/ 'pasta' and *fête* /fɛːt/ 'party'). Also, as mentioned in section 1.1.1.1, these vowels are usually diphthongized in surface forms, at least in the western dialect (/pɑːt/ → [pɑʊt], /fɛːt/ → [faɪt]). (See below for more detail on Québec French diphthongization.) As a consequence of the relative rarity of words containing long vowels in Québec French, no sufficient data could be found in the Clara and Théo corpora to investigate their development.

As mentioned in section 1.1.1, Québec French also displays lengthening of underlyingly short vowels. This process applies in open syllables: *perd* [pɛː.ʁ] / [paɪ.ʁ][25] versus *perte* [pɛʁ.t] and *perdu* [pɛʁ.d͜zy] 'loses / loss / lost' (Charette 1991: 123). The degree of lengthening observed in this context varies a lot between dialects and speakers. The lengthened vowel may undergo diphthongization, as the examples show, the degree of which depends on the speaker / dialect spoken. Regarding Clara and Théo, this diphthongization is particularly noticeable in the mid lax vowels [ɛː] and [ɔː], which tend to be realized as [aɪ] and [ɔʊ]. The target forms used in the corpora are transcribed accordingly.[26]

25. Recall that word-final consonants are onsets of empty-headed syllables (on this issue, see further below).

Branching at the level of the rhyme is also found in (all dialects of) French. Languages typically display a series of phonotactic restrictions on the consonants which appear in this position. For example, nasal codas must agree in place with the following onset consonant (e.g. Lardil [kuɲka] 'groin' but not *[kumka]; see (4b) above). Regarding nasal homorganicity in French, this type of feature sharing is not observed because of the fact that, through the course of historical evolution, nasal codas have been fused with the preceding vowel (e.g. *bombe* [bɔ̃b] < Latin [bomba] 'bomb'). Indeed, there are no nasal codas at all in the language. French tolerates liquid codas (e.g. *perdu* [pɛʁd͜zu] 'lost'; *calculer* [kalkyle] 'to calculate') and obstruent codas under certain conditions: coda obstruents lack distinctive voicing values (e.g. *opter* [ɔpte] 'to opt for', but not *[ɔbte]; *abdomen* [abdɔmɛn] 'abdomen', but not *[apdɔmɛn]).

The general restrictions found in French regarding the melodic content of codas can be expressed with conditions like that in (5), which restricts the range of contrasts that a coda can license in Lardil. As we have just seen, regarding nasal codas in Lardil, the place specification that the nasal consonant bears is licensed by the following onset. Regarding obstruent codas in French, the feature [voice] can only be present in coda if it is licensed by the following onset. Notice that this restriction does not apply to word-final consonants (e.g. *boîte* [bwɑːt] 'box'; *laide* [lɛːd] 'ugly'). This observation supports the syllabification of these consonants as onsets of empty-headed syllables, as will be discussed in section 2.2.7.

Finally, French does not display three-member rhymes, in contrast to the few cases attested in languages like English (e.g. *mountain*; see, among others, Harris 1994). Regarding the examples provided earlier about contextually-predictable vowel lengthening / diphthongization (*perd* [pɛː.ʁ] / [paɪ.ʁ] '(s/he) loses'), I maintain, as mentioned above, that word-final consonants are onsets of empty-headed syllables, whose

26. No account of the development of these variable aspects of Québec French vowels will be offered in this thesis.

status is discussed more in detail in the next section. Thus, words such as French *perd* do not involve three-member rhymes. This is supported by the fact that no lengthening /diphthongization is found on vowels in examples like *perte* [pɛ̠ʁ.t] and *perdu* [pɛ̠ʁ.d͜zy].

In sum, (Québec) French allows for branching nuclei and branching rhymes (although ternary rhymes are not found). I will now turn to the representation of word-final consonants, which, as already mentioned, are assumed to be syllabified as onsets of empty-headed syllables.

2.2.7 Word-final consonants as onsets of empty-headed syllables

Many scholars analyse word-final consonants in the same fashion as word-internal consonants which must be syllabified outside the onset constituent, i.e. as true codas. However, there are arguments against such a position, demonstrating that consonants at the right edge of words often behave like onsets rather than as codas. Within Government Phonology, Kaye (1990), Kaye, Lowenstamm, and Vergnaud (1990), Charette (1991), Harris (1994, 1997), and Dell (1995)[27] have convincingly argued that right-edge consonants should rather be considered as onset consonants.

While the tenets of Government Phonology hold that word-final consonants should *always* be syllabified as onsets, Piggott (1999) departs from this view, which, he argues, is too restrictive. Instead, Piggott demonstrates from distributional evidence[28] that word-final consonants can be syllabified in two ways across languages: as onsets of empty-headed syllables (consistent with the Government Phonology view), or as true codas (rhymal dependents, contra Government Phonology). For example, Piggott demonstrates that

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27. While Dell (1995) does not specifically mention his adherence to Government Phonology, he cites the Government Phonology references given above in support of his position that word-final consonants are syllabified as onsets in French. Concerning Québec French in particular, the status of word-final consonants as onsets of empty-headed syllables is most clearly demonstrated by Charette (1991).

28. Considerations relative to syllable weight are also explored by Piggott (1999). For the matters that are central to this thesis, phonotactic restrictions are sufficient.

(word-internal) codas and word-final consonants must involve different syllabifications in languages such as Diola Fogny (Sapir 1965); while (word-internal) codas are syllabified in the dependent position of the rhyme, word-final consonants must be syllabified as onsets of empty-headed syllables. Piggott also demonstrates that, in contrast to Diola Fogny, languages such as Selayarese (Mithun and Basri 1986; see, also, e.g. Goldsmith 1990) actually allow for word-final codas, whose distribution parallels that of word-internal codas: abstracting away from (word-internal) geminate consonants, which involve a single consonant doubly-linked between a coda and following onset, in both word-internal and word-final positions, the coda is restricted to (a) placeless nasal (realized as homorganic with the following onset in word-internal codas and as [ŋ][29] in word-final position) and (b) glottal stop [ʔ]. Piggott (1999) further argues that syllabification of word-final consonants as onsets of empty-headed syllables reflects the unmarked case.

In the field of child language, Goad and Brannen (2000) convincingly argue that word-final consonants in child language pattern consistently with the predictions of Piggott (1999): the child initially syllabifies word-final consonants as onsets of empty-headed syllables, independently of the syllabification constraints of the target language. Providing both empirical and conceptual arguments, Goad and Brannen demonstrate that this option (word-final consonants as onsets of empty-headed syllables) best accounts for the patterns observed in the acquisition of word-final consonants.

Recall the coda restrictions reported above for Lardil (nasal homorganicity) and French (voicing neutralization). Although French has no nasal codas, nasals freely occur in word-final position in this language, as do obstruents, which display no voicing neutralization (e.g. *manne* [ma.<u>n</u>], *rame* [ʁa.<u>m</u>], *lac* [la.<u>k</u>], *bague* [ba.<u>g</u>] ‘ring’). It follows from Piggott’s (1999) proposal that word-final consonants are syllabified as onsets of empty-headed syllables in French, which, in this regard, represents the unmarked case.

29. See, e.g. Trigo (1988) and Rice (1996c) for dorsal nasals as placeless.

In chapter 3, I will concentrate on the development of consonants in the different syllabic positions in French. Since French reflects the unmarked case in the sense that word-final consonants are syllabified as onsets of empty-headed syllables in this language, the development of word-final consonants and codas should proceed independently. As we will see, this prediction is borne out by the data from Clara and Théo: in both cases, word-final consonants are mastered before codas. There is one exception, Clara's [ʁ], which I turn to now.

In chapter 5, I will discuss the development of the French uvular [ʁ] in Clara's and Théo's outputs. As we will see, the two children have different representations for target [ʁ]: Clara's [ʁ] is unspecified for place features whereas Théo's bears a Dorsal specification. As we will see, the placelessness of Clara's [ʁ] yields a different syllabification word-finally: instead of being syllabified as the onset of an empty-headed syllable, it is syllabified as a coda.

In order to account for Clara's development of [ʁ] in word-final position, I propose, in (22), a set of markedness statements for the syllabification of word-final consonants.

(22) Markedness in the syllabification of word-final consonants
- a) Word-final consonants specified for place features
  - i) Unmarked option: onset of empty-headed syllable
  - ii) Marked option: coda (rhymal dependent)
- b) Word-final placeless consonants
  - i) Unmarked option: coda (rhymal dependent)
  - ii) Marked option: onset of empty-headed syllable

Notice that the proposal in (22) departs from Piggott (1999), as well as from Goad and Brannen (2000), in the sense that these authors take the unmarked case to be that all word-final consonants are onsets of empty-headed syllables. On the contrary, I propose that word-final *placeless* consonants are syllabified in the unmarked case as codas, consistent with the distribution of word-final placeless codas in languages like Selayarese. Clara's syllabification of word-final [ʁ] in coda position thus reflects the unmarked case for placeless consonants. This suggests that the child attends to the melodic content of a consonant before syllabifying it.[30] I will demonstrate that treating the data currently under investigation following the statement in (22) enables us to best account for all of the patterns observed. Some of the implications for the position adopted here are addressed in the next subsection.

2.2.7.1 Consequences for acquisition

The position adopted above regarding the status of word-final consonants in general, as well as the proposal in (22), have a number of consequences for acquisition. I will consider these in turn.

Firstly, onsets of empty-headed syllables constitute singleton onsets and, as such, do not imply any structural complexity. Other things being equal, we should expect these word-final onsets to appear early in development since, as mentioned above, simple CV syllables are the ones which are found at the initial stage. However, as we will see in section 3.2, their appearance is delayed by the fact that onsets of empty-headed syllables are contained within a syllable which is itself relatively marked, as it contains no phonetically realized nucleus. Like the onset, the nucleus must be phonetically realized in the unmarked CV syllable. Consequently, onsets of empty-headed syllables should not be found in early outputs.

Secondly, because onsets of empty-headed syllables and codas involve different syllabifications, we expect these two types of post-vocalic consonants to be mastered at different points in time. Indeed, this prediction finds strong support in the data under investigation, as we will see in both Théo’s and Clara’s outputs.

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30. Notice that I assume that this holds true of *inherently* placeless consonants only (e.g. /r, ʁ, ʔ, h/). Implied by this approach is the claim that coronals are not underspecified by default (cf. Paradis and Prunet 1991). See further section 2.4.3.

Related to this, despite the relative markedness of empty nuclei, given that onsets of empty-headed syllables do not, as mentioned above, involve complexity within a syllabic constituent, and we should expect them to appear before codas, which do imply structural complexity, as was illustrated above in (21b). This hypothesis will also be verified with the data under investigation. One potential caveat, though, is that since the two contexts are regulated by different constraints (one requiring the overt realization of nuclei, the other prohibiting complex rhymes, as we will see), a specific order of acquisition, namely that onsets of empty-headed syllables should be acquired before branching rhymes, cannot necessarily be predicted. However, in the absence of evidence to the contrary, it will be maintained here that onsets of empty-headed syllables are relatively less marked — as they involve no structural complexity — and, thus, are more easily acquired than codas, consistent with Goad and Brannen (2000).

Concerning the proposal in (22), the biggest impact regards the fact that melodic content — at least, place feature specification in consonants — has implications for syllabification options. As mentioned above, this view departs from Piggott (1999) and Goad and Brannen (2000) who propose that word-final consonants should always be syllabified as onsets of empty-headed syllables in the unmarked case. This latter view implies that the learner of Selayarese, which, as we saw above, displays word-final codas, would initially wrongly syllabify word-final target consonants ([ŋ] and [ʔ]) as onsets of empty-headed syllables before attaining the adult stage. However, in spite of the fact that no data from languages like Selayarese are currently available to evaluate the merits of this proposal, the data from the development of Clara’s [ʁ] would seem to argue against it. Indeed, Clara’s data instead support the current view, formalized in (22), that the melodic content of word-final consonants impacts the way that these consonants are syllabified at early developmental stages; Clara’s [ʁ] is the only placeless consonant found in the data and is the only consonant syllabified in coda word-finally. This fact also suggests that the learner of Selayarese should initially syllabify (inherently) placeless [ʔ] in coda position.

The case of [ŋ], however, is less clear. Because it surfaces as velar, this consonant may initially be incorrectly specified as Dorsal by the child, until the distributional facts are sorted out and nasal placelessness is understood. According to (22), a Dorsal specification for word-final [ŋ] would lead to syllabification of this consonant as the onset of an empty-headed syllable. This hypothesis is consistent with Théo, who, as mentioned above, initially assigns a Dorsal specification to target [ʁ]. Théo, contrary to Clara, syllabifies word-final [ʁ] as the onset of an empty-headed syllable.

The status of word-final consonants as onsets of empty-headed syllables also has implications at higher levels of prosodic structure. In the next subsection, I discuss the relevant issues and outline the current position with regard to these implications, which will have direct consequences for the patterns of consonant harmony found in both French and English, as we will see in chapter 4.

2.2.7.2 Onsets of empty-headed syllables and foot shape

Given the proposal that word-final consonants are, in the unmarked case, syllabified as onsets of empty-headed syllables (at least, when they bear place specifications), these consonants can never be licensed in stressed syllables, as stressed syllables must contain an overt nucleus. Recall from section 2.2.2 that English and French have contrasting foot construction; the former displays a left-headed (trochaic) foot while the latter contains a right-headed (iambic) foot, as illustrated in (11) and repeated in (23) for convenience.

(23) English and French foot structure (repeated from (11))

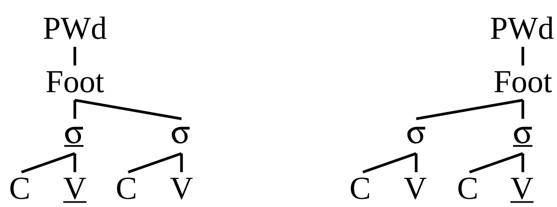
a) English (left-headed) b) French (right-headed)

In this section, I discuss the consequences of this contrast with regard to the way that onsets of empty-headed syllables are anchored to the prosodic word. I then outline the implications for consonant harmony.

In order to illustrate the point of this section, I will compare the full prosodic structure of CVCV and CVC words in the two languages under investigation. Firstly, CVCV words are straightforward. As expected, these words are syllabified as in (24). In (24a), the foot head is projected from the penultimate vowel while, in (24b), the foot head is the last vowel.

(24) Full prosodic structure of CVCV words in English and French

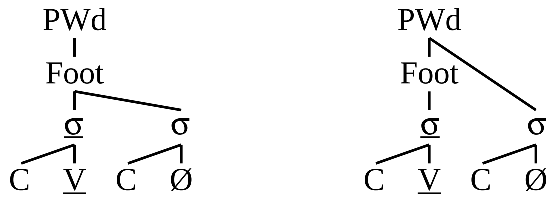
a) CVCV in English b) CVCV in French



Recall that CVC words are in reality CVCØ words, in both English and French, given the status of final consonants as onsets of empty-headed syllables in early grammars. This demonstrates that both CVCV and CVCØ words contain two syllables. We might therefore expect the syllabification of CVCV in (24) to parallel that of CVCØ in (25), except for the fact that the latter contains only one overtly-realized nucleus. Let us start with English CVCØ words. I propose that these words are syllabified exactly like CVCV words and that the only distinction between the two word shapes regards the (non-)realization of the final nucleus. This is illustrated in (25a). The situation, however, is different in the case of French CVCØ words. Given (a) that stress must fall on the only overt vowel in the word, and (b) that the French foot is right-headed, I propose, following Charette (1991), that the final empty-headed syllable falls outside the foot, and is licensed directly by the prosodic word, as illustrated in (25b).

(25) Full prosodic structure of CVCØ words in English and French

a) CVCØ in English b) CVCØ in French



The current position regarding (25b) follows from two conspiring facts: foot headedness and the licensing principle. Firstly, regarding foot headedness, it is unlikely that the child would adopt a foot structure for CVCØ that is different from that for CVCV words. Assuming such a position would entail that the child builds two different foot shapes (namely, iambic feet in CVCV words and trochaic feet in CVC words), a possibility which finds no support in the L1 literature. On the contrary, it has been reported that some children instead tend to regularize words such that all outputs display consistent foot headedness. This is reported by Bernhardt and Stemberger (1998: 446) who mention that English stress-final nouns like *balloon* and *giraffe* are pronounced with word-initial stress by a number of children. Fikkert (1994: 200ff) reports a similar pattern in Dutch which, like English, is a trochaic language.

Secondly, despite the fact that empty-headed syllables cannot be licensed by the iambic French foot, the licensing principle already given in (3) requires these degenerate syllables to be anchored to the rest of the prosodic structure in order for onsets of empty-headed syllables to receive phonetic interpretation. This position is consistent with Charette's (1991) proposal regarding foot structure in French that, as was illustrated above in (10), unfooted syllables are anchored to the prosodic word.

Two additional points must be mentioned regarding the proposal in (25). The first relates to a property of English, a language that exhibits extrametricality, the effect of which is observable in words of three or more syllables with light penults. Given extrametricality, the foot is often not aligned with the right edge of the word in this language, counter to (25a). However, for the stages we are concerned with, words longer than two syllables are typically reduced to bisyllabic forms in the output. In such cases, the stressed and rightmost syllables are the ones that are usually preserved, sometimes with melodic content surviving from the deleted segments (e.g. búffa<lo> → [bʌfo], áni<mal> → [amo], éle<phant> → [ɛfɛnt]; data from various children reported in Pater 1996, 1997).[31]

The current proposal concerning foot construction in English and French also has consequences for the notion of word minimality, according to which words must be binary at the level of the syllable (i.e. contain two moras) or at that of the foot (i.e. contain two syllables). Recall from section 2.2.2 that, at the stages we are concerned with, syllable weight has usually not been mastered by the child. Given this, if word minimality applies in early child phonology, it must yield a bisyllabic foot. Under this hypothesis, (25a) conforms to word minimality. (25b), however, poses a problem, as it only displays a unary (monosyllabic) foot. This situation may not be resolved at the level of the syllable (through vowel lengthening), because, as just mentioned, syllable weight is not mastered at early stages. Word minimality constraints therefore appear to be violated at any level of representation in early French CVC words (see Goad 1997b for similar discussion for early English).

As we will see, the current position finds robust empirical support in the consonant harmony data. In chapter 4, I will propose an approach whereby the long-distance feature assimilation observed in consonant harmony results from a licensing relation at the level of the foot, which thus circumscribes the domain of the place feature assimilation. In English, consonant harmony is observed in both CVCV and CVCØ words, whose syllables are all dominated by the foot ((25a)). By contrast, while consonant harmony is observed in

31. See, for similar generalizations, Allen and Hawkins (1978), Ingram (1978), Echols and Newport (1992), Fikkert (1994), Demuth and Fee (1995), Demuth (1996b), and Curtin (1999).

French CVCV words, CVCØ words do not display consonant harmony alternations. I will attribute this asymmetry to the proposal that, as illustrated in (25b), final consonants are licensed outside the foot in French and, therefore, escape the foot licensing requirements.

2.2.8 Timing units, Root nodes, and the segment

As mentioned above, the timing tier corresponds to the lowest level of prosodic organization (see (2)). I claim that this level of representation also constitutes the lowest level at which prosodic headedness is determined. When only one Root node is anchored to the timing tier — to one or two timing positions, depending on the length of the segment, as illustrated in (26a) and (26b) — this Root node trivially constitutes the head of the segment, as it dominates all the segment's melodic information. As discussed in section 2.2.5 above, head-dependent relations are found under the timing tier when a timing position dominates two Root nodes, as in (26c).[32, 33]

(26) Representations for possible segments (heads are underlined)

a) Plain segment

X

Root

b) Long vowel or geminate consonant

X X

Root

c) Rising diphthong

X

Root Root

Consistent with these representations, I claim that the timing tier represents the highest level of organization of the segment. Segmental preservation or deletion should thus be assessed at this level of representation. As we will see in chapter 3, rising diphthongs are reduced to monophthongs at early stages. This process does not constitute a

32. As we saw in section 2.2.6, headedness in heavy diphthongs, which are represented by two Root nodes, each anchored to its own timing position, is determined at the level of syllable structure.

33. Light diphthongs are not the only complex segments which show head-dependency relationships between two Root nodes. Prenasalized consonants, nasal vowels, and, in some languages, affricates, display similar relationships.

case of segmental unfaithfulness but rather a case of Root node unfaithfulness: only deletion of one of the input Root nodes is observed in the output form. Moreover, we will see that headedness enables us to predict which of the input Root nodes survives in the output: at the stage where complex segments are not allowed to surface, the child is faithful to (a) the input timing position, and (b) the head Root node. Segmental faithfulness is therefore attained, despite deletion of the input dependent Root node.

This last point ends the discussion of the representations which will be assumed throughout the thesis. I will now turn to discuss Optimality Theory. I will introduce the basics of this constraint-based theory, as well as the constraints which I will appeal to in the analysis.

2.3 Optimality Theory

Within generative phonology in the 1960s and 1970s, phonological alternations were formally captured with rules. Constraints played a less important role, taking the form of 'morpheme structure conditions' (e.g. Chomsky and Halle 1968, Kiparsky 1968), which were statements about the shape that morphemes / lexical entries could and could not have. With the subsequent development of 'non-linear phonology' in the late 1970s, where highly-articulated representations were proposed, constraints on these representations assumed a more important role in the assessment of phonological well-formedness, while the role of phonological rules became less prominent. Since then, constraints have become central to most frameworks, including Optimality Theory (henceforth, OT; Prince and Smolensky 1993, McCarthy and Prince 1993a), the framework adopted in this thesis. Within OT, the appeal to phonological rules has been completely abandoned; all aspects of phonological behaviour are accounted for through constraints only.

Within OT, the linguistic competence (grammar) of a speaker is viewed as a set of violable constraints, all of which are provided by UG. Thus, in this framework, every language is based on a finite universal set of constraints.[34] Cross-linguistic variation, i.e.

the differences observed between languages, is accounted for by specific rankings of these constraints. As the requirements of highly-ranked constraints take precedence over lowly-ranked constraints, different constraint rankings predict different grammars (languages). The output forms that are attested in a given language are selected from a set of potential candidates on the basis of the constraint ranking which characterizes that language.[35]

Within OT, candidates are assessed using evaluation tableaux, as exemplified in (27), with three hypothetical constraints, A, B, and C, where A is higher-ranked than B, which is ranked higher than C; A thus takes precedence over B and C, and B takes precedence over C. In the evaluation tableaux, constraint violations are indicated with an asterisk (‘*’), and fatal violations, i.e. violations that prevent a candidate from being optimal and, thus, from appearing on the surface, are indicated by an exclamation mark (‘!’).

(27) Evaluation tableaux in OT: an example

a) Violation of a highly-ranked constraint

	Input	A	B	C
	i) Candidate 1:	*!	*	
☞	ii) Candidate 2:			*
	iii) Candidate 3:		*!	

b) Equal violations

	Input	A	B	C
	i) Candidate 1:	*		*!
☞	ii) Candidate 2:	*		

34. As will be discussed in section 2.4.2, I assume that this holds true of both adult and child grammars.

35. The set of candidates under evaluation in each tableau is generated by the component GEN. The question of what should and should not be produced by GEN, which is subject to debate in the literature on OT, will be left open, as it goes well beyond the scope of this thesis. For criticisms about the unlimited power of GEN as envisioned by Prince and Smolensky (1993), see Currie Hall (1999, 2000) and references cited therein. I will assume, however, that only candidates which are possible outputs in some language are generated; under this view, universally impossible forms are never among the set of potential candidates.

c) Gradient violations

	Input	A	B	C
☞	i) Candidate 1:	*		**
	ii) Candidate 2:	**!		

As we can see in (27a), while Candidate 1 fatally violates the highly-ranked constraint A, and Candidate 3 fatally violates constraint B, Candidate 2 only incurs a violation of the lowly-ranked constraint C. It is thus selected as the optimal output form, as indicated by the symbol '☞'. Shaded cells indicate constraints that are irrelevant to the assessment, a situation which may arise for two reasons. On the one hand, when a candidate fatally violates a constraint, all of the lower-ranked constraints become irrelevant for this candidate, since it is no longer part of the competition. For example, in (27ai), violation of constraint B is irrelevant to Candidate 1 because this candidate has been eliminated by higher-ranked constraint A. On the other hand, shading is used for all of the constraints ranked lower than the one that permits us to select the optimal candidate. For example, in (27a), constraint C is irrelevant to the assessment because selection of the winning (optimal) candidate is determined through fatal violations of constraints A and B.

When a constraint is equally violated by the candidates under contention, selection of the optimal candidate is based on more lowly-ranked constraints. This is exemplified in (27b). As we can see, both candidates equally violate constraint A. However, Candidate 1, in contrast to Candidate 2, also violates constraint C. Candidate 2 is thus selected as optimal and allowed to surface as the output form.

Finally, it is possible that more than one violation for a given constraint is incurred by some candidates. In such a situation, the optimal candidate is the one that incurs the fewest violations of the relevant constraint, as exemplified in (27c).

In the next sections, I will define the constraints which will be used in the evaluation tableaux provided in the subsequent chapters. These constraints will serve two specific purposes, namely, assessing input-output faithfulness relations and regulating structural markedness in output forms. The faithfulness and markedness constraints to be used in the analysis are discussed in sections 2.3.1 and 2.3.2, respectively.

2.3.1 Faithfulness constraints: Correspondence Theory

In order to assess faithfulness between input and output representations, I will appeal to the faithfulness constraints as defined in the framework of Correspondence Theory (McCarthy and Prince 1995), a sub-theory developed as an advancement over the containment-based approach to faithfulness in the original OT manuscripts (Prince and Smolensky 1993, McCarthy and Prince 1993a). Correspondence is defined in (28) (from McCarthy and Prince 1995: 262). In the present context, S_1 is the input, and S_2, the output.

(28) Correspondence (McCarthy and Prince 1995: 262)
Given two strings S_1 and S_2, correspondence is a relation $\Re$ from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ and $\beta \in S_2$ are referred to as correspondents of one another when $\alpha \Re \beta$.

I will appeal to the input-output correspondence constraints in (29). The MAX constraint, in (29a), ensures preservation of input material in output forms. Conversely, the DEP constraint (in (29b)) prevents insertion of phonological material in output forms. Finally, high ranking of the LINEARITY constraint, in (29c), will be useful in accounting for the fact that metathesis (e.g. ABC $\rightarrow$ CBA) is generally not found at the level of the segment or at the level of place features in output forms. This will be discussed further in chapter 4. As we will see, only Clara's grammar tolerates violations of LINEARITY: she displays a place metathesis pattern in CVC words. Thus, for her, LINEARITY will be ranked relatively low.

(29) Faithfulness constraints (after McCarthy and Prince 1995)

a) MAX(α): Every input element α has an output correspondent
b) DEP(α): Every output element α has an input correspondent
c) LINEARITY: The precedence structure in the output is consistent with that of the input, and vice-versa

Notice that the constraints in (29a) and (29b) are stated in a rather general format. More specific versions of these statements will be provided when necessary, in the context of each topic to be discussed. Finally, given the definition in (28), I assume that these constraints may have as arguments any level of representation, segmental, subsegmental or suprasegmental.[36]

2.3.1.1 Head faithfulness

As alluded to above, headedness relationships will play a central role in the analysis. In order to encode input-output head faithfulness, I will appeal to two constraints. The first refers to heads of prosodic constituents while the second refers to headedness at the level of the segment. Independent motivation for these two constraints is provided in the next subsection.

In order to encode the positional faithfulness relations between input and output heads, I will adopt Goad and Rose's (to appear) constraint MAXHEAD. While MAXHEAD is technically a faithfulness constraint, it has a markedness component to it as well, as it makes reference to structural heads, which have a primacy not accorded to non-heads. As reported in Goad and Rose, a number of different approaches to prosodic head faithfulness have been proposed in the OT literature, especially referring to foot headedness (e.g. Alderete 1995, Pater 1996, 1997, Itô, Kitagawa, and Mester 1996, McCarthy 1997). Goad

36. This view departs from McCarthy and Prince's (1995) proposal where appeal is made to MAX and DEP in order to regulate segmental faithfulness only. In McCarthy and Prince (1995), featural faithfulness is expressed through the constraint IDENT.

and Rose (to appear) follow Alderete (1995) in proposing a generalized head faithfulness constraint which takes prosodic categories as its arguments; see the definition in (30).

(30) Prosodic head faithfulness constraint (Goad and Rose, to appear)
MAXHEAD(PCat): Every segment prosodified in the head of some prosodic category in the input has a correspondent in the head of that prosodic category in the output
PCat ∈ {foot, syllable, rhyme, nucleus, onset}

As we can see from the definition in (30), MAXHEAD can have as its arguments any level of prosodic constituency. This constraint constitutes an essential ingredient of Goad and Rose's (to appear) account of onset cluster reduction in West Germanic languages. Goad and Rose argue that headedness within a prosodic constituent, the onset, is central for any account of cluster reduction. They demonstrate that it is the onset head that survives at stages where no more than one consonant is tolerated in this position in the child's output forms, as predicted by the constraint MAXHEAD(Onset). In the analysis of onset cluster reduction in French in chapter 3, I will appeal to both MAXHEAD(Onset) and MAXHEAD(Foot). While the former will enable us to predict which input segment survives in reduced branching onsets, the latter will permit us to account for a positional faithfulness pattern observed for input foot heads: MAXHEAD(Foot) will prevent deletion of the segments that are prosodified in the stressed syllable in the target word. Finally, a pattern of compensatory lengthening concomitant with Clara's deletion of word-final coda [ʁ] will be discussed in chapter 5. Such lengthening is not observed in words where word-internal coda [ʁ] is deleted. I will attribute the word-final lengthening pattern to a high ranking of MAXHEAD(Foot): an input timing position in the foot head will be preserved in the output.

In addition to MAXHEAD(PCat), I will argue for the validity of another MAXHEAD constraint, MAXHEAD(Seg). Recall from section 2.2.8 that I assume that head-dependency relationships take place between the two Root nodes of a rising diphthong. In (30), MAXHEAD(PCat) requires preservation of segments in a given prosodic position, but this constraint does not regulate the melodic content of segments that must be preserved. For the latter, it is necessary to define a constraint that assesses Root node preservation in complex segments. This constraint, MAXHEAD(Seg), is defined in (31).

(31) Segmental head faithfulness constraint
MAXHEAD(Seg): Every Root node in the head of a segment in the input has a correspondent in the head of that segment in the output

In order to independently motivate the two MAXHEAD constraints defined above, I provide evidence from processes observed in two adult languages, namely, cluster reduction in Brazilian Portuguese and rising diphthong reduction in French loanwords in Fula.

2.3.1.2 Independent motivation for MAXHEAD

Although Goad and Rose (to appear) do not appeal to MAXHEAD(Foot) in their analysis of onset cluster reduction, they argue that this constraint, as well as MAXHEAD(Onset), are independently motivated, outside of child phonology, in languages like Brazilian Portuguese. In the southeastern dialect of this language, branching onsets are only tolerated in stressed syllables; in unstressed syllables, input branching onsets are reduced to singletons. Examples of this positional faithfulness pattern are given in (32).[37]

(32) Branching onsets in southeastern Brazilian Portuguese (Harris 1997: 363)

a)	[ˈpratu]	‘plate’
	[paˈt͜ʃiɲu] (*[praˈt͜ʃiɲu])	‘small plate’
b)	[ˈlivu] (*[ˈlivru])	‘book’
	[liˈvretu]	‘small book’

37. As mentioned by Gnanadesikan (1995), based on Whitney (1889), complex onsets are also limited to prosodically strong environments in Sanskrit; while they can appear in base forms, branching onsets are not tolerated in prefixed reduplicants.

Goad and Rose (to appear) argue that both MaxHead(Onset) and MaxHead(Foot) are necessary in order to account for the pattern in (32). Their analysis is given in (33).

(33) Southeastern Brazilian Portuguese (Goad and Rose, to appear)[a]

Inputs:	Candidates:	MAXHEAD (Foot)	MAXHEAD (Onset)	*COMPLEX (Onset)	MAX (Seg)
a) li('vre.tu)	☞ i) li('vre.tu)			*	
	ii) li('ve.tu)	*!			*
b) ('li.vru)	i) ('li.vru)			*!	
	☞ ii) ('li.vu)				*
	iii) ('li.ru)		*!		*

a. Parentheses mark the edges of feet, and periods, the edges of syllables.

The effect of MAXHEAD(Foot) is observed in (33a). A high ranking of this constraint demands that all of the segments present in the head of the foot in the input are preserved in the output. As a result, the stressed syllable (['vre]) surfaces with all of its input segments in the optimal candidate in (33ai), despite incurring a violation of the lower-ranked constraint *COMPLEX(Onset), which rules out branching onsets (see (39)). In contrast to this, we can see, in (33b), that the input branching onset does not appear in the stressed syllable. As a consequence, MAXHEAD(Foot) cannot protect this branching onset, which is thereby reduced to a singleton onset, as required by the ranking of *COMPLEX(Onset) above MAX(Seg). This is where the effect of MAXHEAD(Onset) can be seen: the segment that survives in the reduced onset is the input head ([v], in (33bii)), not the dependent ([r], in (33biii)). Thus, as we have seen from this quick demonstration, MAXHEAD constraints which target different levels of constituent structure are required independently of child phonology.

Additional support for Goad and Rose's (to appear) approach will be provided in this thesis from French-learning children. As we will see in section 3.4, at the first stage in the emergence of branching onsets, the French data parallel Brazilian Portuguese: in both Clara's and Théo's outputs, branching onsets are observed only in stressed syllables; in unstressed syllables, branching onsets are reduced to singletons. This pattern will be analysed through high ranking of MaxHead(Foot). Also, at all stages where branching onset reduction is observed in the children's data, MaxHead(Onset) will determine which segment survives in output forms: like in Brazilian Portuguese, the input head is preserved in the output.

MaxHead(Seg), like MaxHead(PCat), finds independent motivation in adult languages. The evidence provided below comes from Rose (1999a), which is based on loanword data from Lebel (1994) and Paradis and LaCharité (1997). As demonstrated by Rose (1999a), when foreign (input) rising diphthongs are reduced to monophthongs in loanword phonology, it is the head Root node that survives in the adapted (output) form. Examples of this pattern are provided in (34).

(34) [ɥi] → [i] in French loanwords in Fula (Lebel 1994, Paradis and LaCharité 1997)

French word		Adapted form	Gloss
biscuit	[biskɥi]	[biski]	'biscuit'
circuit	[siʁkɥi]	[sirki]	'circuit'
aujourd'hui	[oʒuʁdɥi]	[ɔsɔrdi]	'today'
minuit	[minɥi]	[mini]	'midnight'

As we can see, the input glide ([ɥ]), i.e. the dependent Root node of the input rising diphthong (as discussed in section 2.2.5), is consistently deleted. By contrast, the input head Root node survives in the output. A simple OT analysis of this alternation is offered in (35). Since rising diphthongs are not allowed in Fula, I propose that *Complex(Seg) is undominated in this language, along with MaxHead(Root). These two constraints are ranked above Max(Root), which is violated in every case of Root node deletion.

(35) Head Root node preservation in the adaptation of French rising diphthongs in Fula

	Input: biskɥi	MaxHead(Seg)	*Complex(Seg)	Max(Root)
	i) [biskɥi]:		*!	
☞	ii) [biski]:			*
	iii) [bisky]:	*!		*

As predicted by undominated *COMPLEX(Seg), the French input rising diphthong cannot be realized as such in the output; the input-like candidate in (35i) thus incurs a fatal violation of this constraint. The reduction pattern observed in the adapted form is predicted by the other highly-ranked constraint, MAXHEAD(Seg), which requires the input head Root node to be preserved in the output. Therefore, (35ii) is selected over (35iii), as this latter candidate fatally violates the MAXHEAD constraint.

As we will see in section 3.5, the French data on the acquisition of rising diphthongs parallels the loanword data in (34): at the stage where rising diphthongs are reduced to monophthongs, it is the input head Root node that is preserved in the children's outputs.

Finally, notice that while MAXHEAD(PCat) and MAXHEAD(Seg) belong to the same family of head faithfulness constraints, these two constraints are defined separately because of the level of representation at which their satisfaction is assessed. On the one hand, MAXHEAD(PCat) follows the original view of McCarthy and Prince (1995) that faithfulness is assessed at the level of the segmental string: this constraint assesses preservation of segments within a given prosodic category. A constraint like MAXHEAD(PCat), however, does not permit us to draw a formal distinction between the rising diphthong reduction pattern observed in (34) above ($C_1G_2V_3 \rightarrow C_1V_3$) and the unattested pattern whereby the input glide is preserved as its corresponding vowel ($C_1G_2V_3 \rightarrow *C_1V_2$): in both cases, the head of the syllable is preserved in the output, because the resulting form contains both the timing position and one Root node from the input complex vowel. This is where the need for MAXHEAD(Seg) arises, in order to regulate faithfulness to segmental heads, as demonstrated above and will be further discussed in section 3.5.

2.3.2 Markedness constraints

In addition to the faithfulness constraints introduced above, which assess the match between inputs and outputs, I will appeal to markedness constraints, which assess outputs for structural well-formedness. There are markedness constraints on prosodic structure as well as on segmental structure. In this thesis, I will appeal primarily to the former. Nevertheless, I will also appeal to two segmental markedness constraints, both of which refer to the realization of place features on consonants. The first of these, PLACE, is defined in (36). High ranking of PLACE will ensure that consonants cannot be placeless in output forms.

(36) PLACE
Consonants must bear place features

There is independent evidence for PLACE in adult languages. For example, some languages do not allow for placeless consonants such as /ʔ, h/. Also, in languages like English which have /h/, this consonant takes on the place of articulation of the adjacent vowel (Ladefoged 1993: 37-38).

PLACE will play a role in the analysis of consonant harmony. I will appeal to this constraint in order to prevent consonant debuccalization in contexts where a specific place feature is disallowed by the high ranking of a particular LICENSE constraint (see below). Feature sharing between two consonants will prove to be the only option available to the child: it will enable satisfaction of both PLACE and LICENSE in output forms, as we will see in more detail in chapter 4.

The second segmental markedness constraint I appeal to is a more specific version of PLACE. This constraint, labelled HEADPLACE, is defined in (37).

(37) HEADPLACE
Head consonants must bear place features

HEADPLACE will be central to the analysis of the development of Clara's [ʁ], in chapter 5. As mentioned in section 1.3, [ʁ] behaves asymmetrically during Clara's early stages of development, acquiring its place feature from another consonant in the word, but only when it appears in head position, as the unique consonant of a singleton onset. As mentioned above, I will argue that Clara represents [ʁ] as a placeless consonant. Placelessness of [ʁ] will be ruled out in singleton onsets by a high ranking of HEADPLACE, which requires consonants to bear place specifications in head position. In response to this, the only option available to the child will be to assign place features to target [ʁ], which will consequently undergo assimilation in surface forms.

Turning now to markedness constraints on prosodic constituents, recall from above that syllables can be onsetless, and nuclei can be overtly realized or devoid of any phonetic content (in the case of onsets of empty-headed syllables). In order to formally encode these properties, and their effects in the child's grammar, I will appeal to the constraints given in (38), first proposed by Prince and Smolensky (1993: 85-87), which regulate the realization of the onset, in (38a), and the nucleus, in (38b).

(38) Constraints on the realization of syllabic constituents
- a) ONSET: syllables must have overt (melodically filled) onsets
- b) NUCLEUS: syllables must have overt (melodically filled) nuclei

High ranking of the constraint in (38a) will militate against onsetless syllables while high ranking of (38b) will prevent onsets of empty-headed syllables.[38]

The next markedness constraint, *COMPLEX, whose general definition is taken from Prince and Smolensky (1993: 87), is given in (39). As we saw earlier in the discussion of

38. Recall from section 2.2.3 that while the onset is not an obligatory constituent of the syllable, the nucleus is obligatory in every syllable. Given this assumption, the presence of an onset will necessarily imply the presence of an overt consonant (modulo 'ghost' segments like French h-aspiré; see, e.g. Hyman 1985, Prunet 1986, and Rose 1998 and references cited therein for segmental approaches to French h-aspiré). The constraints in (38) are formulated in parallel terms for reasons of clarity. Thus, syllables without nuclear constituents and possibly also syllables with onset constituents that dominate no melodic material will not be generated by GEN.

Brazilian Portuguese, this constraint rules out branching at a given level of phonological representation.

(39) Constraint on structural complexity
*COMPLEX(α): No branching is allowed in α
($\alpha \in$ {onset, rhyme, nucleus, segment})[39]

Contrary to the MAXHEAD faithfulness constraints defined above in (30) and (31), the set of arguments for *COMPLEX makes reference to all levels of constituency assumed in this thesis (both prosodic and segmental). In subsequent chapters, I will appeal to *COMPLEX in order to limit complexity at three levels of representation, namely, within the onset, the rhyme, and the segment.

The last type of markedness constraint to be discussed in this section concerns the structural relationship that holds between the segment and the prosodic category that licenses it. As already stated, I assume the Licensing principle of Itô (1986) in (3), which will keep its status of 'principle' in the sense that it will not be violable; all phonological elements will have to be licensed by some prosodic category in order to surface in output forms, and GEN will not generate candidates with unlicensed material. The aspect of licensing which I assume to be violable regards the licensor of a particular feature.

In order to incorporate licensing properties into the general setup of OT, I will appeal to the general LICENSE constraint in (40), which is inspired by Piggott (1996, 1997, 2000).[40] (See, also, Rose 1999c.)

39. Given that the coda is not considered to be a constituent of the syllable (as discussed in section 2.2.6), I will account for the absence of coda consonants at early developmental stages through *COMPLEX(Rhyme). Long vowels, by contrast, are ruled out by *COMPLEX(Nucleus); in other words, *COMPLEX(Rhyme) will not be violated by long vowels (for an application of this distinction, see section 5.2.2.2). The appeal to *COMPLEX(Rhyme) to rule out coda consonants contrasts with approaches which adopt the constraint NOCODA (e.g. Prince and Smolensky 1993: 85); this constraint requires that the coda be formally a constituent of the syllable.

40. This constraint is, in essence, the same as that initially invoked by Piggott (1996). However, Piggott, who concentrates primarily on nasal harmony, does not provide as general a definition as that in (40).

(40) LICENSE(F, PCat)
A feature F must be licensed by the head of a prosodic category PCat
PCat $\in$ {foot, syllable, rhyme, nucleus, onset}

As we can see from the definition in (40), LICENSE has many components. Firstly, this constraint must be assigned two arguments. The first is the feature (F) which is targeted by the constraint. The second argument of this constraint is the prosodic category (PCat) licensing F. There is already a consensus in the phonological literature that the prosodic word constitutes a domain of application for harmony processes. However, the status of each of the lower constituents within the prosodic hierarchy is less clear. The position taken in this thesis is that each level of constituent structure represents a domain in which phonological processes can operate. Accordingly, I claim that the PCat argument of LICENSE can be any category along the prosodic hierarchy. Below, I provide evidence in support of this proposal.

Following Piggott (2000), I argue that LICENSE is fulfilled if and only if the segment in the head position of PCat contains F. This proposal implies three well-formed possibilities and one ill-formed one. These are illustrated in (41). As we can see in (41a-c),[41] licensing is achieved whenever the head of PCat bears the feature F. In other words, the dependent position of PCat plays no role in prosodic licensing. This implies that a feature that fails to be anchored to the head of PCat will violate LICENSE, as illustrated in (41d).

41. See below for the distinction between (41b) and (41c).

(41) LICENSE(F, PCat) relations

a) Well-formed b) Well-formed c) Well-formed d) Ill-formed

In contexts where a feature is not present on its licenser in the input, satisfaction of LICENSE may yield two results on the surface: deletion of the feature or preservation through assimilation.

In the next two sections, I elaborate on the role of LICENSE. I will start with an excursus on Piggott's (1996) proposal. I will then turn to additional support for the constraint proposed in (40).

2.3.2.1 Excursus on LICENSE

An example of the effects of licensing was already discussed in section 2.2.1.1. Recall that, in Lardil, non-coronal place features may be realized in coda only if they are also realized on the following onset. In this case, the onset is the licensor of marked place features, which only may surface in coda if they are licensed in onset through sharing.

From alternations such as these, Piggott (1996) proposes that the feature sharing observed in vowel harmony systems is similar to the feature sharing observed in languages like Lardil: it results from licensing requirements. Piggott further suggests that these requirements may apply at any level of prosodic representation. I will focus on licensing at the level of the foot.

Piggott (1996) proposes that two foot types are found across languages: the stress foot and the harmonic foot. He illustrates this point with Chamorro. As reported by Piggott, Topping (1973: 42) demonstrates that primary stress consistently falls on the penultimate syllable in Chamorro, as we can see in the examples provided below in (42).

(42) Chamorro stress placement (Topping 1973: 42)

[ˈhasso]	‘think’
[hiˈnasso]	‘thought’
[hinasˈsomu]	‘your thought’
[hinassonˈmami]	‘our thought’

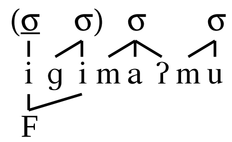
There is a harmony pattern in this language whereby the back vowels /u, o, a/ in roots are fronted to /i, e, æ/ when certain particles / prefixes which contain front vowels are added to the roots. Examples of this fronting harmony are given in (43).

(43) Chamorro vowel fronting (Topping 1973: 52)

a) [ˈgumaʔ]	‘house’
[i-ˈgimaʔ]	‘the house’
[i-giˈmaʔ-mu]	‘your house’
b) [ˈtokchaʔ]	‘spear’
[ni-tekˈchaʔ-mu]	‘your spear’
c) [ˈtungo]	‘to know’
[in-ˈtingo]	‘we know’
[en-ˈtingo]	‘you (pl.) know’
d) [ˈlagu]	‘north’
[sæn-ˈlægu]	‘towards north’

As we can see by comparing the various forms in (43), the fronting harmony always takes place in a two-syllable window, and the target vowel is affected by the harmony whether or not it receives stress in the output form. From these data, it is clear that the harmony domain is independent from the stress foot in Chamorro. Based on this observation, Piggott (1996) proposes that fronting results from a harmonic relation which applies at the level of the harmonic foot in Chamorro which, he argues, is a bisyllabic left-headed foot whose head is projected from the input segment which contains the harmonic feature. This foot determines the domain in which the harmonic feature F is shared, as illustrated in (44).

(44) Harmony within the foot in Chamorro (Piggott 1996)



(The head of the harmonic foot is underlined)

Piggott (1996) explains the feature sharing observed within the harmonic foot through the requirement that the two syllables contained within the foot agree for the harmonic feature. This requirement yields the feature sharing illustrated in (44).

Piggott’s (1996) proposal, however, raises some questions. As discussed in Rose (1999c), the analysis in (44) presents two difficulties. The first concerns the motivation for the feature sharing observed in Chamorro, where, according to Piggott, spreading operates from the foot head to its dependent position. Under the view that harmony results from licensing, why would a feature already licensed by a head spread to a dependent? In Lardil, for example, the feature spreading on nasal consonants illustrated in (6) can be explained through the requirement that all consonants bear place specifications in the output. However, can such a requirement find a correlate in the case of Chamorro’s vowels, since not all vowels need to be front in Chamorro’s outputs? The second point relates to the lack of independent support for the harmonic foot as proposed by Piggott outside of the observation that harmony takes place in a two-syllable window.

In order to reconcile Piggott’s proposal with these remarks, Rose (1999c), who proposes an alternative analysis of the Chamorro facts, suggests that other factors might come into play in the characterization of this harmony system. The argument goes as follows. Firstly, in Chamorro, the harmony is triggered by a prefix, a morphologically weak unit, which affects the first vowel of the root, a morphologically strong unit.[42] As reported by van der Hulst and van de Weijer (1995: 502), some authors such as Siegel (1974) and Kiparsky (1982) have proposed that harmony may make direct reference to

42. I owe this insight to H. Goad.

morphological structure (see, also, Clements 1976). If this proposal is extended to the Chamorro facts, an answer to the two problems raised above can be formulated. Regarding the directionality of the harmonic relation, the head of the foot corresponds to the first vowel of the morphological root, and the foot dependent position to the vowel preceding it, in the prefix. Under this hypothesis, the feature sharing observed between the two vowels results from the requirement that, in order to be borne by the dependent (prefix) vowel, the harmonic feature must be licensed by the head (root) vowel, as illustrated with the right-headed foot in (45).

(45) Foot harmony in Chamorro revised (Rose 1999c; cf. (44))

(σ $\underline{\sigma}$) σ σ
i g i m a ʔ m u
F

(The head of the harmonic foot is underlined)

This analysis provides us with independent motivation for Piggott's (1996) notion of harmonic foot: this construct results from the head-dependency relationship that exists between the morphological root and the prefix that precedes it. An extension of this proposal would be to posit a constraint such as LICENSE(F, MorphCat), which would demand that a feature be licensed by a given morphological category, following the spirit of Siegel (1974), Clements (1976), and Kiparsky (1982).

In view of Rose's (1999c) alternative proposal in (45), independent motivation for LICENSE(F, PCat) in (40) is still sought. In the next subsection, I discuss another set of data analyzed in Rose (1999c) which provide us with the required evidence (see further Piggott 1997, 2000 for additional cross-linguistic support for Piggott's (1996) original proposal that harmony results from feature licensing relationships targeting specific levels of prosodic constituency).

2.3.2.2 Independent motivation for LICENSE

Rose (1999c) proposes an analysis of the harmony systems found in some dialects of European Spanish where reference to the stress foot is required. For example, in Tudanca Montañés, vowel harmony or, more specifically, vowel centralization, takes place between the right edge of the word and the stressed vowel.

Tudanca Montañés has a five-vowel system, all vowels of which have a centralized counterpart. This system in given in (46).

(46) Vowel system of Tudanca Montañés (Hualde 1989)

a) Non-centralized			b) Centralized		
i		u	ɪ		ʊ
e		o	ɛ		ɔ
	a			æ	

The centralized vowels occur in words which end with [-ʊ], the masculine gender suffix (José Hualde, p.c.). Importantly, the central harmony triggered by the presence of [-ʊ] does not apply beyond the stressed syllable; vowels to the left of the stressed syllable never harmonize, as we can see in the examples in (47).

(47) Centralization in words with penultimate stress (Hualde 1989)

a) Non-centralized forms		b) Centralized forms	
[ˈtʃika]	‘girl’	[ˈtʃɪ̱kʊ̱]	‘boy’
[ahamˈbraa]	‘hungry (f.)’	[ahamˈbræ̱ʊ̱] (*[æ̱hæ̱mˈbræ̱ʊ̱])	‘hungry (m.)’
[seˈkalo]	‘to dry it’	[seˈkæ̱lʊ̱] (*[sɛ̱ˈkæ̱lʊ̱])	‘to dry him’
[ˈsola]	‘alone (f.)’	[ˈsɔ̱lʊ̱]	‘alone (m.)’

Even though the stress foot corresponds to the harmonic foot, suggesting an appeal to the constraint LICENSE(F, PCat) in Tudanca Montañés, it is still the case that the feature that triggers harmony in this language, like in Chamorro, comes from an affix. From this observation, one could argue that the Tudanca Montañés and Chamorro systems are similar: the feature contained in the affix is licensed by the morphological root and, thus, an account involving License(F, MorphCat) would be possible for Tudanca Montañés. However, further evidence argues against this possibility. In Tudanca Montañés words with antepenultimate stress, i.e. where the stressed vowel is separated from the word-final affix by an intervening vowel, centralization extends to include the stressed vowel. Consider (48).

(48) Centralization in words with antepenultimate stress (Hualde 1989)

[antiˈgwɪ̱sɪ̱mʊ̱]	(*[antiˈgwisɪmʊ])	‘very old (m.)’
[oˈrɛ̱gæ̱nʊ̱]	(*[oˈregænʊ])	‘oregano’
[ˈpɔ̱rtɪ̱kʊ̱]	(*[ˈportɪkʊ])	‘hall’
[r̄aˈkɪ̱tɪ̱kʊ̱]	(*[r̄aˈkitɪkʊ])	‘rachitic (m.)’

As we can see from these data, realization of the harmonic feature on one vowel inside the root is not enough to ensure well-formedness, contrary to what is observed for Chamorro. Only realization of the harmonic feature in the stressed syllable (the head of the prosodic word) ensures output well-formedness.

To account for this system, Rose (1999c) appeals to the License constraint defined above in (40), which refers to [lax][43] as the feature F and to the prosodic word as the PCat licensor. The harmonic feature must be borne by the head of the prosodic word (the stressed syllable) in order to satisfy License. Notice that reference to the foot head would lead to a non-local licensing relation in words with antepenultimate stress. These words arguably involve extrametricality of the final syllable, which must be licensed directly by the prosodic word.

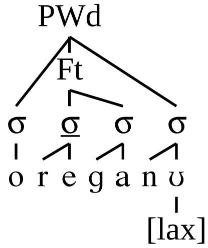
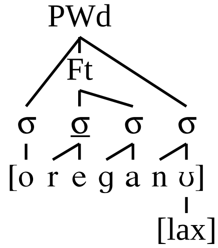
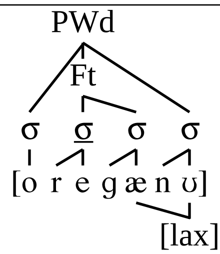
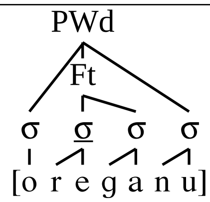
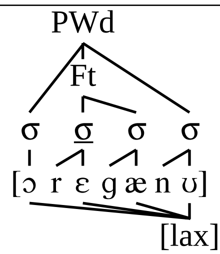
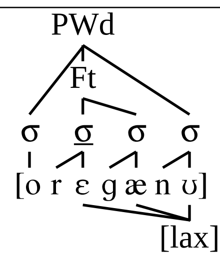
The essence of the analysis is sketched in (49) below, using only three constraints, Lic([lax], PWd), Max([lax]), and NoSpread. While Lic([lax], PWd) regulates licensing of the harmonic feature in the output, Max([lax]) ensures preservation of [lax] in output forms. Finally, NoSpread is a general constraint against feature spreading; each

43. As mentioned in Rose (1999c), [lax] may not be the correct feature; this detail, however, is tangential to the point developed here.

instantiation of [lax] spreading will violate NoSpread. As we can see in (49), this constraint is dominated by both Max([lax]) and Lic([lax], PWd).[44]

44. As we can see in this analysis, I assume that inputs are fully prosodified. This position will be further discussed in section 2.4.3.

(49) [lax] harmony in words in Tudanca Montañés (adapted from Rose 1999c)

Input:		MAX([lax])	LIC([lax], PWd)	NOSPREAD
i) [o'reganʊ]:			*!	
ii) [o'regænʊ]:			*!	*
iii) [o'reganu]:		*!		
iv) [ɔ'rɛgænʊ]:				***!
☞ v) [o'rɛgænʊ]:				**

As we can see in (49i), the input-like candidate cannot surface because it incurs a fatal violation of LIC([lax], PWd): while [lax] is present in the word, this feature is not licensed by the head of the prosodic word, as in the ill-formed configuration illustrated in (41d). Candidate (49ii) also fails to satisfy LIC([lax], PWd), because [lax] is spread only to the dependent syllable of the foot — not to the stressed syllable — in this case. The three remaining candidates all satisfy LIC([lax], PWd). In (49iii), deletion of [lax] fatally violates another dominant constraint, MAX([lax]). In (49iv), [lax] is properly licensed by the prosodic word, but the realization of this feature in the first syllable incurs one too many violations of NOSPREAD. Candidate (49v) is thus the winning contender, as it only incurs minimal violations of lowly-ranked NOSPREAD.[45]

Rose (1999c) reports that Lena Bable, another dialect of Spanish, also displays harmonic alternations within the domain of the foot (see, also, Dyck 1995 for a discussion of similar patterns in other Romance languages). These two dialects of Spanish thus provide independent support for the need for the LICENSE(F, PCat) constraint in (40).

In chapters 4 and 5, I will extend Piggott's (1996, 1997, 2000) proposal to child language data and analyse patterns of feature sharing akin to the ones observed above for Tudanca Montañés. As already mentioned, consonant harmony involves place feature sharing between consonants which are not adjacent at the level of the segmental string (e.g. *duck* → [g̲ʌk̲]). The analysis of patterns such as these will parallel the account of the Tudanca Montañés patterns provided in (49): the feature sharing observed between the two consonants will result from licensing at a level of prosodic structure. In contrast to Tudanca Montañés, the relevant constituent will be the foot. Contrasting evidence from English and French will provide further support for this hypothesis, drawing on the fact that the two languages display different foot shapes, as seen earlier in section 2.2.2. In

45. An additional candidate could be posited in (49): [o'r̲ɛganu], i.e. one where input [lax] is simply 'moved' from the final vowel to the stressed one. Despite the fact that such a candidate would conform to the requirements of LIC([lax], PWd), it would violate recoverability, i.e. the bearer of [lax] in the input would not be recoverable from the output.

chapter 5, I will discuss other feature sharing processes observed in French-learning children. One of these will involve place sharing within the onset constituent (e.g. *train* [t̲χ̲ɛ̃] → [k̲χ̲ɛ] 'train'). This pattern will also be accounted for in terms of licensing, with reference to the head of the onset (LICENSE(Dor, Ons)).

Now that the current approach regarding the interaction of representations and constraints has been outlined in some detail, in the next section, I will discuss the assumptions adopted as concerns child language and first language acquisition.

2.4 Assumptions about child language and L1 acquisition

In this section, I discuss my assumptions about child language. I first briefly address the approach to first language acquisition adopted in this thesis. I then discuss the initial state, i.e. the grammar that is initially available to the child. Finally, I take a position regarding the shape of the input in child language.

2.4.1 The continuity assumption

The approach to first language acquisition developed in this thesis is consistent with Pinker's (1984) *continuity* assumption:[46]

> The null hypothesis in developmental psychology is that the cognitive mechanisms of children and adults are identical; hence it is a hypothesis that should not be rejected until the data leave us no other choice. […] Let us call this the *continuity* assumption. […] The continuity assumption should apply not only to the child's cognitive mechanisms but to his or her grammatical mechanisms as well: in the absence of compelling evidence to the contrary, the child's grammatical rules should be drawn from the same basic rule types, and be composed of primitive symbols of the same class, as the grammatical rules attributed to adults in standard linguistic investigations. (Pinker 1984: 7)

46. Pinker's (1984) formulation of the continuity assumption is inspired by a proposal from Macnamara (1982).

The continuity assumption was proposed for the development of syntax but can be extended to other parts of the grammar, as demonstrated by, e.g. Ingram (1989), Dresher (1994), Demuth (1995), Goad (2000). According to the continuity assumption, the child's grammar develops as a continuous process where the formal properties of the grammar, which are constrained by universal linguistic principles, do not change. Only the structures that are allowed by the grammar change over the course of time, which yields the patterns observed at each developmental stage. The continuity assumption thus implies that child and adult languages do not differ in nature, in the sense that early grammars, at every stage in their development, should reflect possible adult grammars (see Goad 2000 for general discussion).

As we will see in subsequent chapters, the proposals made in this thesis are compatible with the continuity assumption. Firstly, the phonological representations adopted in sections 2.1 and 2.2 are assumed to hold true of both child and adult grammars (on this, see, also, section 2.4.3). Furthermore, following Gnanadesikan (1995), the constraints defined in section 2.3 are assumed to be present in all grammars, including child grammars, as will be discussed more in depth below. Consistent with this view, I will analyse the patterns under investigation in the subsequent chapters through representations and constraints which are independently motivated in adult grammars, in order to demonstrate that child phonology parallels, in essential respects, adult phonology.

2.4.2 The initial state

As already mentioned (in footnote #34), child grammars, like adult grammars, are viewed here as being built from a universal, finite set of constraints, all of which are assumed be part of every grammar (see section 2.3). There is no addition nor removal of constraints during the course of development (cf. Pater 1996, 1997). Only a reranking of these constraints will be necessary in order to account for the discrepancies observed between early and target grammars.[47]

As was observed in some formative work on acquisition (e.g. Jakobson 1941/68, Stampe 1969), early grammars reflect what is cross-linguistically unmarked. In this sense, initial grammars yield a subset of the structures that are allowed in target grammars. For example, adult grammars which contain a marked constituent (e.g. branching onset) also contain the unmarked counterpart of this constituent (here, singleton onset). At early stages, only singleton onsets will be allowed by the child's grammar. With regard to this, I follow Stampe (1969) and many acquisitionists working within OT, who argue that, at the initial state, grammars are inherently organized to yield unmarked outputs. This will be clearly demonstrated in the next chapter, where the acquisition of French syllable structure is discussed in detail. As we will see, development will proceed from the unmarked CV syllable to the target state through successive acquisition of the different structures found in French. Following this idea, an essential part of the acquisition process will consist of a reranking of the constraints in order to allow for the production of the more marked structures which are found in the target language.

The assumption that grammars (constraint rankings), initially organized to yield unmarked outputs, are reranked during the period of acquisition in order to allow for more complex structure fares nicely with the view generally held in generative grammar that acquisition can only be based on positive evidence (Chomsky 1981). In order to illustrate this point, I will describe, in the next two paragraphs, two opposite scenarios on the acquisition of syllable structure.

The first scenario, which is assumed to be correct and, crucially, best accounts for the data, consists of a progression from some unmarked state to the relatively more marked state of the target language. The child, whose grammar is initially organized to yield only the universal (unmarked) CV syllable, observes the presence of more complex structures

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47. Another aspect of acquisition concerns the elaboration of appropriate inputs (both prosodically and segmentally). This issue, which is at the core of the argument developed by Goad and Rose (to appear) in their analysis of cluster reduction patterns, will not be discussed in this thesis. As we will see below, I assume that adult and child inputs are, in essential respects, identical.

such as branching onsets (CL clusters). Based on this positive evidence, the child will reorganize his/her grammar (rerank the relevant constraints) in order to allow for branching onsets.

Conversely, in the opposite scenario, where progression from marked to unmarked structures is assumed, the logic developed above would not hold. If, at the initial state, grammars allowed for relatively marked structures such as branching onsets, the learner of a CV language would have to rely on indirect negative evidence, namely, the absence of branching onsets in the target language, in order to restrict his / her syllable type to CV. Therefore, on conceptual grounds, only a progression from unmarked to marked structure can hold. More importantly, as we will see in the next chapter, the first scenario is the only tenable one on empirical grounds as well. In accordance with the cross-linguistic observations on the shapes of early grammars (e.g. Jakobson 1941/68, Velten 1943, Leopold 1947, Stampe 1969, Smith 1973, Ferguson and Farwell 1975, Ingram 1974a, 1988, 1989, 1992, Macken 1979, Fikkert 1994, Bernhardt and Stemberger 1998), only unmarked structures are found in children's first words. In accordance with this observation, I assume the initial organization of the grammar as formalized by, e.g. Demuth (1995), Gnanadesikan (1995), and Smolensky (1996), in (50).[48]

(50) Initial organization of the grammar
Markedness constraints » faithfulness constraints

This initial ranking predicts the rather general pattern observed in children's first words, namely that only CV syllables are initially allowed in early outputs. This fact results from the initial ranking of markedness constraints such as ONSET, NUCLEUS, *COMPLEX, and LICENSE above the faithfulness constraints.[49]

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48. Virtually all acquisitionists working within the OT framework assume this ranking at the initial stage (but Hale and Reiss 1998).

Related to this, a last issue regards the way that constraints are reorganized (reranked) in the child's grammar. On this, two contradictory views are defended in the literature. The first is by Tesar and Smolensky (1998, 2000) who argue, based on learning algorithms that, starting with a markedness » faithfulness initial ranking, only constraint demotion is possible in the grammar. This proposal is challenged by Bernhardt and Stemberger (1998: 259) who demonstrate that constraint demotion cannot account for regression periods, which are sometimes observed in phonological development; based on this, they argue that constraint promotion is also necessary. Since the focus of this thesis is not about learning algorithms, and since no cases of regression were found in the data under investigation, I will not discuss this issue further and assume the demotion-only approach of Tesar and Smolensky (1998, 2000).

Finally, Bernhardt and Stemberger (1998: 262) have suggested that between each developmental stage, reranking proceeds in minimal steps (this position finds empirical support in the analysis of consonant harmony across developmental stages proposed by Pater 1996, 1997). For example, starting with a hypothetical constraint ranking A » B » C, demotion of constraint A to below C must involve two developmental stages where A is first demoted to below B (B » A » C) and then to below C (B » C » A). However, this hypothesis is neither supported nor contradicted by the data under investigation. For this reason, I will not discuss this issue further (see, however, section 3.5.3.1).

In the next section, to which we proceed now, I discuss the position to be adopted regarding the shape of inputs in child phonology.

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49. The effects of LICENSE constraints will be seen only with the appearance of CVCV and CVCØ words, since CV words do not offer the context necessary for consonant harmony. Also, I do not formally take a position with regard to an initial ranking among markedness constraints and faithfulness constraints, respectively.

2.4.3 The shape of the input

As reported in Goad and Rose (to appear), most OT studies typically assume that, at the segmental level, the child's inputs are essentially similar to the adult's (e.g. Gnanadesikan 1995: 3, Pater 1996, 1997, Smolensky 1996, Hale and Reiss 1998), modulo perceptual problems (Macken 1980). This position contrasts with the earlier-held view that children's underlying representations are initially impoverished and that the detection of contrasts leads to the projection of necessary structure (e.g. Brown and Matthews 1993, 1997, Goad 1993, Rice and Avery 1995).

With regard to underspecification of the input, many proposals can be found in the literature. For example, Spencer (1986), Stemberger and Stoel-Gammon (1991), and Dinnsen, Barlow, and Morrissette (1997), among others, propose that consonant harmony is a consequence of Coronal underspecification in early grammars. Both Goad (1996a, 1997a) and Bernhardt and Stemberger (1998) propose different views. On the one hand, Goad (1996a, 1997a), also based on consonant harmony data, argues against Coronal underspecification in child language (see section 4.4.2 for further discussion). On the other hand, Bernhardt and Stemberger (1998) do accept that some features may be unspecified in the child's representations, but they make no universal claims with regard to which features should be absent, since some degree of variability is observed across children (Bernhardt and Stemberger 1998: 129). Instead, they propose that underspecification can be predicted on the basis of phoneme frequency (Bernhardt and Stemberger 1998: 271). However, they do not demonstrate the validity of this claim on empirical grounds.

Contrary to Bernhardt and Stemberger (1998), who suggest that any place feature (e.g. Labial, Coronal, or Dorsal) can be underspecified in child language, I argue, in chapter 4, that place features cannot be underspecified in early grammars (in line with Goad 1996a, 1997a; see also Pater 1996, 1997). This should not be construed to mean, however, that *all* segments must bear place specifications in child language. In chapter 5, I will provide evidence that inherently placeless consonants can be represented as such in early grammars. In particular, based on Clara's early developmental stages, I argue that [ʁ] is represented as placeless in her grammar. I claim further that this reflects the target representation.[50] This position is consistent with much of the literature on /r/. As reported by Goad and Rose (to appear), this consonant is considered to be placeless by a number of scholars across languages, e.g. Japanese (Mester and Itô 1989), English (Rice 1992), Québec French (Béland, Paradis, and Bois 1993), and German (Wiese 1996). For generalized /r/ placelessness, see, also, Avery (1996) and Brown (1997).

Turning to the level of prosodic structure, it is often assumed in the optimality-theoretic literature that inputs are fully prosodified, although it is fairly difficult to find references on the motivation for this position. In the context of child language, however, Gnanadesikan (1995) and Goad and Rose (to appear) provide empirical support for this position. On the one hand, Gnanadesikan reports patterns of faithfulness to input syllables, i.e. to entire prosodic constituents. On the other, Goad and Rose demonstrate, from cluster reduction patterns observed in West Germanic languages, that children are faithful to the head of the onset constituent. Both of these papers thus provide support for the position that inputs are fully prosodified, at least up to the level of the syllable.

As already discussed in section 2.3.1.1, Goad and Rose (to appear) also provide evidence for inputs as fully prosodified outside of child phonology, from the Brazilian Portuguese data. The argument is as follows: since the input-output faithfulness patterns observed in this language refer to the heads of two different prosodic constituents (the onset and the foot), constituent heads must be specified in the input. Since constituent heads are structurally-defined, prosodic structure must be present in inputs.

In the next chapters, I will provide further arguments in support of this position. For example, I will demonstrate, in chapter 3, that the first stage in the emergence of branching onsets observed in both Clara's and Théo's outputs is characterized by a pattern of

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50. As was mentioned section 1.3, with respect to [ʁ], Théo differs from Clara. Misled by the uvularity of [ʁ] in French, Théo wrongly assigns a Dorsal specification to target [ʁ].

positional faithfulness similar to what was observed above for Brazilian Portuguese: branching onsets are faithfully realized in stressed syllables while they are reduced to singletons in unstressed syllables. I will attribute this pattern to high ranking of MAXHEAD(Foot), i.e. a faithfulness constraint referring specifically to the head of the foot.

2.5 Concluding remarks

In this chapter, I have outlined the various theoretical frameworks which I adopt in the following chapters. I first described the feature geometry that will serve to illustrate organization at the level of the segment. I then turned to discussion of the different levels of the prosodic hierarchy which I will refer to in the analyses to come. After introducing OT, the constraint-based framework adopted in this thesis, I defined the constraints which will be at the core of the arguments proposed in subsequent chapters. The most central constraints are those which make reference to faithfulness to constituent heads (MAXHEAD), as well as to licensing relations which, by definition, refer to heads of prosodic categories (LIC(F, PCat)). I provided independent motivation for both of these constraints from adult languages. Finally, I summarized my assumptions regarding phonological acquisition. Throughout this chapter, I have given hints about the analyses that are offered in the next chapters, to which I now turn.

Chapter 3

THE ACQUISITION OF FRENCH SYLLABLE STRUCTURE: A COMPARATIVE STUDY

3.0 Introduction

In this chapter, I analyse in detail the different stages in the acquisition of French syllable structure by Clara and Théo. As we will see, starting from the core CV syllable, the acquisition of complex onsets and rhymes proceeds through successive developmental stages where markedness constraints are demoted to below faithfulness constraints. We can observe from the timetable in (1) that both children follow the same acquisition path.

(1) Order of acquisition of target syllable constituents

	Onsetless syllables	Onsets of empty-headed syllables	Branching onsets		Branching rhymes
			In str'd syll.	In all contexts	
Clara	1;05.05	1;07.06	1;09.29	2;03.15	2;03.19
Théo	acquired	2;04.06	2;05.29	3;00.07	3;07.06

Starting from the unmarked CV syllable, the first two acquired structures are onsetless syllables (which are already mastered by Théo at his first observed developmental stage) and onsets of empty-headed syllables. The acquisition of branching onsets then proceeds, in two steps: complex onsets are acquired in stressed syllables before they emerge in unstressed syllables. In section 3.5.2.1, the acquisition of branching onsets will be compared with that of target rising diphthongs. As we will see, despite the fact that both branching onsets and rising diphthongs are found in similar segmental strings, namely consonant+sonorant+vowel, the acquisition of these complex structures must be accounted for separately, through different constraints, consistent with the discussion proposed in section 2.2.5. Finally, branching rhymes emerge last. In Clara's outputs, branching rhymes are mastered shortly after branching onsets in unstressed syllables while, in Théo's outputs, they are mastered about six months after branching onsets have emerged in unstressed syllables.

Interestingly, the fact that word-final consonants are mastered before branching onsets correlates with Kaye and Lowenstamm's (1981) generalization that while a language that permits CCV strings also permits CVC strings, the reverse is not true: a language which permits CVC does not necessarily allow for CCV.[1] The order of acquisition found in the children under investigation thus appears to support generalizations based on markedness.[2] As we will see in the next sections, the observation that children's early grammars reflect unmarkedness applies to all of the contexts under investigation. Furthermore, when more than one option is available in the syllabification of a given segmental string, the unmarked option is the one initially selected by the child.

In order to account for the order of acquisition reported in (1), I propose, in section 3.3.3.1, that onsetless syllables and onsets of empty-headed syllables emerge first because they do not involve complexity at the level of syllable constituents. Concerning the order of acquisition of the two target branching constituents (branching onsets and rhymes), I suggest, in section 3.4.4.1, that branching onsets appear before branching rhymes because the evidence necessary for the mastery of branching onsets is easier to understand than that required for the mastery of branching rhymes.

The chapter is organized as follows. In section 3.1, I discuss the first observed states in Clara's and Théo's outputs. I argue that Clara exhibits a grammar that is closer to the UG initial state than Théo in the sense that relatively more marked structures are allowed in the latter's early outputs than in the former's. In section 3.2, I analyse the emergence of onsets of empty-headed syllables. Through a comparison with the acquisition of branching

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1. This typological generalization is challenged by Blevins (1995). However, Matthews (in preparation) provides further evidence in favour of Kaye and Lowenstamm's typology, contra Blevins' observations (see, also Harris 1994: 150-151).
2. However, since in OT (as well as in other frameworks), constraints on word-final consonants and constraints on branching onsets are stated independently, it is difficult to capture this typological observation in formal terms.

rhymes, in section 3.3, I will demonstrate that word-final consonants and word-internal rhymal consonants involve different constraints, save Clara’s [ʁ]. The analysis of the peculiar development of Clara’s [ʁ] will be postponed until chapter 5. In section 3.4, I discuss the emergence of branching onsets in the two French-learning children, as well as a particular positional faithfulness pattern whereby branching onsets emerge in stressed syllables before they emerge in unstressed ones. The development of branching onsets will be compared to that of rising diphthongs, in section 3.5. As we will see, the two structures emerge independently of each other, consistent with the arguments from Rose (1999a,b, to appear) outlined in section 2.2.5; in the unmarked case, the two structures involve complexity at different levels and, therefore, must be regulated by different constraints. Discussion and concluding remarks are offered in section 3.6.

I will now turn to the development of the syllable constituents that are found in French. As we will see, in accordance with the claims made about acquisition in section 2.2, all of the target structures will be acquired from the unmarked to the target state, through successive constraint rerankings which will ultimately lead to the target grammar. In order to avoid repetition of the findings and arguments, the stages where the two children show similar patterns will be exemplified in evaluation tableaux only for Clara’s outputs. When the developmental patterns diverge, I will discuss both children in parallel.

Finally, the constraints needed for the analysis will be introduced only when necessary and will be added to the rest of the rankings in order to account for each new stage of development. In the interest of space, the size of the evaluation tableaux will be reduced in two different ways. On the one hand, only the constraints which are directly relevant to the account of the development under discussion in each section will be provided. On the other, only the structure which is relevant to the point under discussion will be included in the schemas presented in the tableaux.

3.1 The first observed stages

3.1.1 Clara's early outputs

Regarding Clara's data, we cannot talk about the *acquisition* of singleton onsets and rhymes *per se*, as both of these constituents are regularly produced in the child's outputs throughout the entire database, as expected on markedness grounds. As we can see in the examples in (2), which are among Clara's earliest words, only CV syllables are attested. We can also observe that most segment types (obstruents, nasals, liquids and glides) are acquired and can appear in singleton onsets, with some variation in the realization of target fricatives.

(2) Clara: early outputs

a) Core CV syllables

Word	Target form	Child's output	Age	Gloss
Guy	[gi]	[gi]	1;03.07	'Guy'
papa	[papa]	[pa'pæ]	1;03.07	'dad'
dedans	[dədɑ̃]	[da'dæ]	1;03.16	'inside'
maman	[mamɑ̃]	[mə'mæ]	1;00.28	'mom'
l'eau	[lo]	[lɔ]	1;04.07	'the water'
oui	[wi]	[wiː]	1;04.07	'yes'
Caillou	[kaju]	[ta'jæ]	1;05.05	'Caillou'

b) Reduction in non-CV syllables

Word	Target form	Child's output	Age	Gloss
i) *encore*	[ɑ̃kɔʁ]	[kæʊ]	1;02.18	'again'
		[kæː]	1;03.08	
		[kɔː]	1;03.23	
		[kɜː]	1;04.07	
ii) *patate*	[patat]	[pə'tæː]	1;04.07	'potato'
sandale	[sɑ̃dal]	[θa'ðæ]	1;04.14	'sandal'
iii) *fleur*	[flœʁ]	[βœj]	1;07.27	'flower'
crayon	[kχɛjɔ̃]	[ke'jɔ]	1;07.27	'pencil'
iv) *Gaspard*	[gaspɑʁ]	[pə'pæː]	1;03.07	'Gaspard'
tourlou	[tuʁlu]	[dʏ'lʊ]	1;06.22	'bye'
v) *l'oiseau*	[lwazo]	[lɑ'zɔʊ]	1;04.07	'the bird'
lion	[ljɔ̃]	[lɑː]	1;04.07	'lion'

In (2b), we can see that non-CV syllable shapes are not tolerated in Clara’s outputs. Firstly, as we can see from the reduction pattern in (2bi), all syllables must display an onset.[3, 4] Also, we can see that the target marked structures, namely, word-final consonants (onsets of empty-headed syllables), in (2bii) and elsewhere in the example set, branching onsets, in (2biii), codas (word-internal rhymal consonants), in (2biv), and rising diphthongs, in (2bv), are all reduced in a way that yields only CV syllables in the output. These reduction patterns are analysed in turn in the following sections. Finally, notice that the vowel length observed in the examples in (2) is not systematic, except in contexts where word-final [ʁ] undergoes deletion (see chapter 5 for an account of this pattern).

3.1.1.1 Initial vowel deletion

In (2bi), we observed that vowels in word-initial position undergo deletion in Clara’s early outputs. Not only is CV the only syllable shape produced at early stages, but the examples of vowel-initial words suggest that CV syllables are indeed a requirement of Clara’s grammar at the initial state. Although there are few data to permit a definitive characterization of this pattern, initial vowels appear first to be deleted before they can be produced, about five months after the beginning of the interviews, as we can see by comparing the data in (2bi) with those in (3). Also, it is noteworthy that deletion of word-initial syllables only occurs in VCV target words; as we saw above in (2a), CVCV words show preservation of both syllables.

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3. Vowel deletion is also observed in hiatus, i.e. word-internal VV sequences (e.g. *dehors* [dəɔʁ] → [dɔː], 1;03.16 ‘outside’). It it possible that this pattern is caused by the constraint ONSET, which forbids onsetless syllables, or by a different constraint, specifically against VV sequences, as some languages allow for word-initial onsetless syllables while they do not tolerate word-internal VV sequences. However, because too few examples are available to permit a definitive characterization of the development of VV sequences in Clara’s grammar, I will not propose an analysis for these sequences.
4. Unfortunately, no vowel-initial bisyllabic words other than *encore* are available from Clara’s corpus at this point in development. Reduction of vowel-initial trisyllabic words are also found (e.g. *abricot* [abʁiko] → [bʌ'go] ‘apricot’ at 1;09.01). However, such reductions may also be attributed to prosodic factors, as initial vowels fall outside the foot in trisyllabic words (see section 2.2.2 for more discussion on truncation affecting unfooted syllables).

(3) Clara: first faithful productions of vowel-initial words

Word	Target form	Child's output	Age	Gloss
ici	[isi]	[ɪˈsi]	1;05.05	'here'
auto	[oto]	[yˈdɔ]	1;07.06	'car'
encore	[ɑ̃kɔʁ]	[æˈkɔᵘ]	1;06.22	'again'
assiette	[asjɛt]	[æˈɟɛl]	1;07.06	'plate'

The pattern of obligatory onsets at the initial state seems to be well-attested across languages. For example, Bernhardt and Stemberger (1998: 373-375) report that this pattern is often observed in English-learning children. Fikkert (1994: 57) also found in a number of Dutch-learning children that onsets are first obligatory before they become optional, as we can see in (4).[5]

(4) Vowel-initial target words in Dutch (Fikkert 1994: 57-58)

Child	Word	Target form	Child's output	Age	Gloss
Jarmo	*auto*	[ˈoːtoː]	[ˈtaːtoː]	1;06.27	'car'
	apie	[ˈaːpiː]	[ˈtaːpiː]	1;07.15	'ape (diminutive)'
Tom	*auto*	[ˈoːtoː]	[ˈtoːtoː]	1;02.27	'car'
	aap	[aːp]	[baːp]	1;03.24	'ape'
Leonie	*aap*	[aːp]	[paːp]	1;09.15	'ape'
	appel	[ˈapəl]	[ˈpaːpuː]	1;10.29	'apple'

When the pattern in (4) is compared to Clara's outputs in (2bi), it is striking to observe that, in (4), all vowels are preserved and a consonant is inserted to create an onset while, in (2bi), vowel deletion occurs. Indeed, consonant epenthesis before vowel-initial words is never attested in Clara's outputs.[6] Below, in order to reconcile the Dutch and French data, I will propose that the divergence observed is caused by a difference in the prosodic

5. However, as discussed in Grijzenhout and Joppen (to appear), other scholars have reported that vowel-initial words are frequently found in early words across languages (e.g. Velten 1943 and Menn 1971 on English, Elsen 1991 on German, and Costa and Freitas 1998 on Portuguese).

6. A handful of cases of vowel-initial target words that are realized with an initial consonant are observed in Clara's data. However, these examples appear to result from the initial clitic rather than from true consonant epenthesis (e.g. *l'histoire* [l] + [ɪstwɑʁ] → [daᵁtæː] 'the story'; 1;04.07).

structure of these two languages. I will argue that vowel deletion is not an option in Dutch at the stage where onsets are obligatory because it would result in deletion of the input foot head.

3.1.2 Théo’s early outputs

As was the case for Clara, Théo’s initial syllable is maximally CV. Théo’s first recorded words are given in (5). All consonant types are attested in early words, in more or less target fashion, including [ʁ], which is usually realized as a uvular fricative (cf. Clara’s [ʁ] in chapter 5).

(5) Théo: early outputs

a) (C)V syllables

Word	Target form	Child’s output	Age	Gloss
coucou	[kuku]	[guˈgu]	1;10.27	‘peek-a-boo’
bobo	[bobo]	[boˈbo]	1;10.27	‘pain’
ça	[sɑ]	[ʃɑ]	2;02.02	‘it’
non	[nɔ̃]	[na]	1;11.10	‘no’
l’eau	[lo]	[lɔ]	2;03.20	‘the water’
roue	[ʁu]	[χu]	2;05.11	‘wheel’
oui	[wi]	[we]	2;03.06	‘yes’

b) Reduction in non-(C)V syllables

	Word	Target form	Child’s output	Age	Gloss
i)	*encore*	[ɑ̃kɔʁ]	[aˈka]	1;10.27	‘again’
	à papa	[apapa]	[apaˈba]	1;11.10	‘to daddy’
ii)	*bibitte*	[bibɪt]	[pɪˈpe]	2;01.19	‘bug’
	pique	[pɪk]	[pɪ]	2;01.19	‘(it) pikes’
iii)	*clé*	[kle]	[ke]	2;04.28	‘key’
	brisé	[bʁize]	[pɪˈze]	2;04.06	‘broken’
iv)	*porte*	[pɔʁt][a]	[pa]	1;10.27	‘door’
	facteur	[faktœʁ]	[faˈtɔχ]	2;10.24	‘postman’
v)	*miam*	[mjam]	[ma]	2;00.21	‘yum’
	poisson	[pwasɔ̃]	[pɔˈsɔ]	2;04.28	‘(a) fish’

a. As discussed in section 2.2.6, word-final liquid-obstruent clusters are syllabified as a coda followed by the onset of an empty-headed syllable.

However, contrary to what is observed with Clara, Théo does not display a stage of obligatory onsets. Vowel-initial words are found in his early outputs, as we can see from the examples in (5bi). This may be due to the fact that Théo is a few months older than Clara at the onset of data collection. Further, Fikkert (1994: 57-58) observes that obligatory onsets disappear quickly in Dutch-learning children. It is thus possible that Théo actually went through a period where onsets were obligatory which ended before we started recording his outputs. Through an examination of the remainder of the data in (5), we can see that onsets of empty-headed syllables, in (5bii), branching onsets, in (5biii), codas, in (5biv), and rising diphthongs, in (5bv), are all reduced to CV-shaped syllables in Théo's outputs.

3.1.3 Summary of the patterns

The observations made thus far from Clara's and Théo's early outputs are summarized in (6). As we can see in (6a), the only difference between the two children lies in the (non-)realization of vowels in word-initial position.

(6) Observations for Clara's and Théo's early outputs

	Clara	Théo
a) Vowel-initial words	Initial vowel deletion	Target-like
b) Onsets of empty-headed syllables	Deleted	Deleted
c) Complex constituents (branching onsets, branching rhymes)	Reduced	Reduced
d) Rising diphthongs	Reduced	Reduced

In the next subsection, I propose an analysis of these early outputs in which I focus primarily on the strict CV syllable shape observed. I will subsequently address the pattern of word-initial vowel deletion found in Clara's outputs, in section 3.1.5.

3.1.4 Account of the children's first observed stage

Based on the observations made above, I accept the standard view that the universal CV syllable is available to the child at the initial state, suggesting that neither Clara nor Théo had to master CV syllables. As proposed by others (e.g. Jakobson 1941/68, Stampe 1969, Smith 1973, Greenlee 1974, Ingram 1978, 1981, 1989, Chin and Dinnsen 1992, Fikkert 1994, Demuth 1995, 1996a, Fee 1995, Rose 1997), core (CV) syllabification is part of the initial competence of the learner and constitutes the starting point for the acquisition of more complex syllable structures.

To illustrate the initial state, I will use Clara's grammar, since this grammar yields unmarked CV syllables only, in contrast to Théo's, which allows for onsetless syllables. I will appeal to the faithfulness constraints MAX and DEP (defined in section 2.3.1), as well as to the markedness constraints ONSET, NUCLEUS, and *COMPLEX (defined in section 2.3.2). *COMPLEX will be used here in the broadest sense, to prevent the realization of all types of branching structures — syllabic (e.g. branching onsets and rhymes) and segmental (e.g. rising diphthongs) — in output forms. Finally, since this chapter is devoted primarily to the preservation and deletion patterns affecting input segments (i.e. timing positions; see section 2.2.8), rather than the features they dominate, the faithfulness constraints will take the segment as its argument in the tableaux below.[7]

In keeping with the initial ranking for child phonology assumed in this thesis, whereby markedness constraints dominate faithfulness constraints (see section 2.4), I propose that Clara's initial constraint ranking is as in (7), where the markedness constraints *COMPLEX, ONSET, and NUCLEUS are all undominated. Concerning the faithfulness constraints, since deletion is favoured over insertion in all contexts violating the markedness constraints, I propose that DEP(Seg) is ranked above MAX(Seg). The lack of epenthesis to salvage ill-formed structure, which is observed throughout both Clara's

7. Only the analysis of the development of rising diphthongs will refer to segment-internal organization, more specifically, to the level of the Root node, as will be seen in section 3.5.

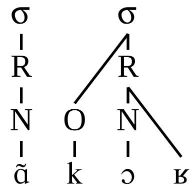
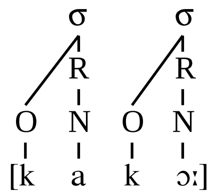
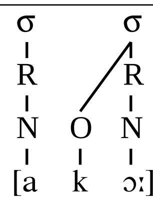
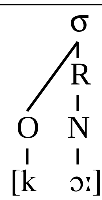
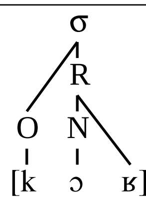
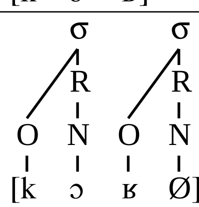
and Théo's databases seems to be typical of child language in general (e.g. Bernhardt and Stemberger 1998: 376). An exception to this generalization was observed in the Dutch data in (4). Below, I explain the Dutch pattern through satisfaction of a higher-ranking faithfulness constraint on prosodic heads.

(7) Clara's initial state constraint ranking (simplified)
*COMPLEX, NUCLEUS, ONSET » DEP(Seg) » MAX(Seg)

The simple grammar given in (7) predicts that only CV syllables can surface in output forms. In order to exemplify this pattern, I will use the word *encore* [ãkɔʁ] 'again' from the example set in (2bi), which contains both an onsetless syllable and a word-final coda, i.e. two structures which are disallowed by Clara's first observed grammar. This analysis is presented in (8).

Concerning the syllabification of word-final consonants, recall from section 2.2.7 that I adopted the view that, in the unmarked case, consonants which bear place features are syllabified as onsets of empty-headed syllables (cf. Piggott 1999 and Goad and Brannen 2000). In addition, I proposed that the unmarked option for the syllabification of word-final inherently placeless consonants is in coda position. This position will be supported in chapter 5, where we see that Clara, who represents [ʁ] as placeless, syllabifies this consonant as a word-final coda. In anticipation of this analysis, in (8), Clara's word-final [ʁ] is syllabified in coda position in the input (cf. Théo's word-final [ʁ] below).

(8) Clara's initial state grammar

Input: 	*COMPLEX	NUCLEUS	ONSET	DEP (Seg)	MAX (Seg)
i) [ka'kɔː]: 				*!	*
ii) [akɔː]: 			*!		*
☞ iii) [kɔː]:[a] 					**
iv) [kɔʁ]: 	*!				*
v) [kɔʁ]: 		*!		*	*

a. The vowel length observed in this example, as well as in candidates (8i) and (8ii), which has no bearing on the present issue, will be discussed in depth in chapter 5.

Concerning the first two candidates, we will focus on the input vowel-initial syllable. The candidate in (8i) violates the constraint DEP(Seg), as it contains an epenthetic consonant in word-initial position. Candidate (8ii), which begins with the target-like initial vowel, fatally violates the constraint ONSET. Thus, only a candidate such as (8iii) which shows initial vowel deletion can surface as optimal. This candidate wins over the last two contenders, where we focus on the final consonant, for two reasons. First, (8iii) satisfies *COMPLEX, a constraint which is fatally violated by the branching rhyme displayed by candidate (8iv). Also, the winning candidate does not contain an empty-headed syllable, contrary to candidate (8v) which, in so doing, incurs a fatal violation of the constraint NUCLEUS. Notice as well, that addition of an empty timing position in (8v) involves a violation of DEP(Seg) because, as was discussed in section 2.2.8, segmental faithfulness is assessed at the level of the timing tier, which represents the highest level of segmental organization. Thus, candidate (8iii) can surface as optimal, despite the fact that it twice violates the lowly-ranked faithfulness constraint MAX(Seg). This supports the standard position held in the OT acquisition literature that, at the initial state, markedness constraints are satisfied at the expense of faithfulness (as was discussed in section 2.4.2).

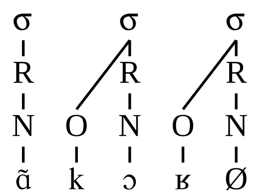
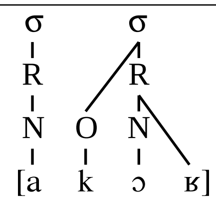
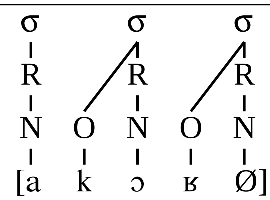
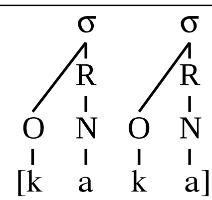
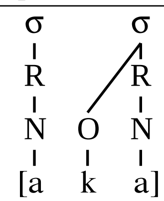
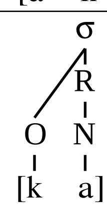
The constraint ranking proposed to account for Théo's first observed stage is given in (9). As we can see, the only difference between (7) and (9) lies in the location of ONSET, which is ranked at the bottom of the hierarchy in order to allow for vowel-initial syllables.

(9) Théo's early constraint ranking (simplified)
*COMPLEX, NUCLEUS » DEP(Seg) » MAX(Seg) » ONSET

In order to evaluate the effects of this ranking, I will again take the word *encore*, which surfaces as vowel-initial [aˈka] in Théo's early outputs.

As we can see in the input form in (10), I propose that Théo syllabifies word-final [ʁ] as the onset of an empty-headed syllable, in contrast to Clara. Further evidence for this claim is provided in section 3.2: Théo's word-final [ʁ] emerges at the same time as other word-final consonants. In addition, as will be argued in chapter 5, Théo's representation for target [ʁ] contains a Dorsal specification. Given this, Théo's syllabification of word-final [ʁ] is consistent with the unmarked syllabification for place-specified consonants as onsets of empty-headed syllables. Thus, the placeless / place-specified contrast in the representation of [ʁ] for the two French children leads them to the two unmarked syllabification options for word-final consonants proposed in section 2.2.7.

(10) Théo's early grammar

	Input: 	*COMPLEX	NUCLEUS	DEP (Seg)	MAX (Seg)	ONSET
	i) [akɔʁ]: 	*!			*	*
	ii) [akɔʁ]: 		*!			*
	iii) [kaka]: 			*!	**	
☞	iv) [aka]: 				**	*
	v) [ka]: 				***!	

Regarding the input word-final consonant, as in Clara's grammar, undominated *COMPLEX and NUCLEUS predict that such consonants are disallowed in output forms. In (10i), we can see that syllabification of word-final [ʁ] as the second member of a branching rhyme fatally violates *COMPLEX. Syllabification of this consonant in input-like fashion, i.e. as the onset of an empty-headed syllable, fatally violates NUCLEUS, in (10ii). Regarding the initial vowel, Théo allows for onsetless words, as reflected by the low ranking of ONSET in his grammar. Violation of this constraint is preferred over that of the higher-ranked DEP(Seg), in (10iii). Finally, candidate (10v) fails as it incurs one too many violations of MAX(Seg), in contrast to the optimal output in (10iv).

I will now proceed to the next section where I focus on the vowel-initial deletion pattern observed in Clara's outputs in (2bi). As we saw above, the deletion pattern attested in Clara's vowel-initial words contrasts with the patterns observed for Dutch-learning children like Jarmo. In order to account for this contrast, I will appeal to a difference between Dutch and French at the level of foot structure.

3.1.5 Initial vowel deletion versus preservation in Clara's outputs

The obligatory onset pattern yielded by the initial markedness » faithfulness ranking proposed in (7) for Clara is further supported by the examples in (2bi), where we observed that vowel-initial words undergo vowel deletion (e.g. *encore* [ɑ̲̃kɔʁ] → [kæː] 'again') in Clara's outputs. However, as we saw in the Dutch examples in (4), in the same context, initial vowels are preserved through consonant insertion (e.g. *auto* [ˈoːtoː] → [ˈtaːtoː] 'car'), as summarized in (11).

(11) Clara's versus Jarmo's vowel-initial words

	Clara	Jarmo
Vowel-initial words	Initial vowel deletion	Consonant epenthesis

While we could analyse these diverging patterns through different rankings of DEP(Seg) and MAX(Seg) — DEP(Seg) » MAX(Seg) for Clara versus MAX(Seg) » DEP(Seg) for Jarmo — I argue that the most explanatory approach requires reference to prosodic structure. I propose that the contrast summarized in (11) results from a difference at the level of the foot. As we saw earlier in section 2.2.2, English and French have different foot structures. While the English foot is trochaic, the French foot is iambic. Dutch parallels English in displaying trochaic footing (van der Hulst 1984, Kager 1989, Trommelen and Zonneveld 1989, Booij 1995); like in English, while some Dutch nouns are exceptionally stressed on the final syllable, most disyllabic nouns are stress-initial, consistent with the foot shape illustrated in (12a), which contrasts with the French right-headed foot in (12b).

(12) Dutch versus French foot shape (heads are underlined)

a) Dutch (left-headed)

Foot

<u>σ</u> σ

b) French (right-headed)

Foot

σ <u>σ</u>

In order to explain the contrasting data observed above in (2bi) versus (4), I will appeal to a combination of two constraints: ONSET and MAXHEAD(PCat), whose general definition is given in section 2.3.1.1. For present purposes, the argument PCat is the foot, following the definition in (13).

(13) MAXHEAD(Foot)
Every segment prosodified in the head of the foot in the input has a correspondent in the head of that foot in the output

I propose that MAXHEAD(Foot) is dominant among the faithfulness constraints, following the ranking in (14).

(14) Clara's early constraint ranking (revised)
*COMPLEX, NUCLEUS, ONSET » MAXHEAD(Foot) » DEP(Seg) » MAX(Seg)

This proposal (markedness constraints » MAXHEAD » faithfulness constraints) holds only for the case currently under discussion, however. As will be discussed in section 3.2.4, MAXHEAD(Onset) must be ranked below DEP(Seg) in order to account for stage 1 in the acquisition of onsets of empty-headed syllables. Nevertheless, it seems that the primacy accorded to MAXHEAD in (14) holds among MAX constraints (i.e. MAXHEAD » MAX(Seg)).

Although no complete analysis is offered here for the Dutch children, who are referred to for comparison purposes only, I will assume for these children the same grammar as Clara's in (14). This ranking, allied with the assumptions on foot structure illustrated in (12), enables us to account for the patterns of vowel deletion versus consonant epenthesis at issue here. I will first revise, in (15), the analysis for Clara's input *encore* in light of the added constraint MAXHEAD(Foot). The vowel-initial deletion observed in this example will then be compared, in (16), with the epenthesis observed in Jarmo's *apie* ['aːpiː] 'ape (diminutive)', which surfaces as ['taːpiː].

Only three candidates will be evaluated in (15) since the other potential candidates (e.g. *[akɔː], *[kɔʁ]) contain illicit structures which have already been discussed. Regarding the input word-final [ʁ], recall that Clara syllabifies it in coda, i.e. within the head syllable of the foot. Consequently, each occurrence of word-final [ʁ] deletion, which is enforced by undominated *COMPLEX, will not permit us to determine the optimal candidate. The analysis will thus focus on other violations.

(15) Initial vowel deletion in French words

Input: Ft σ σ̲ ã k ɔ ʁ	*COMPLEX	NUCLEUS	ONSET	MAXHD (Foot)	DEP (Seg)	MAX (Seg)
i) [a]: Ft σ̲ [a]			*!	***		***
☞ ii) [kɔ]: Ft σ̲ [k ɔ]				*		**
iii) [kakɔ]: Ft σ σ̲ [k a k ɔ]				*	*!	*

I will first discuss violations of MAXHEAD(Foot). Recall from the definition in (13) that this constraint is violated each time a segment dominated by the foot head in the input is deleted from the output. Candidate (15i) incurs three violations of MAXHEAD(Foot), as the whole input head syllable is deleted in this form. These multiple violations would be enough to put this candidate out of contention; however, it also violates the undominated constraint ONSET. The two remaining contenders fare equally well on ONSET and MAXHEAD(Foot). Selection between them is thus left to the ranking of DEP(Seg) above MAX(Seg). While candidate (15ii) displays initial vowel deletion and, thus, violates MAX(Seg), it is preferred over candidate (15iii), which displays consonant epenthesis and, consequently, incurs a fatal violation of higher-ranked DEP(Seg).

Because of the reverse foot structure found in Dutch, the ranking proposed in (14) yields a different effect for the Dutch words. Consider (16).[8]

(16) Consonant epenthesis in Dutch words

	Input: /api/	*COMPLEX	NUCLEUS	ONSET	MAXHD (Foot)	DEP (Seg)	MAX (Seg)
	i) [api]			*!			
	ii) [pi]				*!		*
☞	iii) [tapi]					*	

8. Recall that vowel length is not initially contrastive in outputs; it has been eliminated from the input for clarity.

As we can see, the target-like candidate in (16i) incurs a fatal violation of undominated ONSET at this stage where onsetless syllables are disallowed by the child's grammar. Even though deletion of the input stressed vowel ensures that (16ii) satisfies ONSET, this deletion fatally violates MAXHEAD(Foot). Consonant insertion is thus the favoured option, as illustrated with the winning candidate in (16iii), which minimally violates lower-ranked DEP(Seg).

From the comparison of (15) and (16), we can see that the burden of the analysis has been put on differences in foot structure; with a unique constraint ranking, contrasting patterns observed across languages can be explained. This proposal, which is consistent with the markedness » faithfulness constraint ranking at the initial state, permits a principled and unified account of the data discussed in this section.

In the next section, I turn to the development of onsets of empty-headed syllables. These consonants, which are disallowed at the initial state, emerge in Clara's and Théo's outputs before any type of branching constituents found in target French.

3.2 Onsets of empty-headed syllables

As we saw above, the deletion of onsets of empty-headed syllables at the initial state is attributed to high ranking of the constraint NUCLEUS, which requires nuclei to be overtly realized on the surface. I will explain the emergence of word-final onsets in the children's output forms through the demotion of this constraint below MAX(Seg).[9]

---

9. French also exhibits onsets of empty-headed syllables word-internally (e.g. Charette 1991). However, target words containing such structures are few and far between in the data under investigation. For this reason, I will concentrate only on the word-final context. (For further discussion of word-internal empty nuclei, see sections 3.3.3.1 and 3.4.4.1.)

3.2.1 Stage 1: deletion

The first stage in the development of onsets of empty-headed syllables is characterized by consonant deletion, as was mentioned above. This pattern is further exemplified in (17).

(17) Onsets of empty-headed syllables, stage 1: deletion

a) Clara: 1;00.28 to 1;06.22

Word	Target form	Child's output	Age	Gloss
livre	[liv]	[ji]	1;04.14	'book'
pomme	[pɔm]	[bɔː]	1;06.22	'apple'
patate	[patat]	[pəˈtæː]	1;04.07	'potato'
banane	[banan]	[mæˈnæ]	1;06.22	'banana'
sandale	[sɑ̃dal]	[θaˈðæ]	1;04.14	'sandal'

b) Théo: 1;10.27 to 2;03.20

Word	Target form	Child's output	Age	Gloss
pique	[pɪk]	[pɪ]	2;01.19	'(it) pricks'
bibitte	[bibɪt]	[pɪˈpe]	2;01.19	'bug'
capable	[kapab]	[kœˈpa]	2;01.19	'able to'
encore	[ɑ̃kɔʁ]	[aˈka]	1;10.27	'again'
voir	[vwɑʁ]	[va]	2;02.16	'(to) see'
miam	[mjam]	[ma]	2;00.21	'yum'

As we can see from these examples, word-final consonants are systematically deleted in early outputs. Importantly, the vowel length found in some of Clara's output forms in (17a) does not seem to correlate with consonant deletion.[10] Indeed, there is no clear pattern of lengthening of the vowel that precedes the deleted consonant, except when the deleted consonant is a word-final [ʁ], as already mentioned in section 3.1.1.

10. As already discussed, Clara's (and Théo's) foot shape is iambic. Iambs tend to have a heavy rhyme in their stressed syllable cross-linguistically (Hayes 1995: 71). The vowel lengthening which is sporadically observed in her outputs may be reminiscent of this tendency. However, as no clear pattern could be established, it is considered at most optional here.

3.2.2 Stage 2: mastery

Clara's word-final consonants emerge in output forms at age 1;07.06, as exemplified in (18a). Starting at this age, all input word-final consonants appear in this position in output forms save one, the consonant [ʁ] which, as already mentioned, is syllabified word-finally as a coda and, thus, emerges at a later stage.

Théo's final consonants of all types (including [ʁ]) emerge within a two-week window. At age 2;03.20, there is some variation in the (non-)realization of target final consonants. However, two weeks later, at age 2;04.06, word-final consonants are robustly attested. The first outputs showing word-final consonants are given in (18b).

(18) Onsets of empty-headed syllables, stage 2: mastery

a) Clara: 1;07.06 (except [ʁ]; see chapter 5)

Word	Target form	Child's output	Age	Gloss
banane	[banan̲]	[məˈnæn]	1;07.06	'banana'
livre	[liv̲]	[lɪɸ]	1;07.27	'book'
patate	[patat̲]	[pæˈtæt]	1;09.01	'potato'
bus	[bʏs̲]	[bʊs]	1;10.04	'bus'
bol	[bɔl̲]	[pɔl]	1;07.27	'bowl'
poil	[pwal̲]	[pwæl]	2;03.05	'hair'

b) Théo: 2;04.06

Word	Target form	Child's output	Age	Gloss
embarque	[ãbaʁk̲]	[əˈbak]	2;03.20	‘(he) embarks’
encore	[ãkɔʁ̲]	[əˈkɔᶷʁ]	2;03.20	‘again’
embarque	[ãbaʁk̲]	[ãˈpak]	2;04.06	‘(he) embarks’
bus	[bʏs̲]	[pɔç]	2;04.06	‘bus’
porte	[pɔʁt̲]	[pɔtʰ]	2;04.06	‘door’
voir	[vwɑʁ̲]	[vwɑːχ]	2;04.06	‘(to) see’
mitaine	[mitɛn̲]	[pəˈtɛn]	2;04.06	‘mitten’
cheval	[ʃfal̲]	[fwɛj][a]	2;04.28	‘horse’
		[əˈp͜faj]	2;05.11	
balle	[bal̲]	[paj]	2;05.11	‘ball’
école	[ekɔl̲]	[ɛˈkɔj]	2;05.11	‘school’
		[eˈkɔl]	2;05.11	
pilule	[pilʏl̲]	[bəˈlʏl]	2;05.29	‘pill’

a. At this early stage in the production of word-final consonants, Théo's [l] is often realized as [j]. This pattern, however, quickly disappears, as we can see in the last two examples in (18b).

Before I provide the analysis of the development of onsets of empty-headed syllables, I will first discuss a potential objection that the reader may have on this issue, namely that these consonants could instead be analysed as true codas.

3.2.3 Why not codas?

As stated in section 2.2.7, although I adopt the view that languages vary in whether word-final consonants are syllabified as onsets of empty-headed syllables or as codas, these consonants should be syllabified as onsets in the unmarked case when they bear place, following the markedness options proposed in (22a) in chapter 2 (cf. Piggott 1999 and Goad and Brannen 2000). This prediction is borne out: except for Clara's [ʁ], all consonants are specified for place features in both Clara's and Théo's systems, and these are all onsets of empty-headed syllables word-finally. Word-final placeless consonants, on the other hand, are preferably syllabified in coda position, consistent with the markedness statement in (22b) in chapter 2. By virtue of being placeless, Clara's [ʁ] is syllabified word-finally as a coda. Since Clara's [ʁ] represents the only case of a placeless consonant found in the data under investigation, as well as in the target language, for now I will concentrate only on consonants which are specified for place features.

There are several motivations for considering final consonants to be onsets of empty-headed syllables in the child data under discussion. Firstly, as will be demonstrated below, word-final consonants appear several months before true (word-internal) codas (compare (18) above with (28) below). The current assumption about the difference in syllabification that exists between word-internal codas and word-final consonants nicely accounts for this fact. Secondly, as was mentioned above, deletion of Clara's word-final coda [ʁ] yields a pattern of compensatory vowel lengthening. This pattern finds no correlate when other word-final consonants are deleted, consistent with their being onsets of empty-headed syllables. Thirdly, the analysis is supported by the fact that, except for some minor details (and the peculiar patterning of Clara's [ʁ]), the early outputs of both Clara and Théo display the full range of segmental contrasts in word-final position, paralleling the inventory found in word-initial onset position. If word-final consonants were syllabified as codas in these children's grammars, we would expect a more restricted distribution in this position since, across languages, the segmental content of codas is more restricted than that of onsets, including onsets of empty-headed syllables. Fourthly, the current position is supported by typological facts in adult languages. As argued by Goad and Brannen (2000), word-final consonants can only be syllabified as codas in languages which tolerate word-internal codas, as can be seen from the patterns in (19).

(19) Syllabification patterns observed cross-linguistically (Goad and Brannen 2000)

	Languages	Word-internal codas	Word-final consonants
a)	Selayarese, Japanese	Yes	Coda
b)	Diola-Fogny, French	Yes	Onset
c)	Yapese, Kamaiurá	No	Onset
d)	(unattested)	No	Coda

Goad and Brannen argue that word-final consonants appear before codas in child English as well. In light of the unattested pattern in (19d), this constitutes an argument for the position that word-final codas are initially onsets of empty-headed syllables. French acquisition proceeds in the same fashion. As mentioned above, word-final consonants emerge before word-internal codas. Finally, there is phonetic evidence to support the view that children syllabify word-final consonants as onsets of empty-headed syllables. Goad and Brannen (2000) argue that final consonants in early English words display a number of phonetic characteristics all of which correlate with their status as onsets, for example, aspiration (technically, final release). Aspiration is also found in Clara's and Théo's outputs, as exemplified in (20).[11]

(20) Aspiration of final consonants

a) Clara's word-final consonants

Word	Target form	Child's output	Age	Gloss
Charlotte	[ʃaʁlɔt]	[sæːˈlɔtʰ]	2;01.05	'Charlotte'
bloc	[blɔk]	[blɔˈtʰ]	2;03.15	'bloc'
carotte	[kaʁɔt]	[kæˈʁɔtʰ]	2;05.10	'carrot'
toilette	[twɑlɛt]	[twæˈlɛtʰ]	2;05.25	'toilet'
patte	[pat]	[pætʰ]	2;06.05	'paw'
patente	[patɑ̃t]	[baˈtãtʰ]	2;06.05	'thing'
quatre	[kat]	[kætʰ]	2;07.19	'four'
assiette	[asjɛt]	[æˈsjɛːtʰ]	2;07.19	'plate'

11. Goad and Brannen (2000) propose that the aspiration found on word-final consonants is represented by linking of the consonant under both the onset and the nucleus. This aspect of their analysis, however, is tangential to the present discussion.

b) Théo’s word-final consonants

Word	Target form	Child’s output	Age	Gloss
porte	[pɔʁt]	[pɔtʰ]	2;04.06	‘door’
botte	[bɔt]	[bɔtʰ]	2;04.06	‘boot’
porte	[pɔʁt]	[pɔtʰ]	2;04.28	‘door’
pique	[pɪk]	[pɪcʰ]	2;05.11	‘(it) pricks’
bibitte	[bibɪt]	[pəˈpɪtʰ]	2;05.11	‘bug’
salopette	[salɔpɛt]	[aˈbɛtʰ]	2;05.29	‘overalls’
fourchette	[fʊʁʃɛt]	[əˈʃɛtʰ]	2;05.29	‘fork’
bicycle	[bɪsɪk]	[b̥ɪˈsɪkʰ]	2;06.12	‘bicycle’

In sum, the French data are compatible with other cross-linguistic evidence that final consonants are syllabified as onsets of empty-headed syllables, therefore bringing more empirical support to Goad and Brannen’s (2000) proposal.

3.2.4 Analysis

I propose that the word-final consonant deletions observed at early stages in the development of onsets of empty-headed syllables result from a combination of undominated NUCLEUS and highly-ranked DEP(Root), the latter of which will prevent insertion of melodic material in the word-final empty position. In addition to these, in order to prevent resyllabification of onsets of empty-headed syllables as codas, I will appeal to the specific version of *COMPLEX defined in (21).

(21) *COMPLEX(Rhyme)
No branching is allowed in the rhyme

As mentioned in chapter 2, high ranking of this constraint is responsible for the absence of codas in output forms.

For completeness, I will also invoke the constraint MAXHEAD(Onset), whose definition is given in (22).

(22) MaxHead(Onset)
Every segment prosodified in the head of the onset in the input has a correspondent in the head of that onset in the output

As we will see, this constraint, added to the constraint ranking given earlier in (14), must be ranked below Dep(Root) in order to favour word-final consonant deletion over vowel epenthesis. The new ranking is expressed in (23).[12]

(23) Acquisition of onsets of empty-headed syllables, stage 1: constraint ranking
*Complex(Rhyme), Nucleus » Dep(Root) » MaxHead(Onset) » Max(Seg)

The domination of MaxHead(Onset) over Max(Seg) proposed in (23) will not be motivated from the data analysed in this section. However, this ranking is necessary in order to account for the development of branching onsets, as will be demonstrated in section 3.4.4.

The analysis of onsets of empty-headed syllables at stage 1 is illustrated in (24), with the input word *pomme* [pɔm] 'apple'.[13]

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12. The constraints Onset and MaxHead(Foot) are omitted from the ranking provided in (23). On the one hand, onsetless syllables, prohibited by Onset, have no bearing on the issue being discussed here. On the other, MaxHead(Foot) will be satisfied at both deletion and mastery stages in the acquisition of onsets of empty-headed syllables since these onsets are prosodified outside the foot in French, as was first discussed in section 2.2.7.2.

13. As mentioned above, in order to avoid repetition of the arguments, when Clara and Théo display similar patterns, as in the present case, only one tableau based on Clara's outputs will be provided.

(24) Onsets of empty-headed syllables at stage 1

Input: O N O N X X X X p ɔ m Ø	*COMPLEX (Rhyme)	NUCLEUS	DEP (Root)	MAXHEAD (Onset)	MAX (Seg)
i) [bɔm]: O N O N X X X X [b ɔ m Ø]		*!			
ii) [bɔmə]: O N O N X X X X [b ɔ m ə]			*!		
iii) [bɔm]: O R X X X [b ɔ m]	*!			*	*
☞ iv) [bɔ]: O N X X [b ɔ]				*	**

As we can see from the target-like candidate in (24i), onsets of empty-headed syllables fatally violate undominated NUCLEUS, which requires nuclei to be overtly realized in output forms. Filling the input empty nucleus with an epenthetic vowel, in (24ii), fatally violates highly-ranked DEP(Root).[14] A third option for preserving the input word-final consonant consists of syllabifying this consonant in coda position. However, as we can see from candidate (24iii), this option is ruled out by undominated *COMPLEX(Rhyme). Thus,

14. Rare cases of word-final schwa epenthesis were found in the data (e.g. *magnétophone* [maɲetɔfɔn] → [fɔˈfɔnˈnə] 'tape recorder'; Clara at age 1;10.10). Usually, these examples are found when the child expresses acute feelings (e.g. excitement, vexation) and, consequently, are accompanied with particular intonation and / or stress patterns (e.g. the additional stressed syllable in [fɔˈfɔnˈnə]). Despite the fact that these rare cases of epenthesis are caused by non-linguistic factors, they constitute more evidence in favour of the syllabification of word-final consonants as onsets of empty-headed syllables: if word-final consonants were codas, we would not expect vowel epenthesis because of the absence of an empty position in the input.

deletion of the word-final consonant constitutes the optimal option, which only violates lowly-ranked MaxHead(Onset) and Max(Seg), in (24iv).

At stage 2, Nucleus is demoted below MaxHead(Onset),[15] allowing word-final consonants to surface as onsets, following the ranking in (25). Since it is impossible to determine the relative ranking between Max(Seg) and Nucleus, these two constraints are left unranked with respect to each other.

(25) Acquisition of onsets of empty-headed syllables, stage 2: constraint ranking
*Complex(Rhyme) » Dep(Root) » MaxHead(Onset) » Max(Seg), Nucleus

This stage of mastery of onsets of empty-headed syllables is illustrated in (26) with the example *patte* [pat] ‘paw’.

(26) Onsets of empty-headed syllables at stage 2

Input: O N O N X X X X p a t Ø	*Complex (Rhyme)	Dep (Root)	MaxHead (Onset)	Max (Seg)	Nucleus
i) [pætə]: O N O N X X X X [p æ t ə]		*!			
☞ ii) [pæt]: O N O N X X X X [p æ t Ø]					*
iii) [pæ]: O N X X [p æ]			*!	**	
iv) [pætʰ]: O R X X X [p æ t]	*!		*	*	

15. Recall from section 2.4.2 that minimal reranking is not assumed here, as it finds no support in the data under investigation. However, for more discussion on constraint demotion, see section 3.5.3.1.

We can see, in (26i), that vowel epenthesis is still prohibited at stage 2 by highly-ranked DEP(Root). The new ranking of NUCLEUS below MAXHEAD(Onset) causes, on the one hand, the elimination of candidate (26iii), which fatally violates the latter constraint and permits, on the other, candidate (26ii) to surface as optimal. When compared to (26iv), candidate (26ii) displays the unmarked syllabification option for word-final consonants. It is thus selected as optimal despite the minimal violation of NUCLEUS.

In this subsection, I discussed the reranking of the markedness constraint NUCLEUS, which enabled the realization of word-final consonants as onsets. In the next section, to which we now proceed, we will witness the demotion of another markedness constraint, *COMPLEX(Rhyme).

3.3 Branching rhymes

We have seen, in section 2.2.6, that the rhyme can branch in two different ways, i.e. under the nuclear node or under the rhymal node. As mentioned in chapter 2, footnote #39, I assume that these two branching configurations are regulated by independent constraints, *COMPLEX(Nucleus) and *COMPLEX(Rhyme), respectively. In this section, I will be concerned only with the latter. Demotion of this constraint will permit the realization of true codas, i.e. word-internal consonants which are syllabified outside the onset constituent.

3.3.1 Stage 1: coda deletion

The first stage in the acquisition of branching rhymes is characterized by coda deletion. Regarding Clara's outputs, this stage prevails from the beginning of the recording sessions to age 2;03.05. Similarly, in Théo's outputs, coda deletion is observed until 3;06.13. Examples of coda deletion from both corpora are provided in (27).

(27) Acquisition of branching rhymes, stage 1: coda deletion

a) Clara: 1;00.28 to 2;03.05

	Word	Target form	Child’s output	Age	Gloss
i)	*Gaspard*	[gas̲paʁ]	[pɵˈpæː]	1;04.14	‘Gaspard’
	fourchette	[fʊʁ̲ʃɛt]	[ɸeˈdɛtʰ]	1;09.01	‘fork’
	construit	[kɔ̃s̲tχɥi]	[kæˈkuː]	1;10.04	‘(s/he) builds’
	perdu	[pɛʁ̲d͜zy]	[bøˈdy]	1;11.06	‘lost’
	casquette	[kas̲kɛt]	[tæˈkɛt]	1;11.21	‘cap’
	Charlotte	[ʃɑʁ̲lɔt]	[sæːˈlɔtʰ]	2;01.05	‘Charlotte’
	ourson	[ʊʁ̲sɔ̃]	[ʊˈsɔ̃]	2;03.05	‘teddy bear’
ii)	*regarde*	[gɑʁ̲d][a]	[g̊æːt]	1;11.06	‘look (imp.)’
	parle	[paʁ̲l]	[pæːl]	1;11.21	‘(s/he) speaks’

a. In Québec French, the imperative of *regarde* is often realized as [gɑʁd], i.e. without the first syllable.

b) Théo: 1;10.27 to 3;06.13

	Word	Target form	Child’s output	Age	Gloss
i)	*tortue*	[tɔʁ̲t͜sy]	[tɔˈty]	2;04.28	‘turtle’
	facteur	[fak̲tœʁ]	[faˈtɔχ]	2;10.24	‘postman’
	taxi	[tak̲si]	[taˈsi]	2;11.23	‘taxi’
	partout	paʁ̲tu]	[paˈtu]	3;02.07	‘everywhere’
	marteau	[maʁ̲to]	[maˈto]	3;05.06	‘hammer’
	fourmi	[fʊʁ̲mi]	[fuˈmi]	3;05.26	‘ant’
	coccinelle	[kɔk̲sinɛl]	[kɔsinɛl]	3;06.13	‘ladybug’
ii)	*porte*	[pɔʁ̲t]	[pɔt]	2;04.28	‘door’
	parc	[paʁ̲k]	[pak]	2;07.22	‘park’

The examples in (27ai) and (27bi) illustrate cases of word-internal coda deletion. Further, as can be observed in (27aii) and (27bii), when a coda is followed by the onset of an empty-headed syllable, it is the coda that undergoes deletion. These data provide more evidence for the analysis proposed in the preceding section about the status of word-final consonants. Indeed, the patterning in (27aii) and (27bii) is expected since these examples come from the period after which onsets of empty-headed syllables have been mastered by the children. It also provides more evidence for the assumption that inputs are fully prosodified: consistent with the high ranking of MAXHEAD(Onset) at the stage of mastery of word-final consonants, the input word-final onset is preserved in the output, as it belongs to a different syllabic constituent than the coda, which undergoes deletion.

3.3.2 Stage 2: mastery

The second stage in the acquisition of codas is characterized by mastery of the dependent rhymal position, as shown in (28). As we can see in (28a), starting at age 2;03.19,[16] codas faithfully surface in Clara's output forms. The same holds true of Théo at age 3;07.06, as exemplified in (28b).

(28) Acquisition of branching rhymes, stage 2: mastery

a) Clara: 2;03.19

	Word	Target form	Child's output	Age	Gloss
i)	*pansement*	[pɑ̃s̱mɑ̃]	[pæsˈmæː]	2;03.19	'plaster'
	Gaspard	[gas̱pɑʁ]	[gæsˈpaʁ]	2;03.19	'Gaspard'
	dormir	[dɔʁ̱mɪʁ]	[dɔʁˈmiʁ]	2;03.19	'(to) sleep'
	fourchette	[fʊʁ̱ʃɛt]	[fʊʁˈsɛt]	2;05.25	'fork'
	pourquoi	[pʊʁ̱kwa]	[pʊʁˈkwæ]	2;06.05	'why'
ii)	*regarde*	[ʁəgaʁ̱d]	[ʁəˈgaʁd]	2;07.19	'(s/he) looks at'
	parle	[paʁ̱l]	[pɑʁl]	2;07.19	'(s/he) speaks'

b) Théo: 3;07.06

	Word	Target form	Child's output	Age	Gloss
i)	*escabeau*	[ɛs̱kabo]	[ɛskaˈbo]	3;07.06	'stool'
	fermer	[fɛʁ̱me]	[fɔʁˈme]	3;07.06	'(to) close'
	serpent	[sɛʁ̱pɑ̃]	[saʁˈpɑ̃]	3;07.06	'snake'
	tortue	[tɔʁ̱t͜sy]	[tɔχˈt͜sy]	3;07.06	'turtle'
	coccinelle	[koḵsinɛl]	[kɔksiˈnɛl]	3;07.06	'ladybug'
ii)	*courte*	[kʊʁ̱t]	[kʊʁt]	3;07.06	'short (fem.)'
	gros ours	[gʁozʊʁ̱s]	[gʁoˈnʊʁs]	3;08.19	'big bear'

16. It is possible that codas were actually mastered by Clara at age 2;03.15. However, no relevant examples permit us to verify this. Nonetheless, as there is only a four-day leap between the two dates at stake here, the point in time when codas are mastered remains very well circumscribed. In chapter 5, where the development of Clara's [ʁ] is discussed in depth, I will argue that codas have emerged in Clara's outputs at age 2;03.15.

As we can see, codas followed by onsets of empty-headed syllables ((28aii) and (28bii)) seem to emerge at the same time as codas followed by word-internal onsets ((28ai) and (28bi)).[17] This is expected since both contexts involve the same structure and, thus, are governed by the same constraints. Notice as well that only words containing [ʁ], [s], or [k] in coda are found in the data in (27) and (28). This limited distribution reflects that of the target language; while other consonants such as [l] and [p] are also found in codas in French (e.g. *calcaire* [kal̲kaɪʁ] 'limestone', *calculer* [kal̲kyle] '(to) calculate'; *cheptel* [ʃɛp̲tɛl] 'livestock', *capter* [kap̲te] 'to catch'), codas of this shape are not found in the children's data.

The analysis of the developmental pattern observed within the rhyme is proposed in the next subsection.

3.3.3 Analysis

As alluded to above, I will account for the development observed from (27) to (28) through the demotion of *COMPLEX(Rhyme). At stage 1, this constraint, like any other markedness constraint, is undominated in Clara's grammar, above DEP(Seg) and MAX(Seg), the two other relevant constraints. The MAXHEAD constraints are not relevant for the present discussion, which focuses on the realization of a dependent position, the coda.[18]

17. Although this cannot be verified with precision in Clara's data, due to a lack of relevant forms between age 2;03.19 and 2;07.19, it is certainly true for Théo.

18. Notice, however, that, as already mentioned, deletion of Clara's coda [ʁ] in stressed syllables yields lengthening of the vowel preceding it, as we can see in (27aii). This contrasts with the absence of such lengthening for Théo in (27bii). In chapter 5, I will account for Clara's pattern through the ranking *COMPLEX(Rhyme), MAXHEAD(Foot) » *COMPLEX(Nucleus). The absence of such lengthening in Théo's outputs will be accounted for through *COMPLEX(Rhyme) » *COMPLEX(Nucleus) » MAXHEAD(Foot). In this sense, then, stress (formally, MAXHEAD(Foot)) does play a role in branching rhyme reduction, but only in the context of Clara's word-final coda [ʁ] deletion, because of the domination of MAXHEAD(Foot) over *COMPLEX(Nucleus) in her grammar.

The ranking proposed for the first stage in the acquisition of branching rhymes is given in (29).

(29) Acquisition of branching rhymes, stage 1: constraint ranking
*COMPLEX(Rhyme) » DEP(Seg) » MAX(Seg)

To exemplify this stage of branching rhyme reduction, in the tableau in (30), I use the word *fourchette* [fʊʁʃɛt] ‘fork’ from (27).[19]

(30) Branching rhymes at stage 1

	Input: O R O N O N X X X X X X X f ʊ ʁ ʃ ɛ t Ø	*COMPLEX (Rhyme)	DEP(Seg)	MAX(Seg)
	i) [fʊʁʃɛt]: O R X X X [f ʊ ʁ ʃetØ]	*!		
	ii) [fʊʁəʃɛt]: O N O N X X X X [f ʊ ʁ ə ʃɛtØ]		*!	
☞	iii) [fʊ'ʃɛt]: O N X X [f ʊ ʃɛtØ]			*

We can see, in (30i), that coda production is prohibited by undominated *COMPLEX(Rhyme). Also, as observed in earlier tableaux, vowel epenthesis is never used as a way to salvage input codas; the candidate in (30ii) thus fatally violates DEP(Seg). The winning candidate, in (30iii), only incurs a minimal violation of MAX(Seg).

19. In (27), we can see that the actual output displays non-target-like fricatives ([f] → [ɸ]; [ʃ] → [d]). These alternations are caused by the fact that fricatives display some variation in their realization at the early stage where this example is found, as was mentioned in section 3.1. For the sake of simplicity, I will abstract away from this variation in the present discussion.

This analysis may be directly applied to the examples in (27aii) and (27bii), which, as mentioned above, involve the same input structures, even though codas in these examples are followed by onsets of empty-headed syllables. As already discussed, these cases provide support for the analysis proposed here, which draws a structural distinction between codas and onsets of empty-headed syllables. In order to avoid repetition of the argument, I will not discuss these examples further. For an account of the difference between Clara and Théo with regard to compensatory lengthening of the vowel in this context, however, see section 5.2.2.2.

Turning now to the second stage in the acquisition of branching rhymes, I will again take the example of *fourchette*, which is now realized in target-like fashion. This stage is characterized by the demotion of *Complex(Rhyme) below Max(Seg), as we can see in the new ranking in (31).

(31) Acquisition of branching rhymes, stage 2: constraint ranking
Dep(Seg) » Max(Seg) » *Complex(Rhyme)

The evaluation tableau is given in (32).

(32) Branching rhymes at stage 2

Input: O R O N O N X X X X X X X f ʊ ʁ ʃ ɛ t Ø	Dep(Seg)	Max(Seg)	*Complex (Rhyme)
i) [fʊˈʃɛt]: O N X X [f ʊ ʃɛtØ]		*!	
ii) [fʊʁəʃɛt]: O N O N X X X X [f ʊ ʁ ə ʃɛtØ]	*!		
☞ iii) [fʊʁʃɛt]: O R X X X [f ʊ ʁ ʃetØ]			*

Candidate (32i), which shows coda deletion, cannot be optimal at this stage, as it fatally violates MAX(Seg), which is now ranked above *COMPLEX(Rhyme) in the grammar. Candidate (32ii) still fatally violates DEP(Seg) and so cannot surface as optimal. Thus, candidate (32iii), which displays a consonant faithfully parsed in coda position, is selected as optimal, despite its violation of lowly-ranked *COMPLEX(Rhyme).

The analysis proposed here for the acquisition of branching rhymes assumes that all word-internal consonants which are not syllabified in onset position are syllabified as the second member of a branching rhyme. Because of the fact that target French allows for word-internal empty nuclei, one could propose that the CC clusters found in the data in (26) and (27) are analysed as CØC sequences, i.e. separated by a word-internal empty nucleus. This hypothesis is rejected, however, for a number of reasons, which are discussed in the next subsection.

3.3.3.1 Residual issues

The possibility that word-internal codas are onsets of empty-headed syllables, rather than being codas, can be rejected on empirical and markedness grounds, as well as from the evidence required to master word-internal empty nuclei in target French. We will consider each in turn.

Firstly, in the last two sections (3.2 and 3.3), I demonstrated that word-final consonants and (word-internal) codas are acquired at different points in time by both Clara and Théo. If both contexts were uniformly represented in the children's systems, as word-internal and word-final onsets of empty-headed syllables, we would expect their emergence to be simultaneous or, at least, that they would appear within a relatively short period of time of each other. This is clearly not the case. Given this observation, proposing a uniform representation — or a uniform constraint-based analysis — of these two contexts would be empirically flawed.

Secondly, still from an empirical perspective, the order of acquisition of the two contexts under scrutiny is important. Given the fact that onsets of empty-headed syllables and codas involve different structures and constraints, one could presuppose that these two structures could be acquired in any order. I suggest that this is not the case. Instead, it seems that segmental complexity is relatively easier to master than syllabic complexity. Recall from section 3.2.3 that onsets of empty-headed syllables represent the default option for consonant syllabification at the right edge of words. Given this, and according to the current analysis, faithfulness to word-final consonants only requires a change at the segmental level; no learning of a new (branching) structure is involved. On the other hand, the mastery of true codas involves the learning of a new structure.

Thirdly, regarding markedness, it must be acknowledged that while empty nuclei at the right edge of words are relatively more marked than phonetically-realized nuclei, as evidenced by factorial typology (e.g. Jakobson 1962, Clements and Keyser 1983, Prince and Smolensky 1993, Blevins 1995), in comparison, empty categories within the word are even more marked. To my knowledge, there exist no languages which allow for word-internal empty nuclei without allowing for onsets of empty-headed syllables at the right edge of words. Indeed, while languages such as Diola-Fogny and Kamaiurá allow for onsets of empty-headed syllables word-finally (see (19) above),[20] these languages both disallow word-internal empty nuclei. By contrast, the reverse situation, i.e. a language allowing for word-internal empty nuclei while disallowing for word-final ones, appears to be unattested.

Still from a markedness viewpoint, the featural profiles of the clusters analysed in (26) and (27) also suggest a coda-onset analysis. Recall that the three coda consonants found in the data are [ʁ], [s], and [k]. The first two consonants constitute unmarked codas cross-linguistically. Indeed, as reported by Itô (1986), languages such as Italian allow only

20. Yapese is noticeably missing from this list. As mentioned by Goad and Brannen (2000), based on a word-internal vowel truncation pattern reported by Jensen (1977) (e.g. /luba-dadu/ → [lubdaːd] ‘our breath’), Yapese, like French, seems to allow for word-internal empty nuclei.

for sonorants (nasals and liquids) and [s] in coda position (save coda-onset sequences consisting of a geminate consonant). According to Harris (1997: 331-333), Turkish also displays this distribution in coda position. Finally, concerning coda [k], Rice (1992: 81ff) reports that while word-internal clusters like /kt, pt/ are well-formed in languages such as Attic Greek, English, and French, the reverse clusters, */tk, tp/, are ill-formed (see, also, Kaye, Lowenstamm, and Vergnaud 1988, Rice 1989, Clements 1990). As we can see in the examples in (26) and (27), coda [k] is followed only by coronals ([t, s]). Therefore, from a featural point of view, all of the clusters found in both Clara's and Théo's outputs reflect well-formed coda-onset sequences.

Finally, the evidence required in order to master word-internal empty nuclei in target French must also be taken into consideration. Indeed, this evidence is far more complex than the evidence available for word-final empty nuclei. Starting with the latter, given that onsets of empty-headed syllables constitute the unmarked option for the syllabification of word-final consonants, simple exposure to positive evidence, i.e. ambient words with final consonants, is sufficient. The same does not hold true of word-internal empty nuclei. In order to master these nuclei, the French-learning child must understand (a) the segmental profile of the surface CC strings created by a word-internal empty position, as well as (b) the variation involved with word-internal empty nuclei. This variation has two main sources: speech style / register and morphological alternations. I will briefly address these issues in turn. First, some CØC strings (i.e. surface CC clusters separated by an empty nucleus) are segmentally misleading. For example, a word like *enveloppe* 'envelope' can be pronounced as either [ɑ̃vlɔp] or [ɑ̃vəlɔp]. The former realization constitutes the most commonly-used variant; the latter is used only under special circumstances such as emphasis or when each syllable is spelled out in isolation. In this word, [vl], which results from the non-realization of a word-internal empty nucleus, is ill-formed as a branching onset, as evidenced by the fact that there exist no word-initial [vl] sequences in French. Given this, in order to master the correct distribution of word-internal empty nuclei, the child must understand the asymmetrical distribution of CC clusters in French. Second, evidence from morphological alternations must also be understood. For example, in a verb like *enlever* [ãlve / ãləve] ‘to remove’, the [Ø / ə] alternation is further complicated by an alternation with [ɛ] in some inflected forms. Indeed, the empty nucleus observed in *enlever* is realized as [ɛ] in present tense *enlève* [ãlɛv] ‘(s/he) calls’.[21] Because of the complexity induced by morphological alternations, it would be surprising that the child, at early stages, understands the evidence necessary to attain the correct input representation for word-internal nuclei.

Given all of these observations (order of acquisition, markedness, and complexity of the evidence required to master word-internal empty nuclei), I maintain that the current proposal, which assumes that the target word-internal clusters exemplified in (26) and (27) are all coda-onset sequences, best accounts for the data and, from a formal perspective, constitutes the most restrictive analysis.

In the next section, I turn to the acquisition of branching within another prosodic constituent, the onset. The analysis of the development of branching onsets will proceed along the same lines, with the addition of one factor, foot headedness.

Before proceeding to the next section, it must be pointed out that if the development of prosodic structure were to have been accounted for in chronological order, branching onsets would have been addressed earlier in this chapter, between the acquisition of onsets of empty-headed syllables and that of codas. However, in order to facilitate the discussion of issues pertaining directly to the acquisition of branching rhymes, the account of the development of branching onsets was deferred until now.

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21. See Charette (1991) and references cited therein for a formal account of this aspect of French verbal morphology.

3.4 Branching onsets

As we saw in section 2.2.4, I adopt the standard view that branching onsets are formed by the combination of an obstruent head followed by a dependent sonorant. In French, onset dependents are limited to the liquids [ʁ] and [l].

3.4.1 Stage 1: branching onset reduction

In early outputs, all target branching onsets are reduced to singletons in both Clara's and Théo's outputs, no matter what their position is in the word or in the foot. Examples of branching onset reductions are provided in (33).

(33) Acquisition of branching onsets, stage 1: deletion

a) Clara: 1;00.28 to 1;09.01

Word	Target form	Child's output	Age	Gloss
Cracra	[kχakχa]	[kaˈkæ]	1;07.27	'Cracra'
brisé	[bʁize]	[bœːˈçiː]	1;07.27	'broken'
fleur	[flœʁ]	[βœː]	1;07.27	'flower'
pleure	[plœʁ]	[pœː]	1;07.27	'(s/he) cries'
abricot	[abʁiko]	[pupæˈkoː]	1;09.01	'apricot'

b) Théo: 1;10.27 to 2;05.11[a]

Word	Target form	Child's output	Age	Gloss
clé	[kle]	[ke]	2;04.28	'key'
clown	[klʊn]	[kʊɲ]	2;05.11	'clown'
clé	[kle]	[kɪ]	2;05.11	'key'
brisé	[bʁize]	[pɪˈz̥e]	2;04.06	'broken'
train	[tχɛ̃]	[kɛ]	2;05.11	'train'

a. Regarding branching onsets whose liquid is [l], only [kl] clusters are found in Théo's data at this stage. Also, no CVCLV targets were found at this stage.

As we can see, the consonant that is deleted from the output form is always the liquid. This pattern, which is robustly attested in the literature on L1 acquisition (e.g. Jakobson 1941/68, Smith 1973, Greenlee 1974, Chin and Dinnsen 1992, Fikkert 1994, Barlow 1997, Bernhardt and Stemberger 1998), has been analysed from two different perspectives. On the one hand, some researchers have proposed that it is due to phonetically-defined constraints that favour the least sonorous member of the input cluster in outputs (e.g. Fikkert 1994, Gilbers and Den Ouden 1994, Gnanadesikan 1995, Barlow 1997, Bernhardt and Stemberger 1998, Gierut 1999). On the other hand, other scholars have proposed that this pattern is due to structurally-motivated requirements on head faithfulness (e.g. Spencer 1986, Goad and Rose 2000, to appear; cf. Gilbers and Den Ouden 1994). In line with Goad and Rose (2000, to appear), and in keeping with the general approach pursued in this thesis, which aims to demonstrate the importance of highly-articulated representations in the explanation of acquisition patterns, I will analyse the data in (33) using two interacting constraints referring to the onset constituent, namely, *COMPLEX(Onset) and MAXHEAD(Onset).

This structural approach is further supported by the patterns observed at stage 2, described in the next section, to which I now turn.

3.4.2 Stage 2: faithfulness in stressed syllables only

During the subsequent stage, branching onsets emerge in both children's outputs, but only in stressed syllables. While the emergence of branching onsets is sensitive to prosodic context, it is not affected by melodic content; in stressed syllables, *all* branching onsets surface in the children's outputs while, in unstressed syllables, liquid deletion is still observed, regardless of the segmental quality of the head. This can be observed if we compare the examples in (34ai) and (34bi) with those in (34aii) and (34bii).

(34) Acquisition of branching onsets, stage 2

a) Clara: 1;09.29 to 2;03.05

i) Target-like in stressed syllables

Word	Target form	Child's output	Age	Gloss
biberon	[bibʁɔ̃]	[paˈpχɔ]	1;09.29	'baby bottle'
glisse	[glɪs]	[klɪs]	1;10.04	'(s/he) slides'
citrouille	[sitχʊj]	[θəˈtχuːj]	1;10.04	'pumpkin'
pleure	[plœʁ]	[plœχ]	2;03.05	'(s/he) cries'

ii) Liquid deletion in unstressed syllables

Word	Target form	Child's output	Age	Gloss
frigo	[fʁigo]	[bʊˈko]	1;09.29	'fridge'
brûlé	[bʁyle]	[biˈle]	1;09.29	'burned'
glissade	[glisad]	[kaˈsæd]	1;10.04	'(a) slide'
trouvé	[tχuve]	[tʊˈve]	2;03.05	'found'

b) Théo: 2;05.29 to 2;11.29

i) Target-like in stressed syllables

Word	Target form	Child's output	Age	Gloss
gros	[gʁo]	[gʁo]	2;05.29	'big'
train	[tχɛ̃]	[kχɛ]	2;06.12	'train'
grimpe	[gʁɛ̃p]	[kχɛ̃t]	2;06.30	'(s/he) climbs'
clé	[kle]	[kxi]	2;05.29	'key'
clown	[klʊn]	[klʊn]	2;06.12	'clown'
pleure	[plœʁ]	[plœᶷ]	2;07.06	'(s/he) cries'

ii) Liquid deletion in unstressed syllables

Word	Target form	Child's output	Age	Gloss
crème glacée	[ˈkχɛmglaˈse]	[ˈkχaᶦnaˈse]	2;06.30	'ice cream'
tracteur	[tχaktœʁ]	[taˈtœᶷ]	2;08.22	'tractor'
gruau	[gʁyjo]	[kʰœˈjɔ]	2;10.24	'oatmeal'
trouvé	[tχuve]]	[kʊˈβi]	2;11.29	'found'

In order to account for this positional faithfulness pattern, I will again appeal to MAXHEAD(Foot). Before I turn to the details of the analysis, I will describe, in the next section, the stage of mastery of branching onsets in all prosodic positions.

3.4.3 Stage 3: faithfulness across the board

The third stage in the acquisition of branching onsets is characterized by faithfulness across the board in the two children's outputs. Examples of branching onsets in both stressed and unstressed syllables are given in (35).

(35) Acquisition of branching onsets, stage 3: mastery

a) Clara: 2;03.15

Word	Target form	Child's output	Age	Gloss
gros	[gʁo]	[gʁo]	2;03.15	'big'
trouvé	[tχuve]	[tχuˈve]	2;03.19	'found'
		[tχuˈve]	2;06.28	
plancher	[plɑ̃ʃe][a]	[plɑ̃ˈʃe]	2;05.25	'floor'

a. This is the only target word with a C[l] cluster in an unstressed syllable at this stage. All other C[l] clusters are either in monosyllabic words or are contained in stressed syllables.

b) Théo: 3;00.07

Word	Target form	Child's output	Age	Gloss
trouvé	[tχuve]	[kχaˈve]	3;00.07	'found'
prenez	[pχəne]	[pʁəˈne]	3;00.07	'(you) take (pl.)'
accroché	[akχɔʃe]	[kχɔˈʃe]	3;00.23	'hooked'
pleurer	[plœʁe][a]	[pløˈʁe]	3;05.06	'(to) cry'
plaster	[plastœʁ]	[plasˈtœʁ]	3;09.15	'plaster'
glissade	[glisad]	[kliˈsad]	3;10.26	'(a) slide'

a. No C[l] clusters in unstressed syllables were found before 3;05.06.

As we can see in the data above, both Clara and Théo show a three-stage developmental pattern in the acquisition of branching onsets. In the next section, I turn to the specific constraints which will be necessary in order to provide an adequate account of these data.

3.4.4 Analysis

As alluded to above, in order to account for the patterns of acquisition of branching onsets, I will appeal to *COMPLEX, which takes the onset as its argument, following the definition in (36).

(36) *COMPLEX(Onset)
No branching is allowed in the onset

*COMPLEX(Onset) will interact with the two segmental faithfulness constraints, MAX(Seg) and DEP(Seg), as well as with the two prosodic head faithfulness constraints, MAXHEAD(Onset) and MAXHEAD(Foot). While satisfaction of MAXHEAD(Onset) predicts which of the two input segments is preserved in the onset reduction patterns observed in (33), (34aii), and (34bii) above, satisfaction of MAXHEAD(Foot) requires faithfulness to segments which appear in the head of the foot in the input.

As already mentioned in section 2.3.1.1, this approach to head faithfulness in onset cluster reduction is essentially the same as the one developed in Goad and Rose (2000, to appear). Goad and Rose provide further evidence for this constraint from [s / ʃ]-initial clusters that rise in sonority (e.g. [sn / ʃn], [sl / ʃl]) from children learning English, Dutch, and German.[22] As Goad and Rose demonstrate, in some children, the head that survives does not correspond to the least sonorous member of the input cluster. This observation (e.g. [sn] → [n]; *[s]) supports their structural approach to onset cluster reduction, as opposed to one which is sonority-driven. The same approach is adopted here.

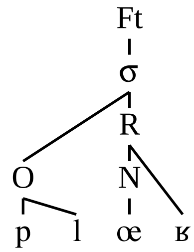
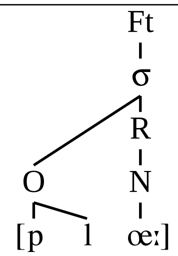
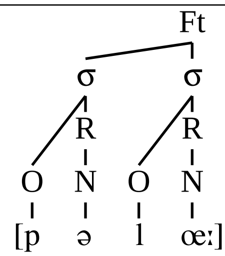
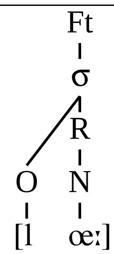
The first stage in the acquisition of branching onsets is characterized by undominated *COMPLEX(Onset). As we can see in (37), MAXHEAD(Foot), which is violated by any instantiation of branching onset reduction in stressed syllables, must crucially be ranked below *COMPLEX(Onset). The relative ranking of the other faithfulness constraints, which are ranked below MAXHEAD(Foot), was discussed in section 3.2.4.

(37) Branching onsets at stage 1: constraint ranking
*COMPLEX(Onset) » MAXHEAD(Foot) » DEP(Seg) » MAXHEAD(Onset) » MAX(Seg)

The effects of this ranking are shown in (38) with the word *pleure* [plœʁ] ‘(s/he) cries’.

22. Such clusters are virtually absent from French; they appear in loanwords only.

(38) Branching onsets at stage 1

		*COMPLEX (Onset)	MAXHD (Foot)	DEP (Seg)	MAXHD (Onset)	MAX (Seg)
	Input: 					
	i) [plœː]:[a] 	*!				
	ii) [pəˈlœː]: 		*	*!		
	iii) [lœː]: 		*		*!	*
☞	iv) [pœː]: 		*			*

a. As I will argue in chapter 5, the vowel lengthening observed in this output results from preservation of the timing position of input [ʁ]. Thus, despite deletion of the melodic content of [ʁ], both MAXHEAD(Foot) and MAX(Seg) are satisfied in this context.

The first candidate, in (38i), fatally violates *COMPLEX(Onset), as it displays a branching configuration under the onset constituent. The three other candidates show branching onset reduction in the stressed syllable, and thus, equally violate MAXHEAD(Foot). In (38ii), this constraint is violated because the [p] of the input syllable, which is syllabified in the foot head in the input, falls in the dependent syllable of the foot in the output. In (38iii) and (38iv), MAXHEAD(Foot) is violated through segmental deletion. The optimal candidate must therefore be selected from lower-ranked constraints. Candidate (38ii) fatally violates DEP(Seg) because it contains an epenthetic vowel between the two members of the input branching onset. The competition is thus left to the two CV-shaped candidates. In candidate (38iii), it is the dependent position which appears in the reduced onset, contrary to the requirements of MAXHEAD(Onset). This leaves us with the candidate in (38iv) as optimal because, in addition to MAXHEAD(Foot), this form only violates the lowly-ranked constraint MAX(Seg).

For reasons of space, the effects of constraints such as ONSET and NUCLEUS are not included in the tableau above. Despite this, notice that, at the initial stage, undominated NUCLEUS rules out the candidate that contains an empty nucleus to break up the illicit cluster (i.e. *[pØlœː]). (See section 3.4.4.1 for further discussion of word-internal empty nuclei.)

During the second stage in the development of branching onsets, we observed, in (34), a positional faithfulness pattern whereby branching onsets faithfully surface only in stressed syllables. In order to account for this pattern, I propose that *COMPLEX(Onset) is demoted below MAXHEAD(Onset) at stage 2. This new ranking permits the realization of branching onsets in stressed syllables only. In addition, it is crucial that, at this stage, *COMPLEX(Onset) is still ranked above MAX(Seg), as we can see in the new ranking in (39).

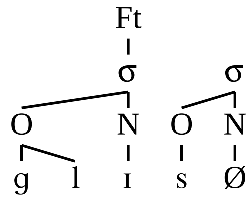
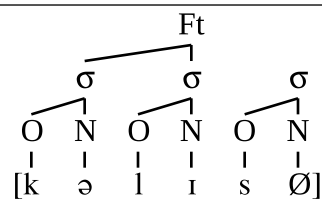
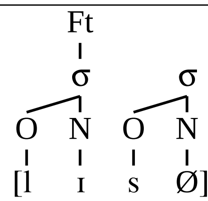
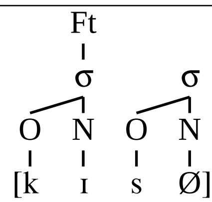
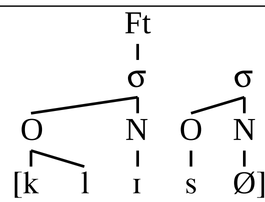
(39) Branching onsets at stage 2: constraint ranking
MAXHEAD(Foot) » DEP(Seg) » MAXHEAD(Onset) » *COMPLEX(Onset) » MAX(Seg)

I will exemplify this second stage by comparing branching onsets in both stressed and unstressed syllables, with the words *glisse* [glɪs] 'slide (3 sg.)' and *brûlé* [bʁyˈle] 'burned' in (40a) and (40b), respectively.

Since *COMPLEX(Onset) has been demoted below MAXHEAD(Foot) at this stage, none of the first three candidates in (40a), which satisfy *COMPLEX(Onset) at the expense of MAXHEAD(Foot), can be selected as optimal. The target-like candidate (40aiv) is thus selected as optimal. Only in this candidate are all segments from the input foot head, [glɪ], present in the output.

(40) Branching onsets at stage 2

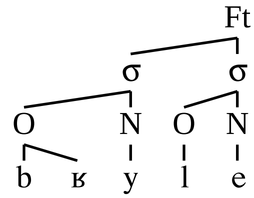
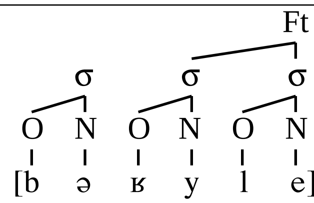
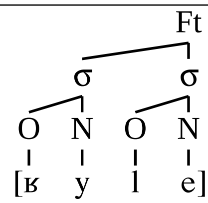
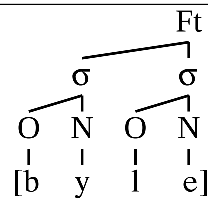
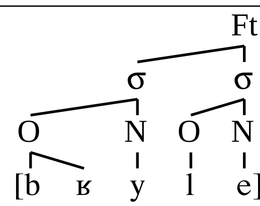
a) In stressed syllables[a]

Input: 	MAXHD (Foot)	DEP (Seg)	MAXHD (Onset)	*COMPLEX (Onset)	MAX (Seg)
i) [kəˈlɪs]: 	*!	*			
ii) [lɪs]: 	*!		*		*
iii) [kɪs]: 	*!				*
☞ iv) [klɪs]:[b] 				*	

a. Regarding the way word-final [s] is prosodified in this tableau, recall from section 2.2.7.2 that onsets of empty-headed syllables are licensed directly by the prosodic word in French. In the interest of space, the prosodic word is not included in the schemas.

b. At this stage, NUCLEUS has been demoted below MAX(Seg). Onsets of empty-headed syllables may thus surface in Clara's outputs, as was discussed in section 3.2.4.

b) In unstressed syllables

Input: 	MAXHD (Foot)	DEP (Seg)	MAXHD (Onset)	*COMPLEX (Onset)	MAX (Seg)
i) [bəʁyˈle]: 		*!			
ii) [ʁyˈle]: 			*!		*
☞ iii) [byˈle]: 					*
iv) [bʁyˈle]: 				*!	

Given that *COMPLEX(Onset) still outranks MAX(Seg), in (40b), the branching onset in the unstressed syllable cannot be preserved, since the constraint that would force preservation, MAXHEAD(Foot), only has scope over stressed syllables. Thus, any segmental deletion outside the input stressed syllable vacuously satisfies this constraint. Candidate (40biii) will therefore be selected as optimal, despite the fact that it displays segmental deletion; this candidate only incurs a minimal violation of MAX(Seg). The other candidates all fatally violate higher-ranked constraints and, therefore, cannot surface. In short, undominated MaxHead(Foot) at this stage in development is only a factor in inputs which, like *glisse* in (40a), contain a branching onset in stressed syllables.

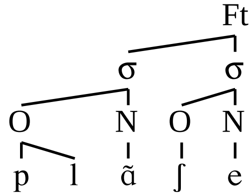
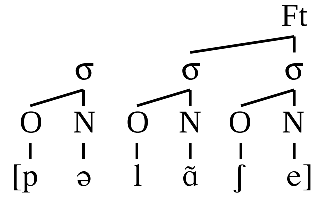
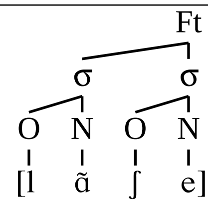
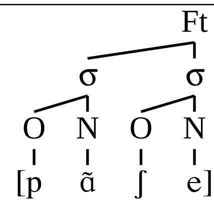
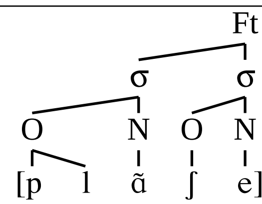
As was mentioned in section 3.2.4, the ranking of MaxHead(Onset) above Max(Seg) proposed in that section could not be motivated on the basis of the data from onsets of empty-headed syllables; an equal ranking of these two constraints would have been sufficient. The tableaux in (39) and (40a) do not provide us with evidence for this ranking either. However, in (40b), when the interaction of these two constraints is witnessed relative to *Complex(Onset), only the ranking MaxHead(Onset) » Max(Seg) (with *Complex(Onset) between them) makes the correct predictions.

Turning now to the third stage in the development of onsets, we saw above, in (35), that at this stage of mastery, the effect of stress has disappeared: all input branching onsets, no matter their position in the word, are faithfully realized in output forms. In order to account for this across-the-board faithfulness pattern, I propose that *Complex(Onset) is demoted to the bottom of the constraint ranking, as expressed in (41).

(41) Branching onsets at stage 3: constraint ranking
MaxHead(Foot) » Dep(Seg) » MaxHead(Onset) » Max(Seg) » *Complex(Onset)

The predictions made by this new ranking are illustrated in (42), with the word *plancher* [plɑ̃ˈʃe] ‘floor’.

(42) Branching onsets at stage 3

Input: 	MAXHD (Foot)	DEP (Seg)	MAXHD (Onset)	MAX (Seg)	*COMPLEX (Onset)
i) [pəlãˈʃe]: 		*!			
ii) [lãˈʃe]: 			*!	*	
iii) [pãˈʃe]: 				*!	
☞ iv) [plãˈʃe]: 					*

As we can see, only the target-like candidate in (42iv) can surface as optimal at this stage of mastery, as it satisfies all of the faithfulness constraints, at the expense of lowly-ranked *COMPLEX(Onset).

Notice that, at this stage, it is not possible to determine with certainty the relative ranking of the three MAX constraints involved in the analysis. In order to account for the difference between stages 2 and 3, the only reranking that is crucial regards the demotion of *COMPLEX(Onset) to the bottom of the constraint hierarchy, in order to ensure full preservation of every segment in branching onsets. Given this, one could propose that the three MAX constraints discussed here eventually become unranked with respect to each other, or, even, that they become fused into a general MAX constraint that would ensure across-the-board faithfulness to the segmental content of the inputs in the target language. However, there is no positive evidence available to the learner for such a possibility. Thus, even if the linguist's end-state grammar allows for an equal ranking of these faithfulness constraints, the learner's end-state grammar must reflect the ranking proposed in (41).

3.4.4.1 Residual issues

Before I conclude this section, I will come back to a number of issues which deserve further discussion. The first of these issues concerns the question of potential candidates which contain empty categories between the two members of an input branching onset. As argued in section 3.2.2, word-final onsets of empty-headed syllables and, thus, empty nuclei, have become possible at age 1;07.06, an age which corresponds roughly to the end of stage 1 in the acquisition of branching onsets. Given this, one could propose that at stages 2 and 3, output forms for words such as *gros* [gʁo], which are realized as target-like, are actually represented as *[gØʁo], i.e. with an empty nucleus between the two consonants of the input branching onset. There are two arguments against this.

Firstly, based on the argument already developed in section 3.3.3.1, it is very unlikely that word-internal empty nuclei, which are fairly marked cross-linguistically, are mastered by the child at such an early stage in development. Recall that the mastery of word-internal empty nuclei in French requires an understanding of evidence from the featural profile of the consonants involved on both sides of the empty nucleus, optional schwa insertion between these two consonants (e.g. *enveloppe* [ɑ̃vlɔp / ɑ̃vəlɔp] 'envelope'), as well as morphological alternations (e.g. *enlever* [ɑ̃lve] '(to) remove' versus *enlève* [ɑ̃lɛv] '(s/he) removes'). Related to this, even if word-internal empty nuclei were mastered in the case of surface clusters such as [vl], which, as already mentioned, are illicit branching onsets in French despite their obstruent-liquid profile, this would not imply that well-formed branching onsets, i.e. obstruent-liquid clusters attested word-initially, would be analysed in a marked fashion by the child. Rather, the learner should resort to marked options only when the unmarked analysis cannot be upheld, which is not the case for the branching onsets exemplified above. Secondly, with respect to branching onsets, as was discussed in section 2.2.4, in the unmarked state of affairs, obstruent-liquid clusters are syllabified as branching onsets, and not in two distinct syllables separated by an empty nucleus. The branching onset option should therefore be the first analysis entertained by the child. The alternative, word-internal empty nuclei, should be entertained only in the face of robust evidence like the [ɛ] / Ø alternation found in French verbal morphology. As argued for above, it is unlikely that such evidence is understood by the child at early stages in development.

The second issue that merits further discussion concerns the fact that, as we saw in section 3.3, the development of codas (branching rhymes), unlike the development of branching onsets, is not subject to the effect of stress (save Clara’s coda [ʁ] in stressed syllables). Many conspiring factors may help our understanding of this observation. Firstly, given the fact that French is invariably stress final, and that final consonants are syllabified as onsets of empty-headed syllables, both by the child and in the target language, the only codas that are found in stressed syllables are in words showing a flat or rising sonority word-final consonant cluster (e.g. *tact* [ˈtak.t] ‘tact’, *parle* [ˈpaʁ.l] ‘speak (3 sg.)’, *malte* [ˈmal.t] ‘malt’). Words like these with a stressed branching rhyme are not the most frequent in French.[23] In fact, no such words could be found at relevant stages in the children’s data. Secondly, the effect of stress observed above for branching onsets disappears before the appearance of the first branching rhymes. Therefore, it is impossible to determine whether stress would have played a role in the acquisition of branching rhymes if they had been acquired during the same period as branching onsets.

23. This generalization holds of both Québec and European varieties since in those dialects where a schwa is inserted word-finally, stress falls on the vowel preceding the word-final schwa.

Thirdly, related to the preceding issue, one could suggest that the acquisition of word-final consonants, analysed above as the mastery of onsets of empty-headed syllables, could instead be analysed as true codas. Under this analysis, word-final codas would emerge before word-internal ones because, by virtue of being rhymal consonants (in contrast to onsets of empty-headed syllables), word-final codas would be licensed in the foot head, along with the stressed vowel. A number of observations, however, argue against such an analysis. First of all, as we saw through a comparison of the examples in (27aii) and (27bii) with those in (28aii) and (28bii), branching rhymes in words which unambiguously contain a coda in the stressed syllable (e.g. *courte* [kʊʁ̠t] ‘short’) emerge at the same time as branching rhymes whose coda appears in an unstressed syllable (e.g. *tortue* [tɔʁ̠ˈt͜sy] ‘turtle’). Moreover, notice that word-final consonants all come in at the same time — i.e. they are not restricted to a coda profile — and that the inventory of contrasts found word-finally matches that of non-final onsets. Thus, an analysis of word-final consonants as codas would not permit an explanation of the facts. Furthermore, from a conceptual perspective, if Clara and Théo had analysed word-final consonants as codas, they would have selected a marked option. Recall from section 2.2.7.1 that, in the unmarked case, word-final consonants are syllabified as onsets of empty-headed syllables, in both adult and child language (Piggott 1999, Goad and Brannen 2000). As first stated in section 2.4.2, in the absence of evidence to the contrary, children select unmarked options. Since evidence for word-final codas is not available in French, syllabification of word-final consonants as onsets of empty-headed syllables must be the option selected by the child. Finally, as discussed above, it can be seen from the developmental patterns of the two children under investigation, and most clearly from Théo’s data, that codas emerge at a time when stress no longer plays a role in the production of branching onsets. Although on its own this argument cannot be taken as conclusive, it still points in the same direction as the analysis defended here.

A fourth issue regards the order of acquisition of branching onsets versus branching rhymes. As we saw above, branching onsets emerge before branching rhymes in both children's outputs. Although it would be premature to draw firm conclusions based on a comparison of two corpora only, I hypothesize that this order of acquisition is as expected, because of the type of evidence which is necessary for an understanding of the two structures. The acquisition of branching onsets only requires evidence of obstruent-liquid clusters in the target language. In contrast to this, the evidence necessary for an understanding of branching rhymes is more complex. For example, in French, a coda position may be occupied by either a liquid or an obstruent.[24] While this, in and of itself, is not too difficult to sort out, the evidence available for an understanding of branching rhymes is confounded by the fact that the coda-onset context corresponds to contexts where word-internal empty nuclei can also be attested. For example, the word *étiqueter* [et͜sikte] '(to) label' which is derived from *étiquette* [et͜sikɛt] 'label', contains a surface [kt] cluster which is broken up by an empty nucleus, as evidenced by the alternation with [ɛ] in the root form and by the fact that schwa insertion is possible in this word ([et͜sikəte]). By contrast, a word like *compacter* [kɔ̃pakte] 'to compress' does not contain an empty nucleus (*[kɔ̃pakɛt], *[kɔ̃pakəte]). Given that the same surface cluster requires two analyses, this type of evidence is more complicated to sort out than that required for an understanding of branching onsets. Importantly, notice that neither OT nor other theories can predict acquisition paths such as the ones discussed here. Only a close look at the evidence from the language under investigation can allow for an understanding of why some structures emerge before others in the child's outputs.

Now that the development of complexity at the level of syllable structure has been analysed, I will discuss, in the next section, the development of rising diphthongs in Clara's and Théo's outputs. As we will see, rising diphthongs, which display complexity at

24. As reported in section 2.2.6, there is no nasal coda in French, because of the historical merger of VN]$_\sigma$ sequences into nasal vowels.

the level of segmental structure, are acquired following a path that is similar to syllable constituents, i.e. from unmarked to marked structures, where headedness permits us to predict the reduction patterns at the stages when the target diphthongs are disallowed by the children's grammars.

3.5 Rising diphthongs

In this section, I discuss the development of rising diphthongs. I will show that for the two children under investigation, the different rising diphthongs observed in French ([j]-, [ɥ]-, and [w]-initial) emerge progressively rather than categorically, in the sense that they appear at different points in time. I argue that this pattern, which contrasts with the fairly categorical acquisition of syllabic constituents, is caused by the fact that the mastery of rising diphthongs is affected by segmental — rather than prosodic — constraints governing the feature combinations involved in each diphthong.

I will also demonstrate that the role that stress plays in the acquisition of branching onsets is not observed in the acquisition of rising diphthongs. This will provide further support for the difference between the representation of a branching onset and that of a rising diphthong. As documented in section 2.2.5, although both are contained within consonant+sonorant+vowel strings, the target structures involve complexity at different levels of representation; branching onsets, in (43a), require branching of a syllabic constituent while rising diphthongs, in (43b), require branching at the level of the segment.

(43) Branching onset versus rising diphthong (heads are underlined)

a) Branching onset b) Rising diphthong

The two structures also differ in the position of their respective heads. While the head of the branching onset is the left-hand timing position which dominates the obstruent, the head of the rising diphthong is the right-hand Root node, i.e. the surface vowel.

3.5.1 Stage 1: rising diphthong reduction

During the first recording sessions, all target rising diphthongs found in Clara's outputs are reduced to monophthongs in output forms. This stage of reduction extends from the first sessions (age 1;00.28) to about age 1;07.27, when some variation is observed between the three types of diphthongs ([jV], [ɥV], and [wV]). Before I comment on this variation, I provide, in (44a), examples of rising diphthong reductions in Clara's outputs. Likewise, Théo's first recording sessions also show rising diphthongs being reduced to monophthongs. This stage of reduction is observed between the ages of 1;10.27 (first sample recorded) and 2;06.30. As in the case of Clara, it is difficult to determine exactly when rising diphthongs are mastered by Théo, since, as mentioned above, the three different target diphthongs appear at different points in time. Examples of diphthong reductions from Théo's corpus are given in (44b).

(44) Acquisition of rising diphthongs, stage 1: reduction

a) Clara: 1;00.28 to 1;07.06

Word	Target form	Child's output	Age	Gloss
pied	[pje]	[pi]	1;04.14	'foot'
piano	[pjano]	[mɜˈnɔ]	1;06.22	'piano'
nuit	[nɥi]	[ni]	1;05.18	'night'
voilà	[vwala]	[βɔˈjæ]	1;03.23	'there (is)'
l'oiseau	[lwazo]	[læˈzuː]	1;04.14	'the bird'

b) Théo: 1;10.27 to 2;06.12

Word	Target form	Child's output	Age	Gloss
miam	[mjam]	[ma]	2;00.21	'yum'
chien	[ʃjɛ̃]	[ʃɛ̃]	2;05.29	'dog'
nuit[a]	[nɥi]	[ni]	2;06.12	'night'
poisson	[pwasɔ̃]	[pɑˈsɔ̃]	2;06.12	'(a) fish'
moi	[mwa]	[mɑ]	2;06.12	'me'

a. This is the only example of a [ɥV] rising diphthong observed at this stage.

As we can see in (44), all of the input rising diphthongs are reduced to CV. Regarding which Root node from the input survives in the output, we can see that, in most examples, it is indisputably the input vowel, i.e. the head of the diphthong. In this regard, however, the word *pied* in (44a) may look problematic; the glide seems to be the segment which survives.[25] I attribute this to the fact that, at this early stage, vowels, and especially vowel height, display some variation in outputs, which may cause some difficulty determining the source of the output segment when the input glide and vowel agree for backness and rounding. Despite this, in the other examples, it is clearly the input head that survives.

3.5.2 Stage 2: mastery

As mentioned above, there is some variation in the acquisition of rising diphthongs. In order to sort out the facts, I will discuss each diphthong separately, for both children. I will attribute the variation to the fact that the mastery of rising diphthongs does not involve the development of prosodic structure; it must rather involve complexity at the level of the segment and, importantly, each combination of Root nodes and features dominated by these Root nodes forming each of the target diphthongs may not be acquired at exactly the same time. Nonetheless, as the three diphthongs are structurally identical (i.e. two Root

25. Another possibility is that both input Root nodes survive through fusion in this example. This hypothesis is further supported by the resulting segments for *piano* and *voilà* where fusion of the input glide and vowel would yield output vowels like [ɜ] and [ɔ], respectively. Importantly, however, in these examples, like in the remainder of the data, melodic content from the input head survives in the output.

nodes dominated by a unique timing position), we expect them to be acquired within a fairly short period of time; as we will see below, this is exactly what is observed in the data.

The first rising diphthong to emerge in Clara's outputs is [jV], at age 1;07.27, as exemplified in (45a). The order of appearance observed in Théo's outputs is very comparable to that of Clara's. Indeed, the first rising diphthong that emerges in his outputs is also [jV], whose faithful production is observed at age 2;05.29, as we can see in the examples in (45b).[26]

(45) Acquisition of [jV] diphthongs, stage 2: mastery

a) Clara: 1;07.27

Word	Target form	Child's output	Age	Gloss
chien	[ʃ<u>jɛ̃</u>]	[çjæ]	1;07.27	'dog'
sorcière	[sɔʁs<u>ja</u>ᶦʁ]	[sɔˈçjæː]	1;07.27	'witch'
avion	[aˈv<u>jœ</u>]	[aˈvjœ]	1;09.29	'plane'
attention	[atɑ̃s<u>jɔ̃</u>]	[ˌætaˈsjɔ̃ː]	1;10.04	'watch out'

b) Théo: 2;05.29

Word	Target form	Child's output	Age	Gloss
lumière	[lʏm<u>ja</u>ᶦʁ]	[jyˈmjɛ]	2;05.29	'light'
sorcière	[sɔʁs<u>ja</u>ᶦʁ]	[saˈsjaᶦ]	2;06.30	'witch'
pied	[p<u>je</u>]	[pje]	2;07.06	'foot'
chien	[ʃ<u>jɛ̃</u>]	[ʃjɛ̃]	2;07.22	'dog'

Concerning the emergence of the second diphthong, [wV], target-like productions are observed in Clara's outputs at age 1;09.01. However, since no relevant examples are available from the corpus between 1;05.05 and 1;09.01, it is impossible to clearly identify the age of mastery of [wV] diphthongs in her grammar.[27] Nonetheless, from the available data, it is possible to verify that, at 1;09.01, i.e. about one month after the appearance of [jV] diphthongs, [wV] diphthongs are mastered by Clara, as exemplified in (46a).

26. No [jV] diphthongs preceded by a velar consonant were found in the data. This reflects the rarity of such sequences in target French.

Similarly, the mastery stage of Théo's [wV] diphthongs is observed about one month later than that of [jV], at age 2;06.30. Examples are provided in (46b).

(46) Acquisition of [wV] diphthongs, stage 2: mastery

a) Clara: 1;09.01

Word	Target form	Child's output	Age	Gloss
doigt	[dwa]	[d̥wæː]	1;09.01	'finger'
bois	[bwa]	[bwa]	1;09.01	'wood'
voir	[vwɑʁ]	[vwæː]	1;09.29	'(to) see'
poisson	[pwasɔ̃]	[pwɛˈsɔ̃]	1;10.04	'(a) fish'

b) Théo: 2;06.30

Word	Target form	Child's output	Age	Gloss
moi	[mwa]	[mwa]	2;06.30	'me'
poisson	[pwasɔ̃]	[pwoˈsɔ̃]	2;06.30	'fish'
trois	[tχwɑ]	[kχwɑ]	2;07.06	'three'
quoi	[kwa]	[kwa]	2;08.05	'what'
arrosoir	[aʁozwaʁ]	[χøˈswa^{ʊ}]	2;08.22	'watering can'

There are not as many examples of the third diphthong, [ɥV], as of the two others. In spite of this fact, which reflects the lower frequency of [ɥV] diphthongs in target French, it is still possible to determine when these sequences emerge in the children's outputs. Regarding Clara, until age 1;10.04, deletion is observed across the board. At age 1;10.10, target-like production is attested, as we can see in (47a). Regarding Théo's [ɥV] diphthongs, target-like outputs are found at age 2;06.30, as we can see from the examples in (47b).[28]

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27. One could appeal to a selection and avoidance strategy on the part of the child (e.g. Ferguson and Farwell 1975, Schwartz and Leonard 1982, Stoel-Gammon and Cooper 1984) in order to explain this gap. According to such a hypothesis, the child avoids words containing structures that are not yet mastered. However, as no such strategy can be observed at the stage where other rising diphthongs are reduced, and since attempts at [wV] are attested before 1;05.05 (see (44a)), a hypothesis based on selection and avoidance would lack empirical support.

28. Théo displays an exceptional pattern whereby target [l]+GV sequences are reduced to [GV]. An investigation of this pattern, which lies beyond the scope of this thesis, is left for further research.

(47) Acquisition of [ɥV] diphthongs, stage 2: mastery

a) Clara: 1;10.10

	Word	Target form	Child's output	Age	Gloss
i)	*biscuit*	[bɪskɥi]	[kuˈkwiː]	1;10.10	'biscuit'
ii)	*nuit*	[nɥi]	[nɥi]	2;01.05	'night'
	lui	[lɥi]	[lɥi]	2;03.19	'him'
	j'appuie pas	[ʒapɥipɑ]	[zæpɥiˈpɑ]	2;06.28	'I do not press'

b) Théo: 2;06.30

	Word	Target form	Child's output	Age	Gloss
i)	*aiguille*	[ɛgɥɪj]	[əˈɣwɪj]	2;06.30	'needle'
	bruit	[bʁɥi]	[bʁwi]	2;10.24	'noise'
ii)	*bruit*	[bʁɥi]	[bʁɥi]	3;02.07	'noise'
	conduit	[kɔ̃d͜zɥi]	[kɔ̃ˈd͜zɥi]	3;05.26	'(s/he) drives'

Notice that in the examples in (47ai) and (47bi), the glide [ɥ] is realized as [w]. This substitution most probably results from segmental constraints. Indeed, the front-rounded glide [ɥ] is cross-linguistically more marked than the two other glides found in French; as illustrated in (48b), in contrast to [j] and [w], this vocoid combines two articulators underneath the Place node.

(48) Representations of /i, y, u/ (= [j, ɥ, w])

a) /i/ (= [j])
Place
|
Coronal

b) /y/ (= [ɥ])
Place
/ \
Labial Coronal

c) /u/ (= [w])
Place
|
Labial

The difficulty of hosting this complexity under a non-head Root node can explain the substitution pattern observed in (47). Importantly, however, despite deletion of one place feature, both input Root nodes are produced. Finally, note that throughout the database, no correlation could be found between the realization of rising diphthongs and the location of stress.[29] The absence of such a correlation contrasts with the patterns described above for branching onsets.

I will now turn to a discussion of the status of rising diphthongs at the level of prosodic structure and, subsequently, proceed to the analysis for the patterns observed above.

3.5.2.1 Rising diphthongs versus branching onsets

As we have seen, if we compare the acquisition of rising diphthongs with that of branching onsets, the two types of structures behave differently in two important respects, mastery time and relation with stress, as summarized in (49), even though both structures are found in consonant+sonorant+vowel strings.

(49) Order of acquisition of target rising diphthongs versus branching onsets

	Rising diphthong[a]	Branching onset	
		Stressed syllable	Unstressed syllable
Clara	1;09.01	1;09.29	2;03.15
Théo	2;06.30	2;05.29	3;00.07

a. The overall acquisition times given here for rising diphthongs abstract away from the segmental considerations discussed above.

In Clara's outputs, while rising diphthongs are mastered at 1;09.01, branching onsets first appear in stressed syllables at 1;09.29, i.e. roughly one month later, but they are not fully mastered in unstressed syllables until 2;03.15. This represents a gap of more than six months between the full mastery of the two structures. Regarding Théo's outputs, while rising diphthongs are mastered at 2;06.30, branching onsets emerge in stressed syllables at 2;05.29 and in unstressed syllables at 3;00.07. Thus, while Théo's branching onsets (in stressed syllables) first occur before rising diphthongs, the opposite pattern is observed in Clara's data. However, in both children, branching onsets are mastered in unstressed syllables well after full mastery of rising diphthongs. This difference in time of mastery

29. Regarding Clara's corpus, this observation is based on the available [wV] diphthongs only; the two other rising diphthongs were only found in stressed syllables at relevant ages. However, it seems plausible that [jV] as well as [ɥV], despite its additional complexity under Place, should behave like [wV] with regard to stress.

supports the view that in the unmarked case, branching onsets and rising diphthongs involve different representations, consistent with the arguments outlined in section 2.2.5 and the representations provided above in (43). Furthermore, as implied by these last observations, while stress constitutes a determining factor in the early realization of branching onsets, rising diphthongs are fully mastered independently of stress.[30]

The current approach provides a straightforward way of explaining the contrasting behaviours observed between branching onsets and rising diphthongs. Firstly, highly-articulated representations at both the segmental and prosodic levels of organization enable us to express the distinction that exists between the two structures (see (43)). Secondly, from constraints reflecting the structural differences between branching onsets and rising diphthongs, it is possible to regulate each structure independently. Recall from the definition given in (13) that the constraint MAXHEAD(Foot), to which I appealed in order to explain the behaviour of stress in branching onsets, does not regulate faithfulness to the melodic content of the stressed syllable; it only requires that input segments (i.e. timing units) found in this syllable appear in the output. Since the reductions observed in rising diphthongs do not involve deletion of an input segment but, rather, deletion of one of the two Root nodes contained in this segment, MAXHEAD(Foot) has no bearing on the reduction patterns observed in input rising diphthongs. As we will see in the next section, only MAXHEAD(Seg) is of relevance in the analysis of the acquisition of these diphthongs.

3.5.3 Analysis

In the interest of clarity, I will present the development of rising diphthongs as a whole, avoiding the differences between the three French glides which are part of these diphthongs.

30. Notice that at stage 1 in the acquisition of both branching onsets and rising diphthongs, the target string consonant+sonorant+vowel is reduced to CV through deletion of the sonorant. This similarity is a consequence of the fact that, in both structures, the sonorant is in the dependent position at relevant levels of representation, as we can see in the schemas in (43).

Four constraints will be used in the analysis. Firstly, I will appeal to the markedness constraint *COMPLEX(Seg), already defined in section 2.3.2, whose high ranking prevents the combination of two Root nodes under a single timing position in output forms. This constraint will interact with three faithfulness constraints. Consistent with the analyses proposed in the previous sections, the first constraint, DEP(Seg), will be highly-ranked, in order to prevent insertion of a new output segment to host one half of the input diphthong. The two other faithfulness constraints will refer to the level of the Root node: MAX(Root) and MAXHEAD(Seg). The former requires input Root nodes to be realized in output forms, as defined in (50).

(50) MAX(Root)
Every input Root node has an output correspondent

MAXHEAD(Seg), whose definition is given in (51), militates against deletion of the head Root node. This constraint will be crucial in order to determine which of the two Root nodes contained in an input rising diphthong will be preserved in the output at stages when output complex segments are prohibited.

(51) MAXHEAD(Seg)
Every Root node in the head of a segment in the input has a correspondent in the head of that segment in the output

For the first stage in the development of rising diphthongs, during which complex vowels are reduced in output forms, I propose that *COMPLEX(Seg) is undominated. Consistent with the markedness » faithfulness ranking assumed for early stages, I propose that the three faithfulness constraints are lower-ranked. Moreover, in keeping with the primacy of MAXHEAD among the faithfulness constraints already discussed in section

3.1.5, I propose that MaxHead(Seg) is highest-ranked among the faithfulness constraints, dominating Dep(Seg) which, itself, crucially outranks Max(Root), as shown in (52).

(52) Rising diphthongs at stage 1: constraint ranking
*Complex(Seg) » MaxHead(Seg) » Dep(Seg) » Max(Root)

This stage is exemplified in (53) with the word *nuit* [nɥi] 'night'.[31]

(53) Rising diphthongs at stage 1

	Input: X X n ɥ i	*Complex(Seg)	MaxHd(Seg)	Dep(Seg)	Max(Root)
	i) [nɥi]: X X [n ɥ i]	*!			
	ii) [nəɥi]: X X X X [n ə ɥ i]			*!*	
☞	iii) [ni]: X X [n i]				*
	iv) [ny]: X X [n y]		*!		*

We can see, in (53i), that the target-like candidate fatally violates undominated *Complex(Seg). This constraint is not violated by the candidate in (53ii). However, in this candidate, the new segments resulting from vowel epenthesis and from syllabification of input [ɥ] in the onset following the epenthetic schwa fatally involve two violations of Dep(Seg). The last two candidates both violate Max(Root). However, candidate (53iv) fatally violates higher-ranked MaxHead(Seg) as well, as it displays deletion of the input head Root node [i]. Candidate in (53iii) is therefore selected as optimal.

31. An additional candidate could be added to (53), namely one showing an output CG sequence syllabified as a branching onset. However, such a candidate, which would fatally violate Dep(Seg), would also be ruled out by undominated *Complex(Onset) at the initial stage (see section 3.4.1).

At stage 2, *Complex(Seg) is demoted to the bottom of the ranking, in order to allow for rising diphthongs in output forms, following the ranking in (54).

(54) Rising diphthongs at stage 2: constraint ranking
MaxHead(Seg) » Dep(Seg) » Max(Root) » *Complex(Seg)

As we can see in the tableau in (55), which illustrates the analysis with the word *doigt* [dwa] 'finger', this new ranking allows input rising diphthongs to surface in output forms.

(55) Rising diphthongs at stage 2

Input: X X d wa	MaxHd(Seg)	Dep(Seg)	Max(Root)	*Complex (Seg)
☞ i) [dwa]: X X [d wa]				*
ii) [dəwa]: X X X X [d ə w a]		*!*		
iii) [du]: X X [d u]	*!		*	
iv) [da]: X X [d a]			*!	

Segmental insertion is prohibited by Dep(Seg), which is still highly ranked at stage 2, as can be observed in (55ii). In addition to violating Max(Root), candidate (55iii) incurs a fatal violation of highly-ranked MaxHead(Seg). At this stage of mastery, satisfaction of *Complex(Seg) at the expense of Max(Root) is fatal, as we can see in (55iv). This leaves us with (55i), the target-like candidate, which only incurs a minimal violation of *Complex(Seg).

The analysis proposed above demonstrates that, in a framework that assumes faithfulness to structural heads, the development of rising diphthongs must be accounted for in terms of segmental complexity. Indeed, assuming that rising diphthongs are complex segments enabled us to account for their acquisition, which proceeds independently from that of branching onsets, despite the fact that, as already mentioned, the two structures surface in similar segmental strings. Finally, notice that an appeal to featural faithfulness, in terms of height features, would not have allowed for an explanation of the French facts: while the non-head is always a high vocoid, the head can also be a high vocoid, as evidenced by examples such as *nuit* [nɥi] 'night'. In the next subsection, to which we now proceed, I will discuss a few issues that emerge from the analysis proposed.

3.5.3.1 Residual issues

Two issues must be addressed regarding the analysis proposed in the last section. The first concerns the hypothesis that rising diphthongs are mastered independently of branching onsets. The second concerns one aspect of the reranking proposed between stages 1 and 2 above, where *COMPLEX(Seg) was demoted directly to the bottom of the hierarchy. I will address these two issues in turn.

As argued for by Kaye (1985), in Vata, a West African language, consonant+liquid+ vowel sequences (CLV) are syllabified as a singleton onset followed by an LV rising diphthong (C.LV). Since such a possibility is attested, we must consider it as an option available to the child in place of the branching onset analysis of CL strings. A few observations, however, argue against such a possibility for the data from both Clara and Théo. Firstly, as stated in section 2.2.5, while CGV sequences must involve, in the unmarked case, the presence of a rising diphthong (C.GV), the unmarked interpretation of CLV sequences, by contrast, must involve a branching onset syllabification of the CL cluster, followed by a singleton nucleus (CL.V). Since the unmarked case is reflected in children's early grammars, the first option entertained by the child for these two sequences must involve different syllabifications. Secondly, related to this, notice that the Vata syllabification constitutes a marked option. Therefore, in order to attain this syllabification, the child must face robust evidence, which is not available in French. Finally, since the positional faithfulness pattern observed in the development of branching onsets finds no correlate in the patterns of development of rising diphthongs, a uniform analysis of both the CLV and CGV sequences would be empirically flawed. Therefore, I maintain the current analysis, which is compatible with the general observation that children's grammars reflect unmarkedness, and, crucially, best accounts for the developmental patterns found in both branching onsets and rising diphthongs.

The last issue to be discussed concerns the account proposed for the acquisition of rising diphthongs, as well as in earlier sections, whereby a constraint (here, *COMPLEX(Seg)), considered to be undominated at a given stage, is demoted directly to the bottom of the constraint ranking at the following stage. This analysis, which does not support minimal reranking (see section 2.4.2), seems to provide support for the constraint demotion algorithm proposed by Tesar and Smolensky (1998, 2000). In short, Tesar and Smolensky propose, in contrast to Bernhardt and Stemberger (1998), who argue for minimal reranking, that constraint demotion does not proceed one step at a time but, rather, that a constraint can be demoted further down in the hierarchy, depending on other relevant constraints in the ranking. Although a complete demonstration of Tesar and Smolensky's learning algorithm would be tangential to the current discussion, it seems that the data from the development of rising diphthongs, as well as those from the development of syllable structure provided in preceding sections, would constitute a nice body of evidence against which Tesar and Smolensky's learning algorithm could be tested.[32] Since it lies well beyond the scope of this thesis, however, further investigation of this issue is left for future research.

32. The developmental patterns covered in other longitudinal studies such as, e.g. Velten (1943), Leopold (1947), Smith (1973), Elsen (1991), and Fikkert (1994) would also be most useful for such an investigation.

3.6 Concluding remarks

3.6.1 The developmental path

In this section, I offer a recapitulation of all of the patterns observed in the development of French syllable structure in both Clara's and Théo's outputs. Overall, we have seen that, except for rising diphthongs, whose acquisition involves the mastery of complexity at the level of the segment, both children display the same acquisition path. In (56), I give the order of mastery displayed by the two children, which is divided in six acquisition periods.[33]

(56) Parallel between developmental stages and adult languages

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
σ structure allowed	CV σ (*V σ)	Onsetless σ ((C)V)	Ons. empty-headed σ	Br. onset (str'd σ)	Br. onset (unstr'd σ)	Br. rhyme
Parallel adult language	Hua	Cayuvava	Yapese	SE Brazilian Portuguese	French	French

As we can see in (56), for each period, the children under investigation parallel (at least) one attested adult language.[34] Thus, the constraints and their rankings used in the analyses proposed represent possible adult grammars. For example, during period 1 (attested only in Clara's outputs), only CV syllables are allowed; onsetless syllables are disallowed. This stage reflects the adult language Hua (Haiman 1980). During period 2, ONSET has been demoted, such that both V and CV syllables are allowed. Such a restriction on syllable shape is found in languages such as Cayuvava (Key 1961). At period 3, the children allow for (a) CV syllables and (b) onsets of empty-headed syllables. During this period, they parallel languages such as Yapese (Jensen 1977), a language which has no word-internal codas[35] but which allows for word-final consonants. At period 4, the children have a grammar which shares properties with the southeastern dialect of Brazilian Portuguese

33. I use the term 'period' in order to avoid confusion with the term 'stage', which is used for each step in the acquisition of a given structure.

34. This observation is similar to the one reached by Levelt, Schiller, and Levelt (2000) which is based on acquisition data from 12 Dutch-learning children.

(Harris 1997; see, also, section 2.3.1.2), which allows for branching onsets in stressed syllables only. Finally, during the last two periods of acquisition, the children gradually reach the adult stage in their mastery of both branching onsets and rhymes. As already mentioned in section 3, Kaye and Lowenstamm (1981) report that there exist no languages which allow for branching onsets without allowing for branching rhymes. Given this generalization, it is impossible to find a language that matches Period 5 exactly.

3.6.2 The role of headedness

From a glance at the analyses provided in the preceding sections, it becomes clear that one factor plays a crucial role in the acquisition patterns: headedness, whose effects are observed at the level of the foot, the syllable, and the segment.

As regards the level of the foot, I appealed to headedness to explain Clara's early pattern of deletion of word-initial (unstressed) onsetless syllables. This pattern differs from the consonant epenthesis pattern observed in vowel-initial words in Dutch children's outputs. The contrast between the French and Dutch data was explained with reference to foot structure and MAXHEAD(Foot): only syllables licensed outside the foot head can be deleted in the output.

Foot headedness also plays an important role in the development of branching onsets: faithfulness is observed in stressed syllables before unstressed ones.[36] However, stress plays no role in the acquisition of complexity within the segment; as we saw in section 3.5, complexity within rising diphthongs develops independently of the location of the target rising diphthong with regard to the head of the foot. This was explained through the fact that, in contrast to branching onsets, which contain two separate segments, rising

35. As mentioned in footnote #20, Yapese displays a vowel deletion process which yields some CC clusters word-internally, which are arguably represented with a word-internal empty nucleus (CØC).
36. Regarding the development of branching rhymes, however, the effect of stress disappears before branching rhymes emerge. It is thus impossible to verify whether stress could have played a role in the development of codas.

diphthongs are single (complex) segments. Their reduction is therefore not regulated by MAXHEAD(Foot).

At the level of the syllable, we observed that heads are never deleted, except in the case of onsets of empty-headed syllables, which, at stage 1 in their development, undergo deletion. A ranking of DEP(Seg) above MAXHEAD(Onset) in conjunction with undominated NUCLEUS was used in order to account for this pattern. In branching onsets, the constituent's input head was always preserved.

Finally, at the level of the segment, we observed that the head Root node, i.e. the surface vowel, is the one that survives at the stages where rising diphthongs are reduced to monophthongs.

A comparison between rising diphthongs and branching onsets provided us with compelling evidence in favour of the approach adopted here. Indeed, this approach enabled us to establish a structural distinction between two target strings which are similar in appearance (consonant+sonorant+vowel) but which are governed by independent constraints, as reflected in the data under investigation.

In the next two chapters, I will continue the elaboration of the structural approach advocated in this thesis and further demonstrate that highly-articulated representations play a central role in the various processes observed in child language. More specifically, in the next chapter, I will explore the role of prosodic structure from another perspective. I will argue that the patterns of consonant harmony observed in child language result from licensing relations at the level of foot structure.

Chapter 4

FOOT LICENSING AND CONSONANT HARMONY: A CROSS-LINGUISTIC INVESTIGATION

4.0 Introduction

As was mentioned in chapter 1, consonant harmony, a process whereby consonants share features (usually place) at a distance is often observed in children's early outputs. The pervasiveness of this process in child language is evidenced by the many works devoted to its study, e.g. Smith (1973), Ingram (1974a), Cruttenden (1978), Vihman (1978), Donahue (1986), Spencer (1986), McDonough and Myers (1991), Stemberger and Stoel-Gammon (1991), Macken (1992, 1995), Pater (1996, 1997), Dinnsen, Barlow, and Morrissette (1997), Goad (1997a, 2000), Bernhardt and Stemberger (1998). So far, however, with the exception of Goad (2000), most studies have envisaged consonant harmony from a segmental viewpoint, analysing properties of the feature sharing process observed in consonant harmony data (e.g. which features trigger or undergo harmony, directionality). In this chapter, I will approach consonant harmony from a prosodic point of view, following the spirit of Piggott (1996, 1997, 2000) and Goad (2000).

I will compare the consonant harmony patterns found in three children, two learning English and one learning French. The data from English come from Amahl (Smith 1973) and Trevor (Compton and Streeter 1977, Pater 1996, 1997, p.c.; see section 1.1.2 for more details on the English data sources). These data will be compared with Clara's French outputs.

As we will see, while consonant harmony is observed in both CVC and CVCV words in the English-learning children, as well as in Clara's CVCV words, this process is absent from Clara's CVC words. I will argue that these different patterns can be accounted for in an approach which (a) views consonant harmony as a relation that takes place at the level of the foot, and (b) draws a formal distinction between the two languages at the level of foot structure. A consequence of this will be that since final consonants in French CVC words fall outside the foot (see earlier section 2.2.7.2), these consonants will not be subject to the requirements triggering consonant harmony within the foot.

The chapter is organized as follows. In section 4.1, I give a detailed description of the three sets of data under investigation. As we will see, the three children differ in both the featural alternations found in their harmony patterns and in the prosodic window in which consonant harmony applies. This last point will emerge from a comparison between the English and French data. In section 4.2, I detail the current proposal, which is based primarily on foot licensing and faithfulness constraints referring to specific place features. The validity of the proposal will be demonstrated in section 4.3. In light of the current account, I will discuss, in section 4.4, some alternative analyses and demonstrate that none of these can provide us with a satisfactory account of the data under investigation. Concluding remarks are presented in section 4.5.

4.1 Consonant harmony: the patterns

4.1.1 Amahl's patterns

The data for Amahl's patterns are given in (1).[1] As we can see in (1a), Coronal obligatorily assimilates to Dorsal in the right-to-left direction. This pattern, exemplified in (1ai), applies in 38 of the 39 [Cor…Dor] words[2] found at ages 2;02.01 and 2;03.25 (Smith's stages 1 and 2). However, Dorsal assimilation in the opposite direction is not as categorical: out of 13 [Dor…Cor] words found at age 2;02.01, assimilation is observed in eight words, while no consonant harmony applies in the remaining five words. Also, at 2;03.25 (Smith's stage 2), consonant harmony in this context has completely disappeared; it is absent from the 11 [Dor…Cor] words found at that stage. This vanishing pattern of Dorsal harmony is exemplified in (1aii).[3, 4]

1. Amahl is a learner of standard southern British English. The target forms are transcribed accordingly.
2. The schema [Articulator…Articulator] refers to the place features of the two consonants found in a given word.

(1) Amahl’s consonant harmony patterns between 2;02.01 and 2;03.25

a) Coronal harmonizing to Dorsal

	Word	Target form	Child’s output	Age[a]
i) [Cor…Dor] 97% of potential targets	*duck*	[d̲ʌk][b]	[g̊ʌk][c]	2;02.01
	chocolate	[ˈtʃɔklɪt]	[g̊ɔgiː]	2;02.01
	Lego	[ˈlɛgəʊ]	[g̊ɛguː]	2;02.01
	tusk	[t̲ʌsk]	[g̊ʌk]	2;03.25
	dog	[d̲ɔg]	[g̊ɔg̊]	2;03.25
	Dougal	[ˈd̲uːgəl]	[g̊uːgu]	2;03.25
ii) [Dor…Cor] 33% of potential targets	*cloth*	[klɒθ̲]	[g̊ɔk]	2;02.01
	glasses	[ˈglɑːs̲ɪz]	[g̊agiː]	2;02.01
	greedy	[ˈgriːdiː]	[g̊iːdiː]	2;02.01
	cat	[kæt]	[g̊æt]	2;03.25
	greedy	[ˈgriːdiː]	[g̊iːdiː]	2;03.25
	get	[gɛt]	[g̊ɛt]	2;03.25

a. For the sake of consistency, the age format used in Smith (1973) is adapted to the standard (Y;MM.DD) adopted in this thesis.
b. The consonants which undergo harmony are underlined in the target forms.
c. Over- and under-rings represent voiceless unaspirated lenis stops in Amahl’s outputs (see Smith 1973: 37).

b) Coronal harmonizing to Labial

	Word	Target form	Child’s output	Age
i) [Cor…Lab] 44% of potential targets	*stop*	[st̲ɒp]	[b̥ɔp]	2;02.01
	table	[ˈt̲eɪbəl]	[beːbu]	2;02.01
	drum	[drʌm]	[d̥ʌm]	2;02.01
	driver	[ˈdraɪvə]	[d̥aivə]	2;03.25
	enough	[ɪˈnʌf]	[iˈnʌp]	2;03.25
	stiff	[stɪf]	[d̥ɪf]	2;03.25
ii) [Lab…Cor] No harmony	*bit*	[bɪt]	[b̥it]	2;02.01
	wash	[wɒʃ]	[wɔt]	2;02.01
	bolt	[bəʊlt]	[bɔːt]	2;02.01
	bottom	[ˈbɒtəm]	[b̥ɔd̥əm]	2;03.25
	money	[ˈmʌniː]	[mʌniː]	2;03.25
	pin	[pɪn]	[b̥in]	2;03.25

3. Throughout this chapter, I will concentrate on obstruent and nasal consonants as potential targets only. Also, since the place features of the vowels intervening between the two consonants have no effects on the patterns observed, they will not be considered in the descriptions and analyses of the data (for related discussion, see section 4.4.1).

4. In Smith’s (1973) transcriptions, [i, u] appear to stand for the lax high vowels [ɪ, ʊ]. The tense counterparts of these vowels are transcribed as [iː, uː].

The data in (1b) display an even weaker pattern of harmony. As we can see in (1bi), Coronal assimilates to Labial in the right-to-left direction, but only optionally. It is observed in 10 of the 14 [Cor…Lab] words found in the corpus at age 2;02.01 and, similarly to what was observed in (1aii), Labial harmony no longer applies at age 2;03.25, being attested in only one out of 11 potential targets. Also, in contrast to the Coronal to Dorsal pattern observed in (1aii), left-to-right Labial harmony is not attested at all in the 56 [Lab…Cor] potential targets found in the data at ages 2;02.01 and 2;03.25, as evidenced by the examples in (1bii).

It is also noteworthy that, during the entire period when consonant harmony is attested, no alternation is observed between labial and dorsal consonants, as we can see in the examples in (2).

(2) No assimilation between Dorsal and Labial consonants

	Word	Target form	Child's output	Age
a) [Lab…Dor]	*black*	[blæk]	[b̥æk]	2;02.01
No harmony	*milk*	[mɪlk]	[mik]	2;02.01
	swing	[swɪŋ]	[wiŋ]	2;02.01
	finger	[ˈfɪŋgə]	[wiŋgə]	2;03.25
	break	[breɪk]	[b̥eːk]	2;03.25
	pig	[pɪg]	[b̥ik]	2;03.25
b) [Dor…Lab]	*grape*	[greɪp]	[g̊eip]	2;02.01
No harmony	*escape*	[ɪsˈkeɪp]	[g̊eːp]	2;02.01
	come	[kʌm]	[g̊ʌm]	2;02.01
	carpet	[ˈkɑːpɪt]	[g̊abit]	2;03.25
	guava	[ˈgwɑːvə]	[g̊aːvə]	2;03.25
	clip	[klɪp]	[g̊ip]	2;03.25

Thus, in a nutshell, only one pattern of consonant harmony is systematically observed in Amahl's data: Coronal harmonizes to Dorsal in the right-to-left direction. Two other patterns are disappearing, as evidenced by a comparison across the two ages where the data given above were gathered. Finally, Dorsal and Labial never assimilate to each other.

The vanishing patterns observed in (1aii) and (1bi) are symptomatic of a grammar that is in a period of change, during which place feature faithfulness requirements are becoming more important in the child's grammar. At age 2;02.01, these harmony patterns were most probably remnants from categorical patterns observed earlier. However, this possibility remains impossible to verify, because of the lack of data before Amahl's age 2;02.01.

Since the focus of this chapter is to demonstrate the role of prosodic licensing in the explanation of consonant harmony, in the analysis to be proposed below, I will assume a steady-state grammar for Amahl, where the two vanishing contexts seen in (1) will be predicted not to harmonize, in accordance with the categorical patterns found at age 2;03.25.[5] I will, however, discuss the optionality observed in the data where appropriate.

Finally, concerning Amahl's data, it is important to note that, in the contexts where consonant harmony applies, CVC and CVCV outputs pattern in the same fashion. This generalization also holds true of Trevor, the second English child under investigation, as we will see in the next subsection.

4.1.2 Trevor's patterns

The second set of English data to be investigated comes from Trevor, a learner of Californian English. These data are taken from Pater (1996, 1997, p.c.), with additional information on the robustness of the patterns from Pater and Werle (2000). Pater and Werle concentrate solely on consonant harmony patterns that apply between Dorsal and Coronal, on the one hand, and Dorsal and Labial, on the other. As a consequence, it is impossible to determine how productive the patterns are between Labial and Coronal.

The data to be discussed are given in (3). As we can see, between ages 1;05 and 1;07, Trevor displays two systematic and two optional patterns whereby both Labial and

5. For an optimality-theoretic account of patterns of variation in child language, see, e.g. Demuth (1997); for an account of variation in consonant harmony, see Pater and Werle (2000).

Coronal harmonize to Dorsal in any direction. However, only the regressive patterns in (3ai) and (3bi) are systematic; the progressive ones, in (3aii) and (3bii), are attested in a minority of examples. Finally, as was the case for Amahl, harmony applies in both CVC and CVCV output forms.

(3) Trevor’s consonant harmony patterns between 1;05 and 1;07
(examples from Pater 1996: 190-193, p.c.; percentages from Pater and Werle 2000)

a) Coronal harmonizing to Dorsal

	Word	Target form	Child’s output
i) [Cor…Dor]	*dog*	[dɔg]	[gɔg]
96% of potential	*stick*	[stɪk]	[gɪk]
targets	*sink*	[sɪŋk]	[kɪŋk]
	tickle	['tɪkəl]	[gɪgʊ]
	jacket	['dʒækɪt]	[gækɪt]
ii) [Dor…Cor]	*cold*	[kold]	[kog]
38% of potential	*good*	[gʊd]	[gɛːg]
targets	*gate*	[geɪt]	[git]
	cat	[kæt]	[kæt]

b) Labial harmonizing to Dorsal

	Word	Target form	Child’s output
i) [Lab…Dor]	*back*	[bæk]	[gæk]
94% of potential	*big*	[bɪg]	[gɪg]
targets	*blanket*	['blæŋkɪt]	[gægi]
	pickle	[pɪkəl]	[kɪku]
ii) [Dor…Lab]	*cup*	[kʌp]	[kʌk]
15% of potential			[kʌp]
targets	*comb*	[kəʊm]	[kom]

The data presented above from both Amahl and Trevor may suggest the following generalizations. First, one could claim that Dorsal is the favoured triggering feature, and that Coronal is the place of articulation which most readily undergoes consonant harmony. This seemingly provides support for Coronal underspecification in child language (e.g. Spencer 1986, Stemberger and Stoel-Gammon 1991; cf. Goad 1996a, 1997a). Second, consonant harmony operates in both CVC and CVCV words. However, as I will demonstrate below, it would be premature to draw conclusions from these generalizations at this point. Before I discuss this issue further, I will turn to the next set of data, from Clara.

4.1.3 Clara’s patterns

As alluded to above, Clara’s consonant harmony patterns differ from Amahl’s and Trevor’s in a few ways. Before I discuss these differences, I will present the relevant data. Clara displays two patterns of consonant harmony: obligatory regressive Labial harmony affecting both Coronal and Dorsal, and optional regressive harmony of Coronal targeting Dorsal.

We can see, in (4a) and (4b), that both Coronal and Dorsal harmonize to Labial in the right-to-left direction only. These two patterns of Labial harmony are very systematic. Between the first recording session and age 2;00.20, Coronal harmonizes to Labial in 55 out of the 59 potential cases found in the database, and Dorsal harmonizes to Labial in 14 out of 15 potential cases.

(4) Clara’s consonant harmony patterns

a) Coronal harmonizing to Labial

	Word	Target form	Child’s output	Age	Gloss
i) [Cor…Lab] 93% of potential targets	*debout*	[d̠əbu]	[bɑˈbuː]	1;03.23	‘standing’
	cheval	[ʃ̠əval]	[væˈvæl]	1;11.06	‘horse’
	savon	[s̠avɔ̃]	[fəˈfɔː]	1;09.01	‘soap’
	chapeau	[ʃ̠apo]	[pæˈpo]	2;00.20	‘hat’
ii) [Lab…Cor] No harmony	*oiseau*	[wazo]	[əwɐˈzʊː]	1;04.07	‘bird’
	minou	[minu]	[məˈnu]	1;04.07	‘kitty’
	balai	[balɛ]	[pɵˈlæ]	1;07.27	‘broom’
	mouton	[mutɔ̃]	[mʌˈto]	1;09.01	‘sheep’

b) Dorsal harmonizing to Labial

	Word	Target form	Child’s output	Age	Gloss
i) [Dor…Lab]	*Gaspard*	[g̲aspɑʁ]	[baˈpæː]	1;03.07	‘Gaspard’
93% of potential	*capable*	[k̲apab]	[paˈpæb]	1;09.01	‘capable’
targets	*café*	[k̲afe]	[pəˈfɛ]	1;10.04	‘coffee’
	Gaspard	[g̲aspɑʁ]	[pæˈpæː]	2;00.02	‘Gaspard’
ii) [Lab…Dor]	*abricot*	[abʁiko]	[pupæˈkoː]	1;09.01[a]	‘apricot’
No harmony	*biscuit*	[bɪskɥi]	[βiˈkiː]	1;09.01	‘cookie’
	frigo	[fʁigo]	[bʊˈko]	1;09.29	‘fridge’
	piquer	[pike]	[piˈkeː]	2;03.05	‘(to) prick’

a. No examples of [Lab…Dor] words could be found before this age in the corpus.

c) Dorsal harmonizing to Coronal

	Word	Target form	Child’s output	Age	Gloss
i) [Dor…Cor]	*couleur*	[k̲ulœʁ]	[tʊ̰ˈl̰œ̰ᵘ][a]	1;04.15	‘colour’
61% of potential	*Caillou*	[k̲aju]	[taˈjæ]	1;05.05	‘Caillou’
targets	*gâteau*	[g̲ɑto]	[tæˈto]	1;07.27	‘cake’
	grelot	[g̲ʁəlo]	[tɔˈlo]	1;09.01	‘little bell’
	crayon	[kχɛjɔ̃]	[keˈjɔ]	1;07.27	‘pencil’
	Cachou	[kaʃu]	[kæⁿt̰ʃu]	1;09.01	‘Cachou’
ii) [Cor…Dor]	No target inputs of this shape were found.				

a. The subscript tildes in this example represent creaky voiced segments.

The data for Dorsal to Coronal harmony are not as systematic. Examples are provided in (4c). Dorsal harmonizes to Coronal in 19 of the 31 relevant contexts found between the first recording session and 1;09.01, the age where the last example of Coronal harmony is found. Notice that this optional pattern suggests that the grammar is evolving towards greater faithfulness, as was hypothesized above for Amahl’s disappearing consonant harmony patterns. This hypothesis is further supported by the fact that, out of the 12 non-harmonizing outputs, the majority are attested during the last two recording sessions where Coronal to Dorsal harmony is observed, namely, four cases at age 1;07.27, and five cases at 1;09.01.

As regards Clara's consonant harmony patterns, three generalizations emerge. First, neither Coronal nor Dorsal ever appears in the unstressed syllable if it does not appear in the stressed syllable as well. Crucially, this condition does not apply to Labial. Indeed, as we can see in the examples in (4aii) and (4bii), Labial can appear in the unstressed syllable preceding both Coronal and Dorsal. Related to this, recall from (4cii) that no target words of the shape [Cor…Dor] were found in the data during the period where consonant harmony is observed.[6] This gap, however, should not detract us from the observation that only Labial consonants can be found in unstressed syllables during this period.

Second, contrary to what was observed in Amahl's and Trevor's data, the feature Coronal triggers consonant harmony in Clara's outputs. This observation demonstrates that Coronal underspecification cannot account for all of the patterns of consonant harmony observed across children. Notice as well that Coronal underspecification cannot play any role in the assimilation patterns observed between Labial and Dorsal in Trevor's data.

Third, it is important to note that, as was previously mentioned, consonant harmony does not apply in Clara's CVC words. This is exemplified in (5) with a series of words taken from the period where the first onsets of empty-headed syllables are attested in the corpus.

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6. This gap in Clara's data may be caused by (at least) two factors. On the one hand, it is my impression that CVCV [Cor…Dor] words are fairly rare in French. The lack of words of this shape in Clara's outputs may reflect this situation. However, conducting a frequency check in order to verify this possibility lies beyond the scope of this thesis and is thus left for further research. On the other hand, as suggested by Goad (p.c.), the absence of attempts at [Cor…Dor] words may result from an accidental gap or from a selection and avoidance strategy. A few observations suggest the latter hypothesis: (a) consonant harmony in Clara's outputs operates from right to left, (b) both Labial and Coronal (but not Dorsal) can trigger harmony, and (c) neither Coronal nor Dorsal is tolerated in unstressed syllables. Dorsal assimilating to Coronal would be counter to (a), Coronal assimilating to Dorsal would contradict (b), and the absence of harmony would violate (c). This 'damned if you do, damned if you don't' situation could yield avoidance of [Cor…Dor] words by Clara. However, in the absence of experimental evidence, this hypothesis cannot be conclusively verified.

(5) Clara's CVC words[a]

	Word	Target form	Child's output	Age	Gloss
a) [Cor…Lab]	*livre*	[liv]	[lɪɸ]	1;07.27	'book'
No harmony	*dame*	[dam]	[dam]	1;07.27	'lady'
b) [Lab…Cor]	*botte*	[bɔt]	[bʌt^{h}]	1;07.06	'boot'
No harmony	*bol*	[bɔl]	[pɔl]	1;07.27	'bowl'
	bus	[bʏs]	[bʏç]	1;07.27	'bus'
c) [Dor…Cor]	*goutte*	[gʊt]	[gʊt]	1;09.01	'(a) drop'
No harmony			[gʊt^{h}]	1;10.10	
d) [Cor…Dor]	*sac*	[sak]	[katʃ]	1;05.05	'bag'
Metathesis			[kæːt]	1;09.01	
	tigre	[t͜sɪg]	[kɪːn]	1;09.01	'tiger'

a. No [Lab…Dor] or [Dor…Lab] CVC words were found in Clara's corpus.

Nevertheless, an interesting pattern is observed in (5d). In the three CVC words that have a [Cor…Dor] profile, while no consonant harmony is observed, as expected, these words instead display place metathesis. This segmental context, which corresponds with the gap observed for CVCV words in (4cii), constitutes the only one where metathesis is observed.

The absence of consonant harmony in Clara's CVC words contrasts with the data provided in (1) and (3) for both of the English children. In section 4.3.4, I will propose that the absence of consonant harmony in this context, as well as the metathesis option used by Clara in CVC [Cor…Dor] words, is caused by the fact that onsets of empty-headed syllables in French are licensed outside the foot, directly by the prosodic word, as was first discussed in section 2.2.7.2.

Before going into the details of the current proposal, I compare, in the next subsection, the three sets of data observed thus far, and draw the generalizations which will be central to the account.

4.1.4 Consonant harmony patterns: summary and comparison

I provide, in (6), a summary of the observations made for each child. The patterns which are considered to be systematic are identified in bold cells.

(6) Summary of the consonant harmony patterns

	Amahl	Trevor	Clara
Word shape where harmony is found:	CVCV CVC	CVCV CVC	CVCV
[Cor…Dor]:	Trigger: Dorsal Target: Coronal 97%	Trigger: Dorsal Target: Coronal 96%	(no examples found in the corpus)
[Cor…Lab]:	Trigger: Labial Target: Coronal 44%	(no comprehensive report available)	Trigger: Labial Target: Coronal 93%
[Dor…Cor]:	Trigger: Dorsal Target: Coronal 33%	Trigger: Dorsal Target: Coronal 38%	Trigger: Coronal Target: Dorsal 61%[a]
[Dor…Lab]:	No consonant harmony	Trigger: Dorsal Target: Labial 15%	Trigger: Labial Target: Dorsal 93%
[Lab…Cor]:	No consonant harmony	(no comprehensive report available)	No consonant harmony
[Lab…Dor]:	No consonant harmony	Trigger: Dorsal Target: Labial 94%	No consonant harmony

a. As reported above, 9/12 of the counter-examples come from the last two sessions where this consonant harmony pattern is attested.

As we can see, different patterns emerge from a comparison between the three children, both within and across languages. For example, while Amahl and Clara, i.e. an English- and a French-learning child, show similar behaviours with regard to input words whose first consonant is Labial (absence of consonant harmony), Trevor, the second English-learning child, conversely displays harmony in [Lab…Dor] words.

Furthermore, when put together, Amahl's, Trevor's, and Clara's patterns demonstrate that every place feature (Labial, Coronal and Dorsal) may trigger or undergo consonant harmony. While Coronal undergoes Dorsal harmony in both English children's outputs, it conversely triggers harmony in Clara's [Dor…Cor] words. Also, while Labial undergoes Dorsal assimilation in Trevor's outputs, the reverse is observed in Clara's outputs. Thus, no universal claims can be made about the behaviour of one place feature over another in the characterization of consonant harmony. A priori, thus, every place feature must have a comparable status, in the sense that they all must be specified in order to yield the patterns observed. Further evidence for this claim will be provided below and in chapter 5. Tendencies do emerge, however. Coronal is harmonized most of the time (cf. Clara's [Dor…Cor] words), and Labial seems to resist harmony more than Coronal. These featural strengths are expressed in the hierarchies in (7) for each child (cf. fixed hierarchies of place faithfulness as proposed by, e.g. Kiparsky 1994, Padgett 1995).[7]

(7) Feature 'strength' hierarchies for each child
  a) Amahl: Dorsal > Labial > Coronal
  b) Trevor: Dorsal > Labial > Coronal[8]
  c) Clara: Labial > Coronal > Dorsal

In addition to feature strength hierarchies, the directionality effects observed in the patterns summarized in (6) must also be taken into consideration. All of the systematic patterns are in the right-to-left direction. This is not construed to mean, however, that the children's grammars impose this directionality as a requirement for consonant harmony. Such a hypothesis would not enable us to account for some of the optional patterns observed, where harmony applies in the opposite direction. Instead, I argue that directionality is a consequence of the constraint interaction that causes consonant harmony to manifest itself in the children's outputs. In the analysis below, I will account for the generalizations expressed in (6) and (7) in light of the prosodic structure of both languages. First, regarding the two English children, we can see that the systematic patterns found in both Amahl's and Trevor's outputs ensure that the feature Dorsal is realized in the initial syllable, which corresponds to the stressed syllable in most English

7. See, also, Menn (1971) for an early approach to feature strength effects.

8. The lack of examples does not permit us to determine with certainty the relative strength of Labial and Coronal in Trevor's grammar. However, as suggested by Trevor's weak consonant harmony patterns summarized in (6), where Coronal appears to undergo Dorsal assimilation more often than Labial does (38% versus 15%), it seems that Labial resists consonant harmony more than Coronal. This hypothesis is also supported by two isolated examples from Trevor found in Pater (1996, 1997): *TV* → [piwi]; *boat* → [bop]. Although no definitive analysis can be proposed, the pattern of Labial assimilation over Coronal they exhibit supports the hierarchy proposed in (7).

nouns. The realization of this strong feature ((7a) and (7b)) will have precedence over that of the two other features. Second, regarding Clara's patterns, we can see that only Labial, the strongest feature in (7c), can appear freely in the initial syllable, which is unstressed in French. Both Coronal and Dorsal can appear in this position only if they are also present in the stressed syllable. Finally, recall that consonant harmony is not attested in Clara's CVC words. As alluded to above, this contrast between Clara and the two English children, who do display consonant harmony in CVC words, will also be accounted for in terms of prosodic structure.

4.2 Proposal

In this section, I outline the current proposal. The patterns described above will be accounted for through the interaction of two competing requirements in the children's grammars. On the one hand, a set of constraints will require place features dominated by the foot to be licensed by a prosodically strong position, the foot head (LICENSE(F, Foot)). High ranking of relevant LICENSE(F, Foot) constraints is considered to be the central cause of consonant harmony. In short, following the proposal outlined in section 2.3.2, in order to be realized in dependent positions, the place features targeted by licensing constraints must appear in head positions as well, in order to be licensed and, consequently, to be able to surface in output forms. Under this view, consonant harmony is the direct consequence of place licensing at a distance, following the spirit of Piggott (1996, 1997, 2000) and Goad (2000).

On the other hand, faithfulness constraints taking place specifications as their arguments (MAX(F)) will militate against feature deletion and, thus, limit the range of application of consonant harmony in output forms. The interaction of licensing and faithfulness will permit an account of all the systematic patterns under investigation (identified in bold cells in the table in (6)). As a result, the directionality effects observed above will be considered a mere artifact of the interaction between the requirement that specific place features must appear in stressed syllables in order to appear in unstressed syllables, on the one hand, and faithfulness constraints, on the other.

4.2.1 Representations

As already mentioned, the analysis is based on prosodic representations at the level of the foot. Recall from section 2.2.2 that English and French children use different foot structures (Paradis 2000). While English-learning children use a trochaic foot, the learners of French use an iamb, as represented in (8).

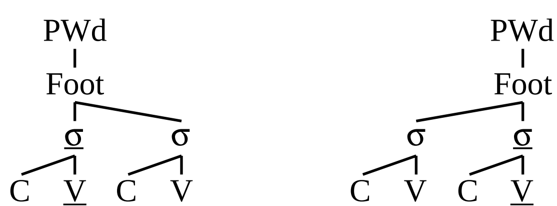
(8) Foot structure in English- and French-learning children

a) English-learning children: trochee   b) French-learning children: iamb

In CVCV words in both languages, the two input syllables appear within the foot, as we can see in (9).

(9) Full prosodic structure of a CVCV word in English and French

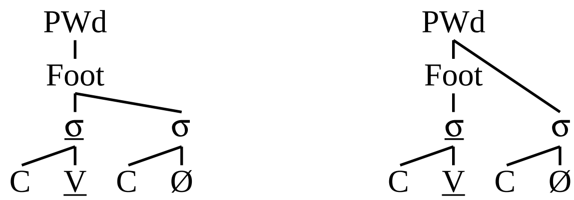
a) CVCV in English   b) CVCV in French



However, the situation is different when we look at the way CVC words are prosodified. In section 3.2.3, in accordance with Piggott (1999) and Goad and Brannen (2000), I argued that word-final consonants are initially syllabified as onsets of empty-headed syllables in child language. When linked to the different foot structures illustrated above in (8), final consonants in CVCØ words have a different prosodic status in the two languages. As we can see in (10a), in a trochaic language, the final consonant is syllabified within the foot, which is a binary, left-headed constituent dominating both syllables. However, in an iambic language, onsets of empty-headed syllables cannot be part of the right-headed foot. As was first mentioned in section 2.2.7.2, I assume, following Charette (1991), that unfooted syllables are licensed directly by the prosodic word, as depicted in (10b).

(10) Full prosodic structure of a CVCØ word in English and French

a) CVCØ in English b) CVCØ in French



We will see that this difference in the prosodification of onsets of empty-headed syllables provides us with a straightforward explanation for the fact that, contrary to what was observed in the English children, Clara's word-final consonants do not participate in consonant harmony. As onsets of empty-headed syllables fall inside the trochee but outside the iamb, an analysis taking the foot as the licensing domain of place features permits us to directly predict the contrast between English and French with regard to final consonants.

An appeal to constraints referring to prosodic constituency will allow us to encode the relationship between segmental content (place features) and the prosodic constituents illustrated above. In the next section, I provide the constraints which will be central to the account.

4.2.2 License and Max constraints

As mentioned above, the analysis will be based primarily on two types of constraints: licensing and faithfulness. I will define both in turn.

Following the general definition of License(F, PCat) already seen in (40) in chapter 2, I propose, in (11), a licensing constraint for each consonantal place feature, each of which specifies the prosodic licensor of place as the foot. As the foot is optimally a binary constituent formed by a head and a dependent syllable, foot licensing implies that the feature targeted by this requirement will need to be realized in the stressed syllable of the word.

(11) Foot licensing constraints for place features
   a) LIC(Lab, Ft): Labial must be licensed by the head of the foot
   b) LIC(Cor, Ft): Coronal must be licensed by the head of the foot
   c) LIC(Dor, Ft): Dorsal must be licensed by the head of the foot

When a feature that must be licensed by the foot appears in an unstressed syllable in the input, LICENSE(F, Ft) determines the domain of the licensing relation, thereby circumscribing the domain of consonant harmony.

The faithfulness constraints which will interact with the licensing constraints are defined in (12). Each version of the general MAX constraint refers to a specific place feature.

(12) MAX constraints
   a) MAX(Lab): every input feature Labial has an output correspondent
   b) MAX(Cor): every input feature Coronal has an output correspondent
   c) MAX(Dor): every input feature Dorsal has an output correspondent

In contexts where consonant harmony is favoured over preservation of a given place feature, LICENSE will be ranked higher than MAX. Conversely, ranking of MAX over LICENSE will prevent consonant harmony in output forms.

4.2.2.1 Additional constraints

To conform to licensing requirements, three strategies will be considered: deletion, assimilation (consonant harmony), and metathesis. To illustrate these three options, I will take the case of [Cor…Lab] input words from Clara's data set in (4a), which surface as [Lab…Lab]. As we will see in section 4.3.3, I will argue that consonant harmony in this case results from the licensing requirement that if Coronal appears in the word, it must be present in the foot head, i.e. in the stressed syllable (LIC(Cor, Ft)). The first strategy to obtain this result consists of neutralizing the Coronal feature in the unstressed syllable through Labial harmony (e.g. *debout* [dəbu] → [bɑˈbuː] 'standing'). The second strategy consists of realizing Coronal into the stressed syllable through Coronal harmony (e.g. [dəbu] → *[dɑˈduː]). The third option consists of place metathesis between the two input consonants (e.g. [dəbu] → *[bɑˈduː]).[9] In Clara's CVCV words, the first option is consistently used. Faithfulness to Coronal is systematically violated in [Cor…Lab] words. Thus, in Clara's grammar, MAX(Cor) must be ranked lower than LIC(Cor, Ft), in order to enforce harmony, as well as lower than MAX(Lab), to favour Labial preservation at the expense of Coronal faithfulness.

An interaction of the constraints proposed above in each of the children's phonologies will enable us to predict the optimal output for the consonant harmony patterns discussed in section 4.1. In order to restrict the number of candidates that will be entertained in the evaluation tableaux, in this section, I will introduce a few constraints, to account for the following observations. Firstly, metathesis, which is observed in Clara's CVC words, is not found in either Amahl's or Trevor's outputs. Secondly, debuccalization, i.e. place feature deletion without substitution, is not found in any of the children's outputs. Thirdly, place features are never inserted in order to conform to LICENSE constraints. Below, I present the constraints regulating these three phenomena. Subsequently, the candidates violating these constraints will not be included in the consonant harmony tableaux.

9. On place metathesis in child language, see, e.g. Smith (1973), Ingram (1974b), Goad (1996b), Vellemann (1996), and Bernhardt and Stemberger (1998).

As mentioned above, place metathesis (e.g. *duck* [dʌk] → *[gʌt]) is never used as a way to resolve licensing problems in the outputs of the two English children under investigation; only Clara displays metathesis, in CVC [Cor…Dor] words. In order to account for this, I appeal to the constraint LINEARITY, already defined in section 2.3.1, and repeated in (13) for convenience.

(13) LINEARITY
The precedence structure in the output is consistent with that of the input, and vice-versa

Anticipating somewhat the analysis to be proposed below, I will use, as an example, the word *duck*, which is pronounced as [g̊ʌk] by Amahl. (The complete analysis for this word is detailed in section 4.3.1.) An undominated ranking of LINEARITY correctly predicts the absence of metathesis in output forms, as we can see from the evaluation tableau in (14). In input *duck* [dʌk], the linear order of the place features is [Cor…Dor]. The first two candidates, in (14i) and (14ii), satisfy LINEARITY, but they fatally violate Dorsal licensing and faithfulness constraints, respectively, as will be detailed in (22). More to the point of the present discussion, candidate (14iv) displays metathesis, as the linear order of its place features is [Dor…Cor]. Although this candidate does not violate Dorsal licensing nor faithfulness, it fails to satisfy undominated LINEARITY and, therefore, cannot surface as optimal. As we will see, the optimal candidate, in (14iii), only incurs a violation of the relatively lowly-ranked constraint MAX(Cor).

(14) Undominated LINEARITY: no place metathesis

	Input: *duck* [dʌk]	LINEARITY	Foot licensing and faithfulness constraints
	i) [d̥ʌk]:		*! (LIC(Dor, Ft))
	ii) [d̥ʌt]:		*! (MAX(Dor))
☞	iii) [g̊ʌk]:		*(MAX(Cor))
	iv) [g̊ʌt]:	*!	*(LIC(Cor, Ft))

Such an inversion of place features, as seen in (14iv), will always be forbidden by undominated LINEARITY. Thus, this ranking must hold true for the two English children under investigation.

However, LINEARITY must be ranked lower in Clara's grammar, in order to allow for the metathesis pattern observed earlier in (5d). This pattern, observed in Clara's CVC words, contrasts with the consonant harmony pattern observed in her CVCV words: while LINEARITY is satisfied in CVC, it is violated in CVCV. In order to account for this contrast, I propose, in (15), more specific versions of LINEARITY, which take prosodic domains as their arguments.

(15) More specific LINEARITY constraints

a) LINEARITY(PWd): Within the prosodic word, the precedence structure in the output is consistent with that of the input, and vice-versa

b) LINEARITY(Foot): Within the foot, the precedence structure in the output is consistent with that of the input, and vice-versa

Since the foot is a subset of the prosodic word, the effects of the two constraints in (15) will only be seen in grammars where LINEARITY(Foot) outranks LINEARITY(PWd); violation of the former necessarily entails violation of the latter, but not vice versa. In order to account for the metathesis observed in Clara's CVC words, and for the absence thereof in CVCV words, I will propose that LINEARITY(Foot) is undominated in her grammar, in contrast to LINEARITY(PWd), which must be lowly-ranked. Because word-final consonants are prosodified outside the foot in French CVC words (see (10b)), LINEARITY(Foot) will be vacuously satisfied in the metathesis cases found in these words. However, in CVCV words, where both consonants fall within the foot (see (9b)), undominated LINEARITY(Foot) will prevent metathesis, consistent with Clara's CVCV forms in (4). Finally, because all consonants in CVCV and CVC words fall within the foot in English, as illustrated in (9a) and (10a), I will assume that both versions of LINEARITY in (15) are undominated in the grammars of the two English children.

Turning now to debuccalization, as we saw in the data sets given above in section 4.1, place feature neutralization always involves substitution by another place feature leading to consonant harmony, not debuccalization. This latter process, which would have the effect of turning consonants with place specifications into laryngeal sounds such as [h] or [ʔ], i.e. into consonants with no supralaryngeal constriction, is never attested in the data under investigation. In order to account for this, I will assume an undominated ranking of the constraint PLACE, defined earlier in section 2.3.2, and repeated in (16).

(16) PLACE
Consonants must bear place features

The effect of this ranking is exemplified in (17). Again, I will take the example of Amahl's *duck*, and consider one more potential candidate, in (17iv), which displays debuccalization of the word-final consonant. Since (17iv) violates undominated PLACE, this candidate cannot surface as optimal.

(17) Undominated PLACE: no debuccalization

	Input: *duck* [dʌk]	PLACE	Foot licensing and faithfulness constraints
	i) [d̥ʌk]:		*! (LIC(Dor, Ft))
	ii) [d̥ʌt]:		*! (MAX(Dor))
☞	iii) [g̊ʌk]:		*(MAX(Cor))
	iv) [d̥ʌʔ]:	*!	*(MAX(Dor))

As we will see in chapter 5, an undominated ranking of a more specific version of PLACE, labelled HEADPLACE, will enable us to explain a substitution pattern affecting the consonant [ʁ] in Clara's onset heads. I will argue that Clara represents [ʁ] as placeless, consistent with the unmarked representation for rhotics. As a consequence of undominated HEADPLACE, [ʁ] in onset heads will acquire place through sharing with another consonant, similar to what is observed in the consonant harmony patterns in this chapter which, by contrast, are attributed to licensing constraints. Thus, place sharing is used by Clara in order to satisfy two independent requirements of her grammar.

Finally, notice that in all of the consonant harmony patterns observed above, no new place features are added to the words as a way to satisfy LICENSE. In order for a feature to surface in a given word, this feature must be present in the representation of at least one segment in the input. I attribute this generalization to the undominated ranking of the DEP constraints for place features, which are defined in (18). (The general statement of DEP is given in section 2.3.1.)

(18) DEP constraints
- a) DEP(Lab): every output feature Labial has an input correspondent
- b) DEP(Cor): every output feature Coronal has an input correspondent
- c) DEP(Dor): every output feature Dorsal has an input correspondent

Since these three constraints are undominated at all stages, I will refer to them under the more general DEP(Place), whose effect is illustrated in (19), again with the example of Amahl's *duck* → [g̊ʌk].

(19) Undominated DEP(Place): no insertion of a new place feature

	Input: *duck* [dʌk]	DEP(Place)	Foot licensing and faithfulness constraints
	i) [d̥ʌk]:		*! (LIC(Dor, Ft))
	ii) [d̥ʌt]:		*! (MAX(Dor))
☞	iii) [g̊ʌk]:		*(MAX(Cor))
	iv) [d̥ʌp]:	*!	

As we can see in this tableau, any insertion of a new place feature, as in (19iv), fatally violates DEP(Place).

When undominated, the three constraints discussed in this section will systematically prevent certain substitution patterns, as exemplified in (14), (17), and (19).

Before I proceed further with exemplification of the analysis, one last point deserves discussion, namely, the formal way that the feature assimilation as observed in consonant harmony is encoded in output representations.

4.2.3 Consonant harmony: feature spreading or feature copy?

One of the ongoing debates about consonant harmony lies in the formal mechanism used to express the feature sharing observed in surface forms. While this issue has little bearing on the present thesis, which concentrates on the motivation for consonant harmony more than on the way it is formally implemented at the level of segmental features, I will briefly discuss the position adopted here, which is based on Goad (1997a, 2000), the latter work which argues that feature spreading is not found anywhere in early grammars.

Based on a thorough investigation of Amahl's data, Goad (1997a, 2000) demonstrates that the use of feature spreading in consonant harmony, which requires an appeal to CV segregation,[10] cannot hold on empirical grounds (see further in section 4.4.2 below).[11] Goad argues that only melody copy permits a satisfactory account of consonant harmony processes. Based on the theory of Generalized Alignment of McCarthy and Prince (1993b), Goad (1997a) proposes that insertion of a new instance of the harmonic feature is required by a highly-ranked feature alignment constraint. In Goad (2000), she abandons the alignment-based approach and defends a structural approach, from which the current proposal is inspired;[12] she argues that melody copy is necessary in order to satisfy licensing.

10. CV segregation requires consonants and vowels to be represented on different planes, thereby making vowels transparent to the long-distance assimilations typical of consonant harmony processes (see, e.g. Macken 1992 and McDonough and Myers 1991 for analyses of consonant harmony based on CV segregation).
11. Levelt (1994) also argues against planar segregation, although not against feature spreading.
12. Although the analysis proposed in this thesis follows the spirit of Goad's (2000) proposal, it is different in its implementation and, crucially, in its predictions. The differences between the two proposals are discussed in section 4.4.3.1.

In the analysis below, I follow Goad's (2000) view that consonant harmony formally proceeds through place feature copy. For clarity, the copied feature is co-indexed with the source feature.

4.3 Analysis

In order to provide an analysis of the three data sets described in section 4.1, I will detail the constraint rankings characterizing each of the children's grammars in isolation. For each child, a tableau for all of the contexts for which data are available in (6) will be provided, in order to ensure a comprehensive account of the place effects and directionality asymmetries observed in the data.

4.3.1 Amahl

As we saw in section 4.1.1, Amahl displays only one systematic pattern of consonant harmony: Coronal assimilates to Dorsal in the right-to-left direction. Two other patterns of consonant harmony are found in his data, in [Cor…Lab] and [Dor…Cor] words. However, as was mentioned above, as they are in the process of disappearing during the period when the data were gathered (Smith's stages 1 and 2), the consonant harmony patterns observed in these contexts will be assumed not to be characteristic of Amahl's grammar. However, I will provide tableaux for both contexts where optionality is found and discuss the problems posed by this optionality.

In order to account for the feature strength hierarchy observed in Amahl's outputs, repeated in (20), and the directionality of his Dorsal harmony pattern, I propose the constraint ranking in (21).

(20) Amahl's feature strength hierarchy (repeated from (7a))[13]
Dorsal > Labial > Coronal

(21) Amahl's constraint ranking[14]

LINEARITY, PLACE, DEP(Place) » MAX(Lab), MAX(Dor) » LIC(Dor, Ft) » MAX(Cor) » LIC(Lab, Ft), LIC(Cor, Ft)

Regarding faithfulness constraints, as Coronal is the only neutralized feature, both MAX(Lab) and MAX(Dor) must outrank LIC(Dor, Ft), the constraint responsible for harmony which, in turn, outranks MAX(Cor). However, with respect to each other, MAX(Lab) and MAX(Dor) appear to be equally ranked, as no harmony applies between Dorsal and Labial consonants. Similarly, since no evidence permits us to determine the ranking between lowly-ranked LIC(Lab, Ft) and LIC(Cor, Ft), these two constraints are left unranked with respect to each other. Finally, the effect of the relatively lowly-ranked MAX(Cor) is observed when this constraint interacts with LIC(Dor, Ft). As this licensing constraint is ranked above MAX(Cor), coronals are targets in Dorsal harmony, consistent with the data observed earlier.

I will now turn to the tableaux, in order to exemplify the validity of the ranking proposed for Amahl's grammar. As already mentioned, Amahl, like Trevor, but contrary to Clara, displays consonant harmony in CVCV as well as in CVC words. As no contrast is observed between the two word shapes in the English children's grammars, discussion regarding word-final consonants will be deferred until the analysis of Clara's harmony patterns, in section 4.3.3.

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13. This hierarchy — in particular Dorsal > Labial — takes into account the fact that Coronal to Dorsal assimilation is obligatory while Coronal to Labial is optional, an observation which is not captured by the ranking in (21). The variation observed in the Coronal to Labial assimilation will be discussed more in depth below.

14. Recall that for Amahl and Trevor, the constraints LINEARITY, PLACE and DEP(Place) are all assumed to be undominated (see section 4.2.2.1 above). The same holds true of Clara, except for LINEARITY(PWd), which is lowly-ranked in her grammar. For the sake of comparison, I will provide candidates which violate these constraints in the first tableaux for Amahl and Clara only. In order not to repeat the argument, these constraints (and the candidates which violate them) will be omitted from the other tableaux.

In order to keep the evaluation tableaux as simple as possible, I will include only the necessary structure in the schemas. Notice also that the place specifications of the input vowels have no effect on the consonant harmony patterns under investigation. For this reason, I will not include them in the representations provided in the tableaux.[15] I will return to this issue in section 4.4.1.

The systematic pattern of consonant harmony found in Amahl's [Cor…Dor] words is exemplified in (22) with the input word *duck*.

15. In order to capture the fact that no harmony between consonants and vowels is attested in the three children's data, three additional constraints must be involved. The absence of harmony from vowels to consonants can be accounted for through the undominated constraint *V-to-C, which captures the fact that spreading of place features from vowels to consonants does not yield a change in primary place of articulation in adult languages (e.g. /dɔg/ → *[bɔg]; see Goad 1997a). Deriving a secondarily-articulated consonant instead, /dɔg/ → *[dʷɔg], can be ruled out by a member of the *COMPLEX(Seg) family that targets consonants. Finally, the absence of feature sharing from consonants to vowels can be accounted for through undominated vowel-place feature faithfulness constraints.

(22) [Cor…Dor] words[a]

Input: Ft σ̲ σ d ʌ k Ø Cor Dor	LIN, PLACE, DEP(Pl)	MAX(Lab), MAX(Dor)	LIC (Dor, Ft)	MAX (Cor)	LIC (Lab, Ft), LIC (Cor, Ft)
i) [dʌk]: Ft σ̲ σ [d ʌ k Ø] Cor Dor			*!		
ii) [dʌt]: Ft σ̲ σ [d ʌ t Ø] Cor$_i$ Cor$_i$		*! MAX(Dor)			
☞ iii) [gʌk]: Ft σ̲ σ [g ʌ k Ø] Dor$_i$ Dor$_i$				*	
iv) [dʌp]: Ft σ̲ σ [d ʌ p Ø] Cor Lab	*! DEP(Pl)	* MAX(Dor)			* LIC (Lab, Ft)
v) [gʌt]: Ft σ̲ σ [g ʌ t Ø] Dor Cor	*! LIN				* LIC (Cor, Ft)
vi) [dʌʔ]: Ft σ̲ σ [d ʌ ʔ Ø] Cor	*! PLACE	* MAX(Dor)			

a. Because of space limitations, constraints which are unranked with respect to each other are stacked in this tableau. Violations of these constraints are identified within the cells in the tableau.

As we can see in (22i), the first candidate, which fails to harmonize, incurs a fatal violation of highly-ranked LIC(Dor, Ft). Harmony does apply in (22ii) and (22iii), as indicated by the co-indexed features. The effects of the domination of MAX(Dor) over MAX(Cor) can be seen by comparing these two candidates. Candidate (22ii) fatally violates MAX(Dor), as it displays deletion of the input Dorsal feature. This leaves us with candidate (22iii) as optimal, as it satisfies the combination of highly-ranked MAX(Dor) and LIC(Dor, Ft) through feature copy, at the expense of lower-ranked MAX(Cor). Each of the last three candidates in (22) satisfies LIC(Dor, Ft) but, in so doing, fatally violates one of the undominated constraints discussed in section 4.2.2.1: candidate (22iv), which shows insertion of the feature Labial in place of the unlicensed Dorsal, violates DEP(Place) (more specifically, DEP(Labial) in (18a)); candidate (22v), which shows place metathesis, violates LINEARITY; finally, candidate (22vi), whose final Dorsal consonant undergoes debuccalization, violates PLACE. As mentioned above, candidates such as these will no longer be considered in the analyses of Amahl's and Trevor's patterns.

Turning now to the [Dor…Cor] context, consider the evaluation tableau in (23), which is exemplified with the input word *cat*.

(23) [Dor…Cor] words

Input: Ft $\underline{\sigma}$ σ k æ t Ø Dor Cor	Max (Lab)	Max (Dor)	Lic (Dor, Ft)	Max (Cor)	Lic (Lab, Ft)	Lic (Cor, Ft)
☞ i) [kæt]: Ft $\underline{\sigma}$ σ [k æ t Ø] Dor Cor						*
ii) [kæk]: Ft $\underline{\sigma}$ σ [k æ k Ø] Dor_i Dor_i				*!		
iii) [tæt]: Ft $\underline{\sigma}$ σ [t æ t Ø] Cor_i Cor_i		*!				

As we can see, the analysis proposed predicts that no consonant harmony is found in [Dor…Cor] words. Recall from (22) that the crucial ranking for determining the optimal candidate in [Cor…Dor] words is Lic(Dor, Ft) » Max(Cor). While consonant harmony is necessary in order for [Cor…Dor] words to conform to this, [Dor…Cor] words satisfy Lic(Dor, Ft) without consonant harmony, since Dorsal is realized in the foot head in the input. The target-like candidate (23i) is thus favoured over (23ii), as the latter incurs a fatal violation of Max(Cor), crucially ranked above Lic(Cor, Ft). Finally, candidate (23iii) fatally violates highly-ranked Max(Dor).

As was summarized in (6), however, harmony is optionally observed in [Dor…Cor] words (see examples in (1aii)). The grammar proposed in (21) with Max(Cor) dominating Lic(Cor, Ft) predicts that no harmony should be found in these words. An equal ranking of the two constraints referring to Coronal would predict the optionality in this context.

Indeed, if MAX(Cor) and LIC(Cor, Ft) were equally ranked, both candidates (23i) and (23ii) would be selected as optimal, as these two candidates do not violate other constraints in (23). In order for equal ranking to work, however, the two optimal candidates must tie on all other constraints which rank below the two constraints which are unranked. In practice, this will rarely, if ever, end up being the case. Thus, the absence of ranking in order to account for optionality is doomed to fail. As mentioned before, since the focus of this chapter is not on explaining the variation observed in consonant harmony, I am assuming the fixed ranking in (21), which is representative of the end of the period of acquisition observed in Amahl's grammar (Smith's stage 2), where the optional pattern exemplified in (1aii) is no longer attested. The problem of optionality will, however, be returned to shortly, in light of all of the patterns observed in Amahl's outputs.

Recall the second context where harmony optionally applies, involving Labial assimilation over Coronal in [Cor…Lab] input words, as was observed in (1bi). The ranking proposed in (21) predicts that harmony should not apply in [Cor…Lab] words, consistent with the fact that harmony in these words is no longer attested at the end of the period covered by the data under investigation. This categorical analysis is exemplified in (24) with the input word *table*.

(24) [Cor…Lab] words

Input: Ft σ σ t e b l Cor Lab	MAX (Lab)	MAX (Dor)	LIC (Dor, Ft)	MAX (Cor)	LIC (Lab, Ft)	LIC (Cor, Ft)
☞ i) [tebu]: Ft σ σ [t e b u] Cor Lab					*	
ii) [pebu]: Ft σ σ [p e b u] Lab_i Lab_i				*!		
iii) [tedu]: Ft σ σ [t e d u] Cor_i Cor_i	*!					

The aspect of the ranking in (21) that is crucial for the absence of harmony in [Cor…Lab] words concerns the domination of MAX(Cor) over LIC(Lab, Ft). Given this ranking, the non-harmonizing candidate in (24i) is selected over the harmonizing candidate in (24ii). The last candidate, in (24iii), incurs a fatal violation of highly-ranked MAX(Lab).

Returning to the data in (1bi), we can see that the absence of Labial harmony is not categorical. In order to account for the optionality observed, it would be necessary to posit an equal ranking of MAX(Cor) and LIC(Lab, Ft) in the tableau in (24), which would have the effect of not allowing for a definitive selection between candidates (24ii) and (24i).

Recall from above the problem that lower-ranked constraints could cause for output selection when optionality is captured through equally-ranked constraints. In addition to this, the combination of the equal ranking of MAX(Cor) and LIC(Lab, Ft) for [Cor…Lab] inputs with the ranking suggested above to capture the optionality observed for

[Dor…Cor] inputs (Max(Cor), Lic(Cor, Ft)) yields undesirable results. Indeed, in order to capture both optional patterns simultaneously, the three lowly-ranked constraints in (21) (Max(Cor), Lic(Lab, Ft), and Lic(Cor, Ft)) would all need to be unranked with respect to each other. While this ranking will account for both of the optional patterns found in Amahl's data, it will *not* permit an account of the fact that no harmony is observed in [Lab…Cor] words. Before elaborating on this, I must first show that the ranking in (21) correctly predicts no harmony in words of this shape. This is exemplified in (25) with the word *bit*.

(25) [Lab…Cor] words

	Max (Lab)	Max (Dor)	Lic (Dor, Ft)	Max (Cor)	Lic (Lab, Ft)	Lic (Cor, Ft)
Input: Ft σ σ b i t Ø Lab Cor						
☞ i) [bit]: Ft σ σ [b i t Ø] Lab Cor						*
ii) [bip]: Ft σ σ [b i p Ø] Lab_i Lab_i				*!		
iii) [dit]: Ft σ σ [d i t Ø] Cor_i Cor_i	*!					

As we can see in (25), in order to select the optimal candidate in (25i) over the non-optimal harmonizing candidate in (25ii), it is essential that Max(Cor) be ranked above Lic(Cor, Ft). Thus, allowing the ranking proposed in (21) to contain some crucially-unranked constraints leads to problems for a simultaneous account of the optional pattern in [Cor…Lab] inputs and the total absence of consonant harmony in [Lab…Cor] words.

Notice that the problem unveiled here will arise in any comprehensive account of Amahl's data because of the fact that the variation observed is, from a strictly empirical perspective, paradoxical: while [Dor…Cor] and [Cor…Lab] sequences are tolerated in some words, the same configurations undergo harmony in other words. As discussed by Bernhardt and Stemberger (1998: 254ff), optionality like that witnessed in Amahl's consonant harmony patterns poses problems for any systemic approach to the study of adult or child language. Bernhardt and Stemberger mention that optionality can arise through different factors such as incorrect input representations or lexical frequency. Regarding the latter, Menn and Matthei (1992) report that exceptional words in child language are often those which are the most frequent. Indeed, as reported by Menn and Matthei, while some high-frequency words exhibit the 'old' pattern for a longer period of time, some other high-frequency words are conversely representative of a 'new' pattern. In section 4.3.3, I will discuss the case of a high-frequency word in Clara's data and suggest that this word perpetuates the pattern observed at the previous stage. Regarding the potential effects of frequency in Amahl's data, however, I will leave this issue open for further investigation.

Since the disappearance of the optional patterns at stake in Amahl's outputs leads to the steady-state grammar proposed in (21), for the remainder of the discussion, I will assume this grammar. This is consistent with the hypothesis suggested in section 4.1.1 that the data under investigation reflect a period of transition between two developmental stages.

I will now turn to the last observation made about Amahl's data, namely, the absence of consonant harmony between Labial and Dorsal. This state of affairs is captured in the ranking in (21) through the domination of MAX(Lab) and MAX(Dor) over LIC(Dor, Ft) and LIC(Lab, Ft). The precedence of the MAX constraints over their LICENSE counterparts prevents Labial assimilation over Dorsal or vice-versa, regardless of whether Labial precedes Dorsal in the input, as in *pig*, or whether Dorsal precedes Labial, as in *come*. This is exemplified in the next tableau, in (26), with the input word *pig*.

(26) [Lab…Dor] words

Input: Ft σ σ p i g Ø Lab Dor	Max (Lab)	Max (Dor)	Lic (Dor, Ft)	Max (Cor)	Lic (Lab, Ft)	Lic (Cor, Ft)
☞ i) [pig]: Ft σ σ [p i g Ø] Lab Dor			*			
ii) [pib]: Ft σ σ [p i b Ø] Lab$_i$ Lab$_i$		*!				
iii) [kig]: Ft σ σ [k i g Ø] Dor$_i$ Dor$_i$	*!					

We can see in this tableau that even though Dorsal appears in the dependent position of the foot, the optimal candidate displays no harmony, due to the high ranking of faithfulness, consistent with what was observed in the data in (2).

In sum, despite the fact that the constraint ranking proposed in (21) cannot formally account for the optionality observed in Amahl’s data, it can capture all of the systematic patterns found in Amahl’s data, both where consonant harmony and the absence thereof are observed. Regarding the word shapes where optionality is attested, the ranking in (21) predicts no harmony patterns in these contexts, which is consistent with the observation that these optional patterns are vanishing at the end of the acquisition period studied, Smith's stage 2.

I now turn to the analysis of Trevor's consonant harmony patterns, in the next subsection.

4.3.2 Trevor

As we saw above in (3), Trevor displays two systematic patterns of consonant harmony as well as two optional patterns: Labial and Coronal both systematically assimilate to Dorsal when this articulator appears second in the input, and they optionally assimilate when Dorsal appears first. As was the case for Amahl, I will describe Trevor's system as categorical, predicting that no harmony should be found in the contexts where optionality is observed. I will discuss the optional patterns when relevant. The constraint ranking proposed to account for Trevor's consonant harmony patterns, based on the feature strength effects observed in his patterns (repeated in (27)), is given in (28).

(27) Trevor's feature strength hierarchy (repeated from (7b))
Dorsal > Labial > Coronal

(28) Trevor's constraint ranking
LINEARITY, PLACE, DEP(Place) » MAX(Dor), LIC(Dor, Ft) » MAX(Lab) »
LIC(Lab, Ft) » MAX(Cor) » LIC(Cor, Ft)

According to (28), both faithfulness to Dorsal and licensing of this feature by the head of the foot have precedence over preservation and licensing of the two other features, Labial and Coronal. Since it is impossible to determine from the data which of the two constraints for Dorsal has precedence over the other, the relative ranking of MAX(Dor) and LIC(Dor, Ft) is left undetermined. Notice that the equal ranking of these constraints has no consequence for the selection of the optimal candidates, because the other place features always assimilate to Dorsal in output forms.

Regarding the features Labial and Coronal, although the ranking of the two constraints referring to Labial over those referring to Coronal cannot be motivated by the data in (3), this ranking finds support in the two isolated examples of Labial harmony from Pater (1996, 1997) and reported in footnote #8, namely *TV* → [piwi]; *boat* → [bop]. These examples suggest that, in Trevor's outputs, Coronal assimilates to Labial in either direction. Despite the fact that the systematicity of these patterns cannot be verified from the information provided in Pater (1996, 1997) and Pater and Werle (2000), these two examples of Labial assimilation over Coronal suggest that constraints requiring preservation and licensing of Labial have primacy over those referring to Coronal. Finally, the domination of MAX(Lab) over LIC(Lab, Ft), on the one hand, and of MAX(Cor) over LIC(Cor, Ft), on the other, will be motivated from the examples analysed below.

Turning now to the preference for preservation and licensing of Dorsal over both Labial and Coronal observed in Trevor's outputs, I begin with the [Cor…Dor] word *dog*, in (29).[16]

16. As already mentioned, since the three undominated constraints yield the same effects in Trevor's outputs as they do in Amahl's, these constraints will not be discussed in this section.

(29) [Cor…Dor] words

Input: Ft σ σ d ɔ g Ø Cor Dor	MAX (Dor)	LIC (Dor, Ft)	MAX (Lab)	LIC (Lab, Ft)	MAX (Cor)	LIC (Cor, Ft)
i) [dɔg]: Ft σ σ [d ɔ g Ø] Cor Dor		*!				
ii) [dɔd]: Ft σ σ [d ɔ d Ø] Cor_i Cor_i	*!					
☞ iii) [gɔg]: Ft σ σ [g ɔ g Ø] Dor_i Dor_i					*	

As we can see in this tableau, Dorsal harmony is correctly predicted in the optimal candidate, in (29iii). The violation of MAX(Cor) by this candidate is minimal, as this constraint is outranked by the licensing and faithfulness requirements on Dorsal, similar to what was seen for Amahl in (22). Finally, while LIC(Dor, Ft) is fatally violated by the target-like candidate in (29i), the candidate in (29ii), which shows Coronal harmony, incurs a fatal violation of MAX(Dor).

Turning now to [Dor…Cor] input words, we can see in the tableau in (30) that the constraint ranking proposed in (28) predicts that no harmony is found in this context, which is exemplified with the input word *gate*.

(30) [Dor…Cor] words

Input: Ft σ̲ σ g e t Ø Dor Cor	MAX (Dor)	LIC (Dor, Ft)	MAX (Lab)	LIC (Lab, Ft)	MAX (Cor)	LIC (Cor, Ft)
☞ i) [git]: Ft σ̲ σ [g i t Ø] Dor Cor						*
ii) [gik]: Ft σ̲ σ [g i k Ø] Dor$_i$ Dor$_i$					*!	
iii) [dit]: Ft σ̲ σ [d i t Ø] Cor$_i$ Cor$_i$	*!					

As we can see in (30), the ranking that is crucial to predict the absence of harmony in this case concerns the domination of MAX(Cor) over LIC(Cor, Ft). A comparison of the target-like candidate in (30i) with the candidate showing Dorsal harmony in (30ii) reveals that this ranking favours Coronal preservation over assimilation. As was the case in (29ii), Dorsal deletion, as observed in the candidate in (30iii), is ruled out by highly-ranked MAX(Dor).

Recall from (3aii) that for [Dor…Cor] inputs, Dorsal harmony is attested 38% of the time. In order to account for this optionality, an equal ranking of MAX(Cor) and LIC(Cor, Ft) would need to be posited. Given this ranking, both (30i) and (30ii) would be selected as optimal. However, in light of the discussion above about the empirical inadequacy of crucially-unranked constraints in accounting for optionality, a resort to this analysis would probably fail in the broader context.

Turning now to the [Lab…Dor] data in (3b), I will demonstrate the effects of the domination of the constraints referring to Dorsal over those referring to Labial in the ranking proposed in (28). As was the case for the [Cor…Dor] context discussed in (29), Dorsal harmony is predicted for [Lab…Dor] inputs, as exemplified in (31) with the input word *back*.

(31) [Lab…Dor] words

Input: Ft <u>σ</u> σ b æ k Ø Lab Dor	MAX (Dor)	LIC (Dor, Ft)	MAX (Lab)	LIC (Lab, Ft)	MAX (Cor)	LIC (Cor, Ft)
i) [bæk]: Ft <u>σ</u> σ [b æ k Ø] Lab Dor		*!				
ii) [bæp]: Ft <u>σ</u> σ [b æ p Ø] Lab_i Lab_i	*!					
☞ iii) [gæk]: Ft <u>σ</u> σ [g æ k Ø] Dor_i Dor_i			*			

As we can see in (31i), the target-like candidate, which fails to license Dorsal in the head of the foot, incurs a fatal violation of LIC(Dor, Ft). The second candidate, in (31ii), which shows Labial harmony at the expense of Dorsal faithfulness, cannot be selected as optimal, as it fatally violates MAX(Dor). Candidate (31iii) can thus surface as optimal, as it satisfies both of the highly-ranked constraints referring to Dorsal and minimally violates lower-ranked MAX(Lab).

Finally, [Dor…Lab], the last context available for Trevor, is exemplified in (32), with the input word *cup*. As we can see, similar to what was observed in (30), the categorical ranking proposed for Trevor in (28) predicts a non-harmonized optimal candidate.

(32) [Dor…Lab] words

Input: Ft σ σ k ʌ p Ø Dor Lab	Max (Dor)	Lic (Dor, Ft)	Max (Lab)	Lic (Lab, Ft)	Max (Cor)	Lic (Cor, Ft)
☞ i) [kʌp]: Ft σ σ [k ʌ p Ø] Dor Lab				*		
ii) [kʌk]: Ft σ σ [k ʌ k Ø] Dor_i Dor_i			*!			
iii) [pʌp]: Ft σ σ [p ʌ p Ø] Lab_i Lab_i	*!					

The target-like candidate in (32i) is selected over the candidate in (32ii) through the domination of Max(Lab) over Lic(Lab, Ft). (32i) is also favoured over (32iii), as the latter candidate incurs a fatal violation of highly-ranked Max(Dor).

In order to allow for the optionality observed in this context, which was reported in (3bii), a grammar can be posited for Trevor where Max(Lab) and Lic(Lab, Ft) are left unranked with respect to each other. Thus, when combined with the ranking allowing for the optionality discussed above for the [Dor…Cor] context, a grammar of variation results for Trevor, which is formalized in (33).

(33) Trevor's revised constraint ranking allowing for optionality
LINEARITY, PLACE, DEP(Place) » MAX(Dor), LIC(Dor, Ft) » MAX(Lab), LIC(Lab, Ft) » MAX(Cor), LIC(Cor, Ft)

Interestingly, in contrast to the optional contexts discussed above for Amahl, all of Trevor's contexts, both categorical and optional, can be encoded through a single constraint ranking, i.e. through a single grammar. Thus, while the optionality observed in Amahl's outputs appears to force the positing of paradoxical constraint rankings, the patterns observed in Trevor's data do not lead to such a problem. This is not construed to mean, however, that crucially-unranked constraints constitute the best way of encoding variation. Indeed, as already mentioned, positing such rankings has a very good chance of leading to spurious results when other (lower-ranked) constraints are taken into consideration. This cannot be demonstrated from the small number of constraints utilized in the tableaux above, which constitutes a very restricted subset of the child's grammar. This issue must be tackled from a much broader perspective, which lies beyond the scope of this thesis. I will return to optionality at the end of section 4.3.3, in light of Clara's consonant harmony patterns.

Finally, in both Amahl's and Trevor's outputs, the feature Dorsal appears to have primacy over Labial which, in turn, has primacy over Coronal, as was expressed in the hierarchies in (7a) and (7b) and captured in the constraint rankings proposed for both of the English children. In the next subsection, I turn to the analysis of Clara's patterns. Her grammar, as we will see, reflects a different feature strength hierarchy, that expressed in (7c).

4.3.3 Clara's CVCV words

Recall from (4) above that in Clara's outputs, Labial is the only feature that can appear in non-harmonized fashion in unstressed syllables (e.g. [m̲əˈnu] 'kitty'). When harmony applies, i.e. in contexts where either Coronal or Dorsal are in unstressed syllables in the input, Labial preservation has precedence over Coronal, which, itself, is preferably preserved over Dorsal, following the hierarchy repeated in (34).

(34) Clara's feature strength hierarchy (repeated from (7c))
Labial > Coronal > Dorsal

Consistent with the approach adopted for the two English children, I will analyse Clara's grammar as categorical and subsequently discuss the weaker harmony pattern found in [Dor…Cor] words which, as mentioned under (4c), shows optionality during the last two recording sessions during which it is attested. The proposed constraint ranking for Clara is given in (35).

(35) Clara's constraint ranking
LINEARITY(Foot), PLACE,[17] DEP(Place) » MAX(Lab) » LIC(Dor, Ft) » LIC(Cor, Ft) » MAX(Cor) » MAX(Dor) » LIC(Lab, Ft) » LINEARITY(PWd)

The feature strength hierarchy in (34) is expressed through MAX(Lab) » MAX(Cor) » MAX(Dor) in (35); MAX(Dor) is thus ranked relatively low as compared to its ranking in the two English grammars analysed previously. Also, as was mentioned in section 4.2.2.1, while LINEARITY(Foot) is undominated in Clara's grammar, LINEARITY(PWd) is ranked low, in contrast to the two other children, who require all LINEARITY constraints to be undominated. The low ranking of LINEARITY(PWd) will enable us to account for the metathesis pattern observed in Clara's [Cor…Dor] CVC words seen in (5d). As will be further motivated in section 4.3.4, the relatively high ranking of LIC(Dor, Ft) is also required for metathesis. Regarding the lower-ranked constraints, while the ranking

17. As we will see in chapter 5, the PLACE constraint that operates in Clara's grammar is actually HEADPLACE rather than PLACE, since placeless [ʁ] is allowed in dependent position in her outputs but not in head position. HEADPLACE, contrary to PLACE, is (vacuously) satisfied in contexts where a placeless consonant appears in a dependent position. However, for the sake of the current discussion, the constraint PLACE is sufficient.

MAX(Lab) » LIC(Dor, Ft) » MAX(Dor) will account for the regressive assimilation observed in [Dor…Lab] inputs in (4bi), the ranking LIC(Dor, Ft) » MAX(Cor) » MAX(Dor) will be motivated from the Coronal harmony over Dorsal exemplified in (4ci). The low ranking of LIC(Lab, Ft) will capture the fact that only this feature can appear in unstressed syllables without being present in stressed syllables. Finally, in contrast to what was observed for both Amahl and Trevor, the feature Coronal is not tolerated in weak position in Clara's outputs. This is accounted for, in (35), through LIC(Cor, Ft) » MAX(Cor), which constitutes the mirror image of Amahl's and Trevor's MAX(Cor) » LIC(Cor, Ft).

In (36), I demonstrate the effects of the ranking in (35) for [Cor…Lab] words, exemplified with the input word *debout* 'standing'. Since the effects of undominated PLACE and DEP(Place) were already discussed in (22), I will not repeat the arguments here. However, I will add to this first tableau for Clara the two LINEARITY constraints and focus specifically on undominated LINEARITY(Foot). The low ranking of LINEARITY(PWd) will be discussed in section 4.3.4.

(36) [Cor…Lab] words

Input: Ft σ σ̲ d ə b u Cor Lab	Lin (Ft)	Max (Lab)	Lic (Dor, Ft)	Lic (Cor, Ft)	Max (Cor)	Max (Dor)	Lic (Lab, Ft)	Lin (PWd)
i) [dɑbu]: Ft σ σ̲ [d ɑ b u] Cor Lab				*!				
ii) [dɑdu]: Ft σ σ̲ [d ɑ d u] Cor$_i$ Cor$_i$		*!						
☞ iii) [bɑbu]: Ft σ σ̲ [b ɑ b u] Lab$_i$ Lab$_i$					*			
iv) [bɑdu]: Ft σ σ̲ [b ɑ d u] Lab Cor	*!						*	*

As we can see in the target-like candidate in (36i), because the feature Coronal appears in the dependent position of the French right-headed foot, it is not licensed by the foot head and, therefore, incurs a fatal violation of Lic(Cor, Ft). The remaining candidates invoke harmony or metathesis to satisfy this constraint. Harmonizing Coronal through copying it into the stressed syllable does not constitute a viable option, as the resulting form, in (36ii), violates the requirements of highly-ranked Max(Lab). Labial harmony is thus preferred, as we can see in the candidate (36iii), which only violates lower-ranked Max(Cor). Finally, the effects of undominated Lin(Ft) are witnessed in (36iv), where we can see that metathesis between the two consonants prosodified within the foot fatally violates this constraint.

In Clara’s outputs, Dorsal, like Coronal, cannot appear in unstressed syllables without being licensed in stressed syllables. Because of this, the analysis proceeds in the same fashion in the case of [Dor…Lab] words, through LIC(Dor, Ft) » MAX(Dor), as we can see in (37) with the word *Gaspard* [gaspɑʁ].

(37) [Dor…Lab] words

Input: Ft; σ <u>σ</u>; g a s p ɑ ʁ; Dor Lab	MAX (Lab)	LIC (Dor, Ft)	LIC (Cor, Ft)	MAX (Cor)	MAX (Dor)	LIC (Lab, Ft)
i) [gapaː]:[a] Ft; σ <u>σ</u>; [g a p a]; Dor Lab		*!				
☞ ii) [bapaː]: Ft; σ <u>σ</u>; [b a p a]; Lab_i Lab_i					*	
iii) [gakaː]: Ft; σ <u>σ</u>; [g a k a]; Dor_i Dor_i	*!					

a. Recall from chapter 3 that at the stage from which this example is taken, neither codas nor onsets of empty-headed syllables are allowed in Clara’s grammar and that word-final [ʁ] deletion yields compensatory lengthening of the preceding vowel.

The target-like candidate in (37i) incurs a fatal violation of highly-ranked LIC(Dor, Ft), as it contains the feature Dorsal in the dependent position of the foot. Since MAX(Lab) is ranked above MAX(Dor), reflecting Clara’s feature strength hierarchy in (34), Labial harmony is favoured over Dorsal harmony. The candidate in (37ii), which violates lowly-ranked MAX(Dor) is thus selected over (37iii).

Still focusing on the observation that Labial appears as the strongest feature in Clara's outputs, I will now turn to the next pattern, namely, the absence of consonant harmony when Labial appears in an unstressed syllable. This context is exemplified in (38), with the input word *minou* [minu] 'kitty'.

(38) No harmony when Labial is in unstressed syllable

	Input: Ft (σ <u>σ</u>) m i n u; Lab Cor	MAX (Lab)	LIC (Dor, Ft)	LIC (Cor, Ft)	MAX (Cor)	MAX (Dor)	LIC (Lab, Ft)
☞	i) [minu]: Ft (σ <u>σ</u>) [m i n u]; Lab Cor						*
	ii) [ninu]: Ft (σ <u>σ</u>) [n i n u]; Cor_i Cor_i	*!					
	iii) [mimu]: Ft (σ <u>σ</u>) [m i m u]; Lab_i Lab_i				*!		

We can see, in (38ii), that Labial preservation is predicted from the ranking in (35): the candidate showing Labial deletion through Coronal harmony violates highly-ranked MAX(Lab). If Labial had to be licensed by the head of the foot, Labial harmony would have been favoured in [Lab…Cor] words, because of the ranking of MAX(Cor) above LIC(Lab, Ft); however, this is not the case, as exemplified by the candidate in (38iii). The target-like candidate in (38i) thus surfaces as optimal, as it minimally violates LIC(Lab, Ft).

I will now turn to [Dor…Cor] words, in which we saw, in (4c), that Coronal appears as featurally stronger than Dorsal. Indeed, in [Dor…Cor] words, Coronal harmony applies regressively in these words at the expense of Dorsal preservation. This pattern is shown in (39) with the input word *gâteau* [gɑto] 'cake'.

(39) [Dor…Cor] words

Input: Ft; σ σ; g ɑ t o; Dor Cor	MAX (Lab)	LIC (Dor, Ft)	LIC (Cor, Ft)	MAX (Cor)	MAX (Dor)	LIC (Lab, Ft)
i) [gæto]: Ft; σ σ; [g æ t o]; Dor Cor		*!				
ii) [gæko]: Ft; σ σ; [g æ k o]; Dor$_i$ Dor$_i$				*!		
☞ iii) [dæto]: Ft; σ σ; [d æ t o]; Cor$_i$ Cor$_i$					*	

The target-like candidate in (39i) fatally violates the highly-ranked licensing requirement for Dorsal. Despite the fact that this requirement is satisfied in the Dorsal-harmonized candidate in (39ii), this candidate fails on MAX(Cor), which is ranked above MAX(Dor). Coronal harmony is thus the preferred option, as shown in (39iii). The domination of MAX(Cor) over MAX(Dor) illustrated here thus accounts for the observation expressed in the hierarchy in (34), that Coronal is relatively stronger than Dorsal in Clara's outputs.

As was previously discussed in section 4.1.3, optionality is observed for the consonant harmony pattern analysed in (39) during the last two recording sessions where it is attested (at ages 1;07.27 and 1;09.01). Before 1;07.27, the ranking in (35) prevails. However, the optionality observed after this age suggests that LIC(Dor, Ft) is demoted to the same position as MAX(Dor). An equal ranking between the faithfulness and licensing requirements for Dorsal would allow for the optionality observed between 1;07.27 and 1;09.01. However, such a ranking would also predict that optionality should be found in [Dor…Lab] words as well, which is not the case. This further supports the argument proposed earlier that an appeal to equally-ranked constraints does not constitute a viable solution for capturing optionality. Indeed, an appeal to crucially-unranked constraints leads to incorrect empirical results for both Amahl's and Clara's outputs. Moreover, as mentioned above, the correct predictions made for Trevor's outputs would arguably not hold if the other constraints of his grammar were taken into consideration.

Consistent with Menn and Matthei's (1992) proposal that high-frequency words are the ones that often contain the exceptional patterns, I propose that in order to account for optionality, other (non-linguistic) factors such as frequency must be taken into consideration. This hypothesis is empirically supported in target words such as *Gaspard*, Clara's older brother's name, which is, obviously, a high-frequency word for Clara. While other consonant harmony patterns have disappeared by age 2;00.20, *Gaspard* displays consonant harmony until 2;03.05. Nevertheless, only further research on this issue will enable us to disentangle the issues that pertain to optionality and exceptionality in child language. I will thus leave this issue open and maintain the ranking in (35) as representative of Clara's grammar at the stage where consonant harmony is attested in her output forms.

In short, as demonstrated above, apart for the additional complications related to optionality and the factors such as lexical frequency driving it, the ranking proposed in (35) correctly predicts the patterns observed in Clara's CVCV words. In the next section, to which we now proceed, I will discuss the patterns observed in Clara’s CVC words in (5).

4.3.4 Clara’s CVC words

As we saw in the examples in (5), two observations can be made about Clara’s CVC words. Firstly, these words do not display consonant harmony. Also, although it is hard to draw any conclusive generalizations from the limited amount of data available, we observed, in (5d), that [Cor…Dor] CVC words display place metathesis, a pattern which is not found in CVCV words. I will begin with the absence of consonant harmony in CVC words.

4.3.4.1 Absence of consonant harmony

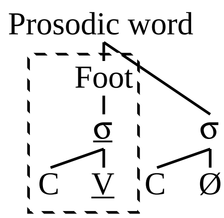
Recall that in [Cor…Lab] CVCV words, Coronal assimilates to Labial (e.g. *debout* [dəˈbu] → [bɑˈbuː] ‘standing’). Contrary to this, however, [Cor…Lab] CVC words surface as target-like (e.g. *dame* [dam] → [dam] ‘lady’).

In order to account for this asymmetry, I argue that consonant harmony cannot apply between word-medial and final consonants in Clara’s grammar because of the Locality condition, which, as stated in section 2.2.1.4, prevents structural relationships (e.g. licensing relations such as the ones causing assimilation patterns like consonant harmony) from applying outside the domain delimited by the highest category involved. The definition of Locality is repeated in (40) for convenience.

(40) Locality
A relation is bound within the domain delimited by the highest category to which it refers

Above, I analysed the consonant harmony patterns in Clara’s grammar as licensing relations that refer specifically to the level of the foot.[18] In section 4.2.1, I discussed the way that word-final onsets of empty-headed syllables are prosodified in English and French. I proposed that, in French, word-final empty-headed syllables are licensed outside the foot, directly by the prosodic word, as was illustrated in (10b). Therefore, onsets of empty-headed syllables fall outside the domain of any relationship referring to the foot, as illustrated in (41).

(41) Onsets of empty-headed syllables in French: outside the domain of the foot



Given this, any licensing relationship that holds between onsets of empty-headed syllables and the foot in French will involve a non-local relation, thereby violating the Locality condition. Such relations are considered here as universally impossible; the only licensing domain that can include both of the foot and word-final empty-headed syllables in French is the prosodic word. Therefore, licensing constraints referring to the foot do not apply to segments which are prosodified outside of this constituent. Consequently, word-final consonants in iambic French vacuously satisfy these constraints. In order to illustrate this, I will take the example of *goutte* [gʊt] '(a) drop' and evaluate a set of candidates against Clara's proposed ranking in (35).

18. The analysis proposed above for the English children also involved licensing by the foot. In the absence of evidence to the contrary, I will assume that this is correct. However, given the prosodic approach developed here, it is also possible that consonant harmony could apply at the level of the prosodic word in some children. Under this option, the prediction would be the same for the English CVCV and CVC words analysed above. In these words, all of the segments are dominated by the foot, itself dominated by the prosodic word. Therefore, these segments belong to the same prosodic domain at both of these levels. In contrast to this, the final consonant in French CVC words escapes the level of the foot and is licensed directly by the prosodic word.

(42) CVC [Dor…Cor] words

Input: PWd Ft σ σ g ʊ t Ø Dor Cor	MAX (Lab)	LIC (Dor, Ft)	LIC (Cor, Ft)	MAX (Cor)	MAX (Dor)	LIC (Lab, Ft)
i) [gʊk]: PWd Ft σ σ [g ʊ k Ø] Dor_i Dor_i				*!		
ii) [dʊt]: PWd Ft σ σ [d ʊ t Ø] Cor_i Cor_i					*!	
☞ iii) [gʊt]:[a] PWd Ft σ σ [g ʊ t Ø] Dor Cor						

a. This candidate actually violates lower-ranked licensing constraints; this will be exemplified in the next subsection.

As we can see in (42), the presence of place features in word-final position does not violate the foot licensing constraints. There is thus no highly-ranked constraint to drive consonant harmony. The optimal candidate must therefore be selected through other constraints, namely, faithfulness. Both of the harmonizing candidates, in (42i) and (42ii), fatally incur a violation of place faithfulness. The non-harmonizing candidate in (42iii), which shows faithfulness to all input features, is thus selected as optimal.

Importantly, this analysis is not construed to mean that the content of onsets of empty-headed syllables is not regulated by licensing constraints at all. As we will see in the next subsection, to which we now proceed, licensing is taken to be the source of the metathesis pattern observed in Clara's CVC [Cor…Dor] words.

4.3.4.2 Metathesis

In order to explain the pattern observed in (5d), where input [Cor…Dor] CVC words surface as [Dor…Cor], I propose that metathesis arises from a family of licensing constraints specifically targeting the head of the prosodic word, LIC(F, PWd). The specific LIC(F, PWd) constraints used below are defined in (43).

(43) Prosodic word licensing constraints for place features
- a) LIC(Lab, PWd): Labial must be licensed by the head of the prosodic word
- b) LIC(Cor, PWd): Coronal must be licensed by the head of the prosodic word
- c) LIC(Dor, PWd): Dorsal must be licensed by the head of the prosodic word

In order to satisfy these constraints, the relevant features must be realized in the head of the prosodic word, i.e. the stressed syllable. LIC(F, PWd) was independently motivated in section 2.3.2.2. As we saw, LIC(F, PWd) permitted an account of the harmony relationship between footed and unfooted syllables in Tudanca Montañés. The crucial difference between the Tudanca Montañés harmony pattern and the metathesis pattern observed in Clara's outputs lies in the interaction between LIC(F, PWd) and MAX(F) constraints: while, in Tudanca Montañés, both LIC(F, PWd) and MAX(F) are highly-ranked, in Clara's grammar, the MAX(F) constraints outrank their LIC(F, PWd) counterparts, such that feature assimilation, as observed within the foot above, cannot apply between onsets of empty-headed syllables and the consonants preceding them. In (44), I give the revised constraint ranking for Clara, which incorporates the constraints in (43). The newly-added constraints are underscored in order to facilitate comparison with the ranking previously given in (35).

(44) Clara's constraint ranking (revised)[19]

LIN(Ft), PLACE, DEP(Place) » MAX(Lab) » LIC(Dor, Ft) » LIC(Cor, Ft) » MAX(Cor) » MAX(Dor) » LIC(Lab, Ft) » <u>LIC(Dor, PWd)</u> » LIN(PWd) » <u>LIC(Lab, PWd)</u>, <u>LIC(Cor, PWd)</u>

On the one hand, the ranking of both LIC(Lab, PWd) and LIC(Cor, PWd) below LIN(PWd) will account for the fact that word-final labials and coronals do not trigger metathesis. These constraints are left unranked with respect to each other, as it is impossible to determine their relative ranking based on the available data. On the other hand, the domination of LIC(Dor, PWd) over LIN(PWd) will capture the pattern of metathesis observed in (5d). Notice that metathesis caused by Dorsal only applies to CVC words since such a process in CVCV words would violate undominated LIN(Ft), because both syllables in these words are contained within the foot, consistent with the analysis provided in (36). In order to illustrate the effects of the newly-added constraints, I will compare one example from (5d), which displays metathesis, with one from (5a), where no metathesis is observed.

The first context is exemplified in (45) with the [Cor…Dor] word *sac* [sak] 'bag' which is realized as [katʃ].[20]

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19. This ranking also predicts metathesis in CVC [Lab…Dor] words. However, because of the absence of relevant data, this prediction cannot be verified on empirical grounds.

20. In the interest of space, only the LICENSE constraints referring to the prosodic word, the MAX constraints, and LIN(PWd) will be included in the tableaux. Also, equally-ranked LIC(Lab, PWd) and LIC(Cor, PWd) are stacked in the same column.

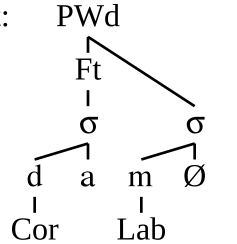
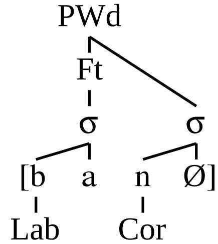
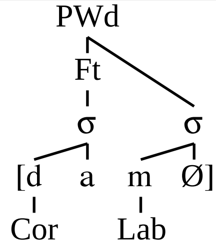
(45) CVC [Cor…Dor] words

Input: PWd Ft σ σ s a k Ø Cor Dor	MAX (Lab)	MAX (Cor)	MAX (Dor)	LIC (Dor, PWd)	LIN (PWd)	LIC (Lab, PWd), LIC (Cor, PWd)
i) [sat]: PWd Ft σ σ [s a t Ø] Cor_i Cor_i			*!			
ii) [xak]: PWd Ft σ σ [x a k Ø] Dor_i Dor_i		*!				
iii) [sak]: PWd Ft σ σ [s a k Ø] Cor Dor				*!		
☞ iv) [kas]: PWd Ft σ σ [k a s Ø] Dor Cor					*	* LIC (Cor, PWd)

Similar to what we saw in (42), the candidates in (45i) and (45ii), which undergo harmony, both violate a highly-ranked MAX constraint. Such candidates will not be discussed further. The effects of the ranking of LIC(Dor, PWd) above LIN(PWd) are unveiled with a comparison of the input-like (45iii) with the metathesized (45iv). As we can see, violation of LIN(PWd) is preferred over violation of the higher-ranked LIC(Dor, PWd). Candidate (45iv) is thus selected as optimal.

Turning now to a context where metathesis does not apply, we can see in (46), with the input word *dame* [dam] 'lady', that the ranking proposed in (44) correctly accounts for the faithful pattern found in CVC words whose final consonant is not dorsal.

(46) CVC [Cor…Lab] words

	Input: 	MAX (Lab)	MAX (Cor)	MAX (Dor)	LIC (Dor, PWd)	LIN (PWd)	LIC (Lab, PWd), LIC (Cor, PWd)
	i) [ban]: 					*!	* LIC (Cor, PWd)
☞	ii) [dam]: 						* LIC (Lab, PWd)

As we can see, the ranking of LIN(PWd) above both LIC(Lab, PWd) and LIC(Cor, PWd) prevents metathesis of Labial and Coronal. The metathesized candidate in (46i) violates LIN(PWd). This constraint, however, is satisfied by the candidate in (46ii), which, despite a minimal violation of LIC(Lab, PWd), can surface as optimal.

As we can conclude from the above demonstration, the behaviour of Clara's CVC words can be explained through a combination of (a) highly-articulated representations, which enable us to establish a structural distinction between non-final onsets and onsets of empty-headed syllables with regard to how these onsets are linked to the rest of prosodic structure, and (b) a set of constraints governing the licensing of place features at the level of the prosodic word, similar to what was observed in Tudanca Montañés. The comparison between French and English CVC words further supports this approach. The different behaviours observed in onsets of empty-headed syllables, which participate in consonant harmony in English but not in French, are explained through the fact that these onsets belong to different prosodic domains in the two languages; onsets of empty-headed syllables are prosodified within the foot in English but outside this constituent in French.

The lack of consonant harmony in CVC words provides robust support for the view that consonant harmony results from a relation that takes place at the level of the foot. Given (a) French foot structure and (b) the status of word-final consonants, non-final and final consonants can never be licensed within a single foot in French. Because of the Locality condition, the licensing constraints which yield consonant harmony do not have scope over word-final consonants. Consequently, these consonants escape the foot licensing requirements which are the source of consonant harmony.

Place metathesis, however, is another type of option available to the child to ensure that certain place features are licensed. Instead of involving a relationship between two like positions within the foot, metathesis as witnessed in Clara’s outputs is a relationship that takes place at the level of the prosodic word. In contexts where consonant harmony cannot be invoked to preserve an input feature that would otherwise not be licensed, the child reorders the features present within the word in order to satisfy independent faithfulness requirements of his / her grammar.

This last point ends the discussion of consonant harmony and metathesis. I will now turn to the last section of this chapter, where I discuss alternative views on consonant harmony.

4.4 Alternative views

In this section, I review a number of previous approaches to consonant harmony and compare them with the current proposal. In order to not repeat the oft-cited arguments against a strictly linear approach to phonology in the *SPE* tradition (Chomsky and Halle 1968), whose lack of explanatory power led most modern phonologists to reject it, I will restrict the discussion to the main approaches adopted in the literature on non-linear phonology in order to account for consonant harmony. These approaches, which fall into three main categories — ‘no skipping’, feature spreading and coronal underspecification, and optimality theoretic — are discussed in turn in the next subsections.

4.4.1 ‘No skipping’ approach

In order to account for apparent consonant harmony data from Dutch-learning children, Levelt (1994) proposes a feature sharing approach which only applies between strictly adjacent segments. Indeed, Levelt rejects the idea that consonant harmony results from a relation between two consonants at a distance.[21] Instead, she claims that consonant harmony actually follows accidentally from an independent vowel-to-consonant assimilation which yields feature identity between two consonants in output forms (see, also, Gierut, Cho, and Dinnsen 1993).

A few representative examples of the data supporting Levelt’s view are given in (47). As we can see, in all of these examples, the feature shared by the consonants is also found on the vowel that intervenes between these consonants.

21. Gafos (1996: 162-163), which is based on Levelt’s data, also rejects the idea of consonant harmony as a long-distance relation. Instead, he proposes that the feature sharing observed between the harmonizing consonants results from the persistence of the articulation of one consonant to another consonant through the intervening vowel (C-to-V-to-C). If this were the case, however, this articulation (e.g. Labial) should be heard on the intervening vowel (as rounding), which is not the case. See below.

(47) ‘Apparent’ consonant harmony (Levelt 1994)

Word	Target form	Child’s output	Gloss	Feature shared
boek	[buk]	[bup]	‘book’	Labial
vis	[vɪs]	[siʃ]	‘fish’	Coronal
kast	[kɑst]	[kɑχt]	‘closet’	Dorsal

Thus, in these examples, a vowel-to-consonant assimilation, indicated by the underlining, yields a consonant which matches the place specification of the consonant that appears on the other side of the vowel.

Goad (2000) discusses Levelt’s (1994) approach and argues that these apparent cases of consonant harmony must be viewed as speech errors instead of as outputs reflecting aspects of the children’s phonologies. Among other arguments, Goad (2000) mentions the low number of harmonized outputs, citing Levelt’s (1994) comment that “apparent Consonant Harmony forms are present in about 10% of the utterances of a child in recordings with a peak in such assimilations” (Levelt 1994: 57, footnote #3).

Contrary to Levelt’s data, the alternations discussed above in this chapter do not represent the exception but the rule. As was summarized in (6), apart from the cases where optionality is observed, the data on the three children under investigation are very systematic. Amahl’s categorical pattern of right-to-left Dorsal harmony over Coronal is observed in 97% of potential cases. The two patterns found in Trevor’s outputs, whereby Coronal and Labial assimilate to Dorsal in regressive fashion, are attested in 96% and 94% of the cases, respectively. Two of Clara’s systematic patterns, namely, Labial assimilation of Coronal and Dorsal in the right-to-left direction are both found in 93% of the relevant target forms. Only Clara’s third pattern, regressive assimilation of Dorsal to Coronal shows a smaller mean, 61%. However, recall that 9/12 counter-examples come from the last two sessions where this pattern is observed. The numbers from the three children are thus much higher than the maximum 10% in Levelt’s data. Furthermore, in the data analysed above, the quality of the intervening vowel has nothing to do with the alternations observed in section 4.1. Consider some examples, repeated in (48) for convenience.

(48) Vowel quality independent of consonant harmony
(examples repeated from section 4.1)

	Word	Target form	Child's output	Harmony type
a) Amahl	*snake*	[sneɪk]	[ŋeᶦk]	Coronal to Dorsal
	sticky	[ˈstɪkɪ]	[g̊igiː]	
	Dougal	[ˈduːgəl]	[g̊uːgu]	
b) Trevor	*stick*	[stɪk]	[gɪk]	Coronal to Dorsal
	dog	[dɔg]	[gɔg]	
	sink	[sɪŋk]	[kɪŋk]	
	big	[bɪg]	[gɪg]	Labial to Dorsal
	back	[bæk]	[gæk]	
	pickle	[pɪkəl]	[kɪku]	
c) Clara	*debout*	[dəbu]	[bɑˈbuː]	Coronal to Labial
	savon	[savɔ̃]	[fəˈfɔː]	
	chapeau	[ʃapo]	[pæˈpo]	
	Gaspard	[gaspɑʁ]	[pæˈpæː]	Dorsal to Labial
	capable	[kapab]	[paˈpæb]	
	café	[kafe]	[pəˈfɛ]	
	couleur	[kulœʁ]	[tʊ̰ˈl̰œ̰ᵘ]	Dorsal to Coronal
	grelot	[gʁəlo]	[tɔˈlo]	
	Caillou	[kaju]	[taˈjæ]	

As we can see from these examples, the quality of the vowel intervening between the two harmonized consonants is independent from the place being shared.

These systematic patterns thus argue against Levelt's view that consonant harmony results from an independent vowel-to-consonant assimilation process. Instead, these data support an approach along the lines of the one proposed above, where consonant harmony is viewed as a relation that takes place between two consonants across an intervening vowel.

4.4.2 Feature spreading and Coronal underspecification approaches

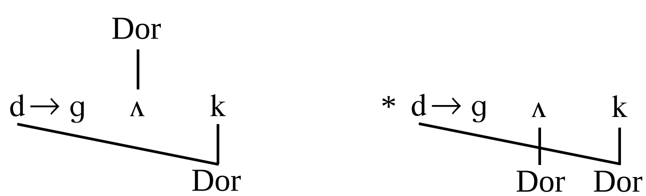
During the pre-OT period, within the tradition of non-linear phonology, consonant harmony was typically analysed as a feature spreading relation between segments (e.g. Spencer 1986, Macken 1992, McDonough and Myers 1991, and Stemberger and Stoel-Gammon 1991; see also Dinnsen, Barlow, and Morrissette 1997).[22]

As reported by Goad (1997a), in order to avoid crossed association lines, Macken (1989, 1992) and McDonough and Myers (1991) propose that, at the stage where consonant harmony is observed, consonants and vowels must be represented on different planes, following the schema in (49a), with Amahl's *duck* → [gʌk] (cf. (49b)).

(49) CV segregation and consonant harmony (schema from Goad 1997a)

a) Planar segregation

b) No planar segregation: crossed association lines



In order to account for the feature strength effects found in much of the data investigated whereby Coronal assimilates to Labial and Dorsal, authors such as Spencer (1986) and Stemberger and Stoel-Gammon (1991) argue in favour of Coronal underspecification. For example, in (49), the consonant [d] of *duck* is represented without a Coronal feature. As a result, only Labial and Dorsal can trigger consonant harmony.

Both CV segregation and Coronal underspecification, however, are problematic. CV segregation, on the one hand, which is traditionally supported in the literature on Semitic and templatic morphology, as well as in languages where the order between consonants and vowels is predictable (see, especially, McCarthy 1989), finds no independent support

22. Levelt (1994) also appeals to Feature Geometry in the analysis of the vowel-to-consonant assimilation patterns reported in (47).

in child language. As Levelt (1994) and Goad (1997a) report, consonant harmony still occurs at stages when the order between consonants and vowels is no longer predictable. Coronal underspecification, on the other hand, is empirically problematic when put in a broader context. For example, Goad (1997a) demonstrates that the realization of Amahl's liquids, at the stage where consonant harmony is observed, requires that coronal consonants which contrast for place specifications, namely, obstruents and nasals, be specified for place, like consonants at other places of articulation. In the example of *duck* → [gʌk], Coronal is the *target* of the assimilation. When Coronal appears in a word where the other consonant is a liquid, however, Coronal acts as the *trigger* of consonant harmony, similar to other place features, as evidence by *light* → [dait]. In this example [l] is realized as [d] by harmonizing to the coronal [t]. This example contrasts with the case where [l] is found in words with no place-bearing consonants to trigger consonant harmony (e.g. *hello* → [ɛluː]; *lorry* → [lɔliː]). Thus, Coronal acts as a trigger of consonant harmony and, therefore, must be specified in the input, contrary to the prediction made by across-the-board Coronal underspecification.

The comparative analysis offered above in this chapter provides additional support against Coronal underspecification. Indeed, if Coronal were underspecified across the board in child language, as proposed by Stemberger and Stoel-Gammon (1991), it would be impossible to explain the fact that Dorsal assimilates to Coronal in Clara's outputs. Moreover, recall that Trevor displays Dorsal assimilation over both Labial and Coronal (see earlier Pater 1996, 1997). While an approach based on Coronal underspecification would account for the Coronal to Dorsal assimilation, it would not be able to account for the Labial to Dorsal pattern. Finally, in order to maintain that underspecification underlies consonant harmony systems like these, it would be necessary to assume that two target features are underspecified, something which is impossible under any theory of underspecification.

4.4.3 Optimality theoretic approaches

4.4.3.1 Alignment

In order to overcome the difficulties posed by feature spreading and underspecification approaches, Goad (1997a) proposes an optimality theoretic approach to consonant harmony. As mentioned in section 4.2.3, central to Goad's (1997a) analysis is the idea that feature copy (as compared to feature sharing which is appealed to in the approaches reviewed in the preceding subsection) is forced by the demands of constraints making intervening vowels impossible targets. The two constraints that are central to Goad's (1997a) proposal are PARSE, a constraint similar to MAX which is part of the original OT approach to faithfulness by Prince and Smolensky (1993), and ALIGN, a constraint proposed by McCarthy and Prince (1993b) which requires that some element be aligned with the edge of some prosodic domain. Specific versions of these two constraints are defined in (50) and (51) respectively.

(50) PARSE(Cor)
Underlying Coronal features must be parsed in surface forms

(51) ALIGN(Dor, L, ArticDomain, L)
The feature Dorsal must be aligned with the left edge of the articulator domain

Adopting Pulleyblank's (1996) definition of harmonic domain, Goad proposes that the argument 'ArticDomain' refers to any place feature (Labial, Coronal, Dorsal). In her analysis of Amahl's Dorsal harmony over Coronal, Goad (1997a) proposes that ALIGN(Dor, L, ArticDomain, L) outranks PARSE(Cor), accounting for the feature strength asymmetry, as well as for the directionality effects observed in Amahl's outputs (see (1a)).

However, under such an approach, which in essence views consonant harmony as a relation at the level of the prosodic word instead of at the level of the foot, it is impossible to account for the asymmetry observed between Clara's CVCV versus CVC words. Recall from section 4.1.3 that Clara's [Cor…Lab] CVCV words surface as [Lab…Lab]. An alignment-based account of this pattern would require domination of the constraint PARSE(Cor) by ALIGN(Lab, L, ArticDomain, L). However, recall further that Clara's [Cor…Lab] CVC words surface as such, i.e. without consonant harmony. This last context is difficult to reconcile with high ranking of the Labial alignment constraint required for the CVCV context.

4.4.3.2 Repeat

Another proposal found in the recent literature comes from Pater (1996, 1997), who analyses consonant harmony as the result of REPEAT, a constraint which accounts for the preference for repeated gestures in children's productions, as defined in (52).

(52) REPEAT
Successive consonants must agree in place specification

Pater (1996, 1997) proposes that REPEAT must be active in grammars showing consonant harmony alternations but that this constraint must be eliminated from the system prior to the adult stage, in order to account for the absence of consonant harmony in adult language.

As Pater admits, however, this approach to child-specific constraints raises a few problems. Recall from section 2.3 that OT adopts the premise that all grammars contain a finite number of constraints, at any stage in their development, i.e. from the initial to the adult state. This premise is consistent with Pinker's (1984) continuity assumption (see section 2.4.1). Given this, and given that child-specific constraints find no independent support in the literature beyond consonant harmony, appealing to such a constraint should be considered only as a last resort option. Furthermore, from an empirical perspective, as formulated, REPEAT cannot account for the asymmetries regarding directionality and / or domain of application of consonant harmony mentioned above such as Clara's contrast between CVCV and CVC words.

To the contrary, the current approach appeals primarily to (a) licensing, a notion well-established in the literature on non-linear phonology, and (b) markedness and faithfulness constraints which are central to most analyses framed within OT. Furthermore, no constraint needs to be eliminated from the grammar. Indeed, all of the constraints used in this thesis are independently motivated in the OT literature on adult languages, as was demonstrated in section 2.3.

Finally, the question as to why consonant harmony appears not to be found in adult languages pertains to a long-standing problem regarding the empirical differences that are observed between child and adult phonology. This problem lies beyond the scope of this thesis will not be further addressed. However, for related discussion, I refer the interested reader to, e.g. Drachman (1978), Vihman (1978), Pater (1996, 1997), Goad (1997a, 2000), and Bernhardt and Stemberger (1998).

4.5 Concluding remarks

In sum, I have demonstrated, from a comparison of the three corpora discussed in this chapter, that reference to prosodic structure, combined with variable rankings of place feature faithfulness constraints, are central to the characterization of consonant harmony.

Indeed, the comparison between English and French unveiled an interesting contrast between CVCV and CVC words. Because of the different foot structures found in these two languages, word-final consonants are prosodified in different ways, namely, within the foot in English but outside this constituent in French. The foot-based analysis proposed provided us with an explanation for the observation that consonant harmony fails to apply to word-final consonants in the French data.

Regarding the features involved in consonant harmony, I demonstrated that every feature can trigger or undergo consonant harmony. While both English-learning Amahl and Trevor display a Dorsal > Labial > Coronal feature strength hierarchy, French-learning Clara displays a Labial > Coronal > Dorsal hierarchy. It follows from this that neither fixed rankings of place faithfulness constraints nor Coronal underspecification finds universal support in the data observed, as both of these theoretical devices would make the wrong predictions regarding the French patterns: as was seen in (4c), the data from Clara show Dorsal assimilating to Coronal. This conclusion supports the position taken by Goad (1996a, 1997a) and Pater (1996, 1997) that consonant harmony requires Coronal specification: Coronal must be present in representations in order to be the 'active' feature in this process.

Nonetheless, both Amahl and Trevor display constraint rankings which conform to typological tendencies where Coronal is more prone to assimilation (see, especially, contributions to Paradis and Prunet 1991) and is allowed in prosodic positions which disallow other place features. For example, in Lardil (section 2.2.1.1), only Coronal can be licensed in coda position. From a typological point of view, Amahl's and Trevor's constraint rankings appear to reflect the relative unmarkedness of Coronal. However, given Clara's data, where Dorsal assimilates to Coronal, the weaker faithfulness to Coronal observed in Amahl's and Trevor's data must not be construed as universally invariable or fixed. Rather, it must be viewed as a tendency, perhaps expressed in a favoured (unmarked) ranking. However, it would be premature to make any strong claims on this point, as the only way of verifying it with greater certainty would require a much larger set of data, from several children learning different languages.

I now turn to the next chapter, where I discuss variability in feature specification in the development of French [ʁ] and its effects on Clara's and Théo's outputs. As we will see, the various developmental and assimilation patterns to be discussed are also directly correlated with headedness in prosodic constituents.

Chapter 5

Variability in feature specification in the development of [ʁ]

5.0 Introduction

In this chapter, I discuss the development of the French rhotic [ʁ] in both Clara's and Théo's grammars. As we will see, the two children display contrasting patterns: while [ʁ] appears as the target to assimilation in Clara's singleton onsets, this consonant acts as a trigger of assimilation in Théo's branching onsets.

Following the approach adopted throughout the thesis, highly-articulated prosodic representations will be central to the analysis. Nonetheless, part of the explanation will also be placed on segmental representations. I will argue from the distinct behaviours of [ʁ] observed in the two children's outputs that Clara and Théo have different representations for this segment. Two constraints will be central to the account of these patterns. The first, used in the analysis of Clara's patterns, is a specific PLACE constraint, which will require prosodic heads, more specifically, consonants in head positions, to bear place features (HEADPLACE). The second constraint, which I will invoke in order to explain the behaviour of Théo's [ʁ], is LICENSE(F, PCat), which will require that the feature Dorsal be licensed by the head of the onset constituent (LICENSE(Dor, Ons)).

The chapter is organized as follows. In section 5.1, I describe the data to be accounted for. Regarding Clara's data, two phenomena related to the development of [ʁ] will be observed: [ʁ]-substitution in word-initial and word-medial onsets, and the late emergence of [ʁ] in word-final position. Regarding Théo's data, I will focus on the fact that, in singleton onsets, [ʁ] emerges with a constant shape (without undergoing assimilation) at the same time as the other consonants. In addition, [ʁ] triggers Dorsal assimilation when it is preceded by a coronal consonant in branching onsets. Following from the description of these data, I will provide, in section 5.2.1, the representations for [ʁ] for each child. I will propose that [ʁ] is placeless in Clara's inputs but specified for the feature Dorsal in Théo's inputs. This position will be defended in the analysis detailed in section 5.2. A summary and discussion of the arguments follow in section 5.3.

5.1 The data

In this section, I describe the peculiar behaviour of [ʁ] in the different syllabic positions where it can be found in Clara's and Théo's outputs. Instead of presenting the two children's data in parallel, as was done in chapter 3, I will describe the data for each child separately, in order to facilitate understanding of the complexities involved in each grammar. At the end of the section, I will offer a summary of the patterns observed and a comparison between the two children.

5.1.1 Clara's [ʁ]-substitutions in singleton onsets

Recall from chapter 3 that at early ages, Clara's outputs conform to the universal CV syllable, i.e. a singleton onset followed by a singleton nucleus. At this stage, Clara cannot produce [ʁ] in target-like fashion. Despite this, when [ʁ] appears in target singleton onsets in word-initial or word-medial position, it is never deleted; instead, [ʁ] takes on the place specification of another consonant in the word, as exemplified in (1).[1]

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1. There exists one notable counter-example to this generalization, which concerns the [ʁ] contained in the word *Clara* [klaʁa]. Indeed, Clara shows a peculiar way of pronouncing her name, which she consistently produces as [kala]. However, it is possible that Clara has a stored representation for her name which differs from the adult representation. A look at other words containing [kl] branching onsets and singleton [ʁ] allows us to confirm this hypothesis. Indeed, throughout the whole data collection period, other [kl] clusters are target-like as soon as branching onsets are acquired (see section 3.4 for more details on the acquisition of branching onsets).

(1) Clara’s [ʁ] in early singleton onsets: substitution (1;00.28 to 2;00.02)[a]

	Word	Target form	Child’s output	Age	Gloss
a)	*carotte*	[kaʁɔt]	[kaˈgɜ]	1;07.27	‘carrot’
			[tʰɔˈdɔːt̚]	1;09.01	
			[kəˈjɔːt̚]	2;00.02	
	gorille	[gɔʁɪj]	[ʤyˈjɪʝ]	1;10.04	‘gorilla’
	girafe	[ʒiʁaf]	[ʋɛˈwæʃ]	1;10.04	‘giraffe’
	oreille	[ɔʁɛj]	[əˑˈjɛːʝ]	1;09.01	‘ear’
			[œˑˈjɛːj]	2;00.02	
	souris	[suʁi]	[zʊji]	1;11.06	‘mouse’
b)	*robe*	[ʁɔb]	[wɔb̥]	1;10.10	‘(a) dress’
	rouge	[ʁuʒ]	[jʊʃ]	1;11.06	‘red’
			[zʊⁱʒ]	1;11.21	
c)	*renard*	[ʁənɑʁ]	[leˈn̰a̰][b]	1;07.27	‘fox’
	marionnette	[maʁjɔnɛt]	[mæɲiˑˈnɐː]	2;00.02	‘puppet’

a. No examples of words containing no consonant other than [ʁ] (e.g. *roue* [ʁu] ‘wheel’) were found in the data. It is thus impossible to determine what the default articulator is in Clara’s grammar.
b. The subscript tildes in these examples represent creaky-voiced sounds.

As we can see, assimilation of target [ʁ] manifests itself when this consonant appears in stressed syllables, in both CVCV and CVC words, in (1a) and (1b), respectively, as well as when [ʁ] appears in unstressed syllables, in (1c). Indeed, the only potential context where [ʁ] does not display assimilation is in word-final position, where it undergoes deletion. The word-final context is discussed further below.

At age 2;01.05, Clara starts producing [ʁ] in singleton onsets in target-like fashion, with some variation in the voicing specification: target [ʁ] appears as either [ʁ] or [χ]. Examples are provided in (2).

(2) [ʁ] in singleton onset at stage 2: production (age 2;01.05)

	Word	Target form	Child's output	Age	Gloss
a)	*furet*	[fyʁɛ]	[fy'ʁɛ]	2;05.25	'ferret'
	oreille	[ɔʁɛj]	[ə'ʁɛj]	2;03.05	'ear'
	Paris	[paʁi]	[pæ'χi]	2;02.06	'Paris'
b)	*rouge*	[ʁuʒ]	[χuːs]	2;01.05	'red'
			[ʁʊʃ]	2;03.05	
	arrive	[aʁiv]	[æ'ʁiːf]	2;03.05	'(s/he) arrives'
c)	*arranger*	[aʁɑ̃ʒe]	[aʁa'ʒe]	2;03.15	'(to) arrange'
	Marina	[maʁina]	[mæʁi'næ]	2;03.19	'Marina'
	raison	[ʁɛzɔ̃]	[ʁeɪ'zɔ̃]	2;05.10	'reason'

To a great extent, the assimilation exhibited in (1) resembles the consonant harmony patterns discussed in chapter 4: place feature sharing is observed between two consonants at a distance in the output. Importantly, however, contrary to Clara's consonant harmony patterns, there is no directionality effect observed here: while consonant harmony always applies from right to left in Clara's outputs (see summary in section 4.1.4), the place specifications acquired by [ʁ] in the examples in (1) can come from the left or the right. Furthermore, while consonant harmony ends at age 1;09.01, [ʁ]-substitution is observed until age 2;00.02, i.e. for an additional three months. Notice, finally, that while [ʁ] undergoes substitution in singleton onsets until 2;00.02, it appears in target-like fashion as the second member of a branching onset when these onsets emerge in the child's outputs (at least in stressed syllables), at age 1;09.29, as was seen in section 3.4.2. Thus, at the same time as *souris* [suʁ̲i] is realized as [zʊj̲i] 'mouse', i.e. with [ʁ] assimilation, *biberon* [bibʁ̲ɔ̃] is realized as [pa'pχ̲ɔ] 'baby bottle', i.e. with a target-like [ʁ / χ].

In section 5.2.1, I will propose that [ʁ] is devoid of place features in Clara's input representations. In section 5.2.2, I will argue that placelessness in onset heads violates a highly-ranked constraint requiring that consonants in this position bear place features in output forms (HEADPLACE). This proposal will permit us to account for the systematic substitutions observed in (1). It will also provide us with an explanation for why [ʁ] is realized as target-like in branching onsets while it still undergoes substitution in singleton onsets; while placeless [ʁ] is tolerated in the dependent position of a branching onset, where it vacuously satisfies HEADPLACE(Onset), it is disallowed in the onset head position, as it violates the requirements of this constraint. Before I elaborate on this account, in order to have a complete picture of the behaviour of [ʁ] in Clara's outputs, I will first discuss the second pattern found in the development of Clara's [ʁ].

5.1.2 Clara's development of [ʁ] in word-final position

As mentioned earlier in section 3.2.2, Clara's word-final consonants generally emerge at age 1;07.06. Word-final [ʁ], however, is mastered much later. Some examples of word-final [ʁ] deletion after 1;07.06 are given below in (3). Notice that the input vowel preceding the deleted [ʁ] surfaces as long in most examples, contrary to what was observed in contexts of deletion of word-final consonants other than [ʁ] in section 3.2.1.

(3) Word-final [ʁ] deletion and vowel lengthening between ages 1;07.06 and 2;01.05

Word	Target form	Child's output	Age	Gloss
canard	[kanɑʁ]	[næˈnæː]	1;07.27	'duck'
Babar	[babɑʁ]	[bɑˈbɑː]	1;09.29	'Babar'
beurre	[bœʁ]	[bœː]	1;10.04	'butter'
encore	[ɑ̃kɔʁ]	[ɛˈkɔː]	1;11.21	'again'
Claire	[klaɪʁ]	[klæː]	2;01.05	'Claire'
dehors	[dəɔʁ]	[dæˈɔː]	2;01.05	'outside'

Clara's [ʁ] in word-final position emerges only seven months later, i.e. one to two months after it is mastered in singleton onsets, between ages 2;02.06 and 2;03.05. During this period, variation is observed. Examples of this variation are provided in (4), where three words are compared.

(4) Emergence of [ʁ] in word-final position (2;02.06 to 2;03.05)

a) Word-final [ʁ] realization

Word	Target form	Child's output	Age	Gloss
encore	[ɑ̃kɔʁ]	[ɑ̃ˈkɔχ]	2;02.20	'again'
pleure	[plœʁ]	[plœʁ]	2;03.05	'(s/he) cries'
voir	[vwɑʁ]	[ɸwæʁ]	2;02.06	'to see'

b) Word-final [ʁ] deletion and vowel lengthening

Word	Target form	Child's output	Age	Gloss
encore	[ɑ̃kɔʁ]	[əˈkæː]	2;02.20	'again'
pleure	[plœʁ]	[plɐː]	2;03.05	'(s/he) cries'
voir	[vwɑʁ]	[vwæː]	2;02.06	'to see'

As we can see, when deletion is observed, the vowel preceding word-final [ʁ] in the input surfaces as long. Overall, during this period of emergence, [ʁ] is produced one third of the time, in 15/47 target contexts. Two weeks later, [ʁ] has been completely mastered in this context, as we can see (5).

(5) Word-final [ʁ] mastery (2;03.15)

Word	Target form	Child's output	Age	Gloss
dort	[dɔʁ]	[dɔʁ]	2;03.15	'(s/he) sleeps'
Gaspard	[gaspɑʁ]	[gæsˈpaʁ]	2;03.19	'Gaspard'
dormir	[dɔʁmɪʁ]	[dɔʁˈmiʁ]	2;03.19	'(to) sleep'
chaussure	[ʃosʏʁ]	[ʃœˈʃyʁ]	2;03.15	'shoe'
chaudière	[ʃɔd͡zjaɪʁ]	[sɔˈdjɛʁ]	2;03.19	'bucket'
foulard	[fulɑʁ]	[foˈlæːʁ]	2;03.19	'scarf'

Regarding the late emergence of Clara's word-final [ʁ], one could argue that this pattern is due to perceptual factors, namely that [ʁ] is difficult to perceive in this position. A few points, however, argue against such a position.

Firstly, this proposal is undermined by Théo's data. As we saw earlier in section 3.2.2, contrary to what is observed for Clara, Théo's word-final [ʁ] emerges at the same time as his other final consonants. Importantly, both children are acquiring the same variety of [ʁ] (a uvular approximant), as was noted earlier in section 1.1.1. This last point is further demonstrated by the fact that, at their respective mastery stages, both children produce target [ʁ] in a similar fashion, [ʁ / χ], which corresponds to the forms of the target language.[2] Finally, if [ʁ] were not perceived word-finally, it would be rather difficult to explain the compensatory lengthening observed in this context when [ʁ] undergoes deletion.

The solution to the problem for Clara's late emergence of word-final [ʁ] must therefore lie in some aspect of her system. A crucial observation in this respect is that the acquisition of word-final [ʁ] coincides with the period when true (word-internal) codas emerge in Clara's outputs. As we saw earlier in section 3.3, example (28a), codas are first attested in Clara's outputs at age 2;03.19, because no relevant examples could be found within the data set gathered four days earlier, at 2;03.15. It is within this four-day window that both word-final [ʁ] and word-internal codas systematically appear in the child's outputs, as illustrated in the examples repeated in (6). Notice as well that, as was pointed out in section 3.3, coda deletion in unstressed syllables does not yield vowel lengthening in the output, contrary to what was observed above for the word-final [ʁ] deletion context.

(6) Codas and word-final [ʁ] acquired during the same period

a) Stage 1: word-final [ʁ] and coda deletion (1;00.28 to 2;03.05)

	Word	Target form	Child's output	Age	Gloss
i) Word-final [ʁ]	*canard*	[kanɑʁ]	[næˈnæː]	1;07.27	'duck'
	encore	[ɑ̃kɔʁ]	[ɛˈkɔː]	1;11.21	'again'
	dort	[dɔʁ]	[dɔ]	2;03.05	'(s/he) sleeps'
ii) Coda	*fourchette*	[fʊʁʃɛt]	[ɸeˈdɛtʰ]	1;09.01	'fork'
	casquette	[kaskɛt]	[tæˈkɛt]	1;11.21	'cap'
	ourson	[ʊʁsɔ̃]	[ʊˈsɔ̃]	2;03.05	'teddy bear'

2. The [ʁ / χ] variation found in the two children's outputs does not correspond exactly to where the alternation between these two variants is observed in target French. However, this variation can be attributed to the fact that voicing is not fully mastered at early stages (see further below).

b) Stage 2: word-final [ʁ] and coda realization (2;03.15-19)

	Word	Target form	Child's output	Age	Gloss
i) Wd-final [ʁ]	*dort*	[dɔʁ̲]	[dɔʁ]	2;03.15	'(s/he) sleeps'
	Gaspard	[gaspɑʁ̲]	[gæsˈpaʁ]	2;03.19	'Gaspard'
	dormir	[dɔʁmɪʁ̲]	[dɔʁˈmiʁ]	2;03.19	'(to) sleep'
ii) Coda	*pansement*	[pɑ̃s̲mɑ̃]	[pæsˈmæː]	2;03.19	'plaster'
	Gaspard	[gas̲pɑʁ]	[gæsˈpaʁ]	2;03.19	'Gaspard'
	dormir	[dɔʁ̲mɪʁ]	[dɔʁˈmiʁ]	2;03.19	'(to) sleep'

When combined with the observation that other word-final consonants are mastered several months before word-final [ʁ], these data strongly suggest that word-final [ʁ] is syllabified in coda position. Thus, [ʁ] contrasts with Clara's other word-final consonants, which, as argued for in section 3.2, are syllabified as onsets of empty-headed syllables.

Further evidence for this hypothesis comes from the vowel lengthening pattern observed in the data in (3) and (4b): in almost all of the examples where word-final [ʁ] is deleted, the vowel is realized as long in the output. This pattern of vowel lengthening contrasts with both (a) the absence of systematic lengthening of the preceding vowel in contexts where word-final consonants other than [ʁ] are deleted and (b) the absence of vowel lengthening in contexts of coda deletion in unstressed syllables. In the analysis below, I will attribute vowel lengthening to MAXHEAD(Foot), which will prevent complete segmental deletion in word-final [ʁ] contexts, where a coda consonant appears in the head of the foot in the input, at the stage when codas are not tolerated in Clara's outputs.

Before I proceed to the details of the proposal, I will describe the various patterns found in Théo's data for [ʁ], which contrast with those observed for Clara.

5.1.3 Théo's Dorsal assimilation in Coronal-[ʁ] branching onsets

Contrary to Clara, Théo's first attempts at [ʁ] production reveal that [ʁ] behaves symmetrically with the other consonants, showing target-like realization in singleton onsets, branching onsets and word-final position, when the latter two structures emerge in Théo's outputs, as we saw in sections 3.2 and 3.4, respectively. Only the voicing of [ʁ] is not fully mastered in Théo's earliest words, as we can see by the variation among [ʁ / χ] in (7).

(7) Théo's [ʁ] in singleton onsets

Word	Target form	Child's output	Age	Gloss
roue	[ʁu]	[χu]	2;05.11	'wheel'
		[χu]	2;05.29	
		[ʁu]	2;06.12	
sirop	[siʁo]	[a'χo]	2;05.29	'syrup'
rue	[ʁy]	[χy]	2;06.12	'street'
roche	[ʁɔʃ]	[χɔç]	2;06.12	'(a) rock'
oreille	[ɔʁɛj]	[ɑ'χɛj]	2;06.12	'ear'
roule	[ʁʊl]	[ʁʊj]	2;07.22	'(it) rolls'
rouge	[ʁuʒ]	[ʁʊç]	2;08.05	'red'

These first attempts at [ʁ] occur relatively late, however. Given that data collection started when Théo was 1;10.27, these words occur more than six months later. It may be the case that Théo was avoiding target words containing [ʁ] in onsets before this period (on avoidance strategies, see, e.g. Ferguson and Farwell 1975, Schwartz and Leonard 1982, Stoel-Gammon and Cooper 1984). However, this is difficult to evaluate without experimental investigation; the absence of words containing [ʁ] in early recording sessions could also be accidental, given the child's vocabulary, which was very restricted and, also, the sampling methodology, which obviously could not cover his entire lexicon. Nonetheless, when the first attempts are produced at 2;05.11, target [ʁ] surfaces in fairly regular fashion.

The patterning of [ʁ], straightforward in singleton onsets, becomes more interesting with the emergence of branching onsets: Théo's coronal consonants in input Coronal-[ʁ] clusters display Dorsal assimilation, as exemplified in (8a). By contrast, no assimilation occurs in Labial-[ʁ] clusters, in (8b), and Dorsal-[ʁ] clusters surface as target-like, as expected, in (8c). These data strongly suggest that [ʁ] is Dorsal, in contrast to Clara's placeless representation for this consonant.

(8) [ʁ] in branching onsets (2;05.29 to 4;00.00)

a) Coronal-[ʁ] clusters: Dorsal assimilation

Word	Target form	Child's output	Age	Gloss
train	[tχɛ̃]	[kχɛ]	2;06.12	'train'
trois	[tχwɑ]	[kχɔ]	2;06.12	'three'
		[kχwɑ]	2;07.06	
citrouille	[sitχʊj]	[kʁœj]	2;07.22	'pumpkin'
cadran	[kadʁɑ̃]	[kʰa'gχa]	3;01.18	'alarm clock'
drôle	[dʁol]	[kχal]	3;03.18	'funny'
		[gʁol]	3;04.19	
		[gʁol]	3;05.06	
entrer	[ɑ̃tχe]	[ɑ̃kχe]	3;04.00	'(to) come in'
dragon	[dʁɑgɔ̃]	[kχɔgɔ̃]	3;04.19	'dragon'
montrer	[mɔ̃tχe]	[mɑ̃'kχe]	3;07.06	'(to) show'
trop	[tχo]	[kχo]	4;00.00	'too much'
travailler	[tχavaje]	[kχavaje]	4;00.00	'(to) work'

b) Labial-[ʁ] clusters: no assimilation

Word	Target form	Child's output	Age	Gloss
bras	[bʁɑ]	[bʁɑ]	2;10.05	'arm'
brosse	[bʁɔs]	[bʁɔːs]	2;08.22	'(a) brush'
brun	[bʁœ̃]	[b̥ʁœ̃]	2;08.22	'brown'
prendre	[pχɑ̃d]	[pʁɑ̃d]	2;07.06	'(to) take'
presse	[pχɛs]	[pχas]	2;08.22	'(in a) hurry'
pris	[pχi]	[pχi]	2;09.12	'occupied'

c) Dorsal-[ʁ] clusters: no assimilation

Word	Target form	Child's output	Age	Gloss
crie	[kχi]	[kʁi]	2;11.23	'(s/he) screams'
croche	[kχɔʃ]	[kʁɔʃ]	2;10.05	'curved'
		[kχo]	2;05.11	
		[gʁo]	2;10.24	
gris	[gʁi]	[kχi]	2;08.22	'grey'
micro	[mikχo]	[mɪ'kʁo]	2;10.24	'microphone'

We can also see from these examples that there is variation in voicing of both [ʁ] and the consonant that precedes it. In most cases, the variation is consistent with the patterns observed in the target language. Recall from section 1.1.1.2 that in Québec French, input [ʁ] in branching onsets is realized as a voiceless fricative when it is preceded by a voiceless obstruent (e.g. *trop* /tʁo/ → [tχo] ‘too much’). In the data in (8), both members of the branching onset generally agree in voicing, apart from some cases where a mismatch is observed (e.g. *citrouille* in (8a), *prendre* in (8b), and the first output for *croche* in (8c)). Notice as well that mismatches show both possible patterns, namely, voiced obstruent followed by voiceless [χ] and voiceless obstruent followed by voiced [ʁ].

Apart from the variation observed in voicing specifications, the pattern of Dorsal assimilation observed is very robust. It extends until the end of the period when the data were collected, as we can see from the last two examples in (8a). It is thus impossible to determine with exactness when it disappeared from Théo’s speech.[3]

Finally, notice that the assimilation seen in (8a) is strictly confined to the onset constituent. In words where coronal consonants are separated from [ʁ] by one or more segments, in (9a), or when a coda [ʁ] precedes a coronal onset, in (9b), no assimilation occurs.

(9) [ʁ] in other contexts: no assimilation

	Word	Target form	Child’s output	Age	Gloss
a)	*facteur*	[faktœʁ]	[faˈtɔχ]	2;10.24	‘postman’
	terre	[taɪʁ]	[teɪχ]	3;00.07	‘ground’
			[taɪʁ]	3;04.00	
	tortue	[tɔʁt͡sy]	[tɔʁˈt͡sy]	3;10.26	‘turtle’
	tournevis	[tʊʁnəvɪs]	[tɔʁnəˈvɪs]	3;05.06	‘screwdriver’
b)	*tortue*	[tɔʁt͡sy]	[tɔʁˈt͡sy]	3;10.26	‘turtle’
	tarte	[taʁt]	[taʁt̚]	3;10.26	‘pie’
	fourchette	[fʊʁʃɛt]	[fuʁʃɛt]	3;10.26	‘fork’

3. However, during a visit with Théo a few months after the last recording session, we noticed that the pattern in (8a) had disappeared.

The examples in (9a), on the one hand, differ from Clara's data in (1), where [ʁ] agrees with other consonants at a distance. The forms in (9b), on the other, contrast with languages like Diola Fogny where, as reported by Sapir (1965), liquid-obstruent coda-onset sequences must agree for place. On that point, Diola Fogny differs from several languages which — like French, English, as well as Clara's and Théo's grammars — allow coda liquids to be followed by obstruents with any place of articulation. Consistent with the observation that Dorsal assimilation is found only in branching onsets in Théo's outputs, the analysis proposed below will restrict the domain of the assimilation process to the onset constituent. Nevertheless, since languages very rarely permit onset heads and dependents to agree in place, other options must be entertained before the current hypothesis can be accepted.

One possibility could be that Coronal assimilation as observed in (8a) results from a perception problem, namely that the coronality of input [t, d] is phonetically masked by the uvularity of [ʁ], along the lines of the proposal by Macken (1980). Macken argues that Amahl's realization of input words like *beetle* as [b̥iːg̱u] results from a perceptual problem where the dorsality of the input word-final dark [ɫ] hides the coronality of the preceding input [t].

I argue that a perception problem does not underlie the pattern of Coronal assimilation observed in Théo's branching onsets. Firstly, the pattern of apparent dark [ɫ] assimilation over Coronal found in Amahl's data only occurs in a context where the coronal consonant is in a weak prosodic environment, i.e. in unstressed syllables. To the contrary, the pattern observed in (8a) applies consistently in both stressed syllables as well as in unstressed syllables. Since cues for contrasts are enhanced in stressed syllables, we would expect, under a perception-based approach, to see target-like Coronal-[ʁ] branching onsets in stressed syllables, which is not the case. Secondly, still under a perception-based approach to the problem, we would expect the quality of surrounding vowels to hinder or enhance perception of [t] as Coronal. However, this possibility finds no support in Théo's outputs. As we can see in (8a), Dorsal assimilation is attested both before back vowels, which could hinder accurate perception, and before front vowels, which could enhance it (e.g. *drôle* and *train*, respectively). Thirdly, some idiosyncratic examples reveal that Théo represents Coronal-[ʁ] in target-like fashion in the input. These examples are reported in (10).

(10) Coronal-[ʁ] as target-like in the input

	Word	Target form	Child's output	Age	Gloss
a)	*train*	[tχɛ̃]	[tɥɛ̃ː]	2;05.11	'train'
	trouvé	[tχuve]	[tʃoˈve]	3;01.18	'found'
b)	*droit*	[dʁwa]	[dwa]	3;01.18	'straight'
	trouvé	[tχuve]	[tʊʁe]	3;10.03	'found'
	tracteur	[tχaktœʁ]	[taˈtaɪ]	2;08.22	'tractor'
			[taˈtœᶷ]	2;08.22	
c)	*trop*	[tχo]	[tʁo]	2;11.23	'(too) much'
	apportera	[apɔʁtχɑ]	[apɔʁˈdʁɑ]	4;00.00	'will bring'

As we can see in (10a), in the rare cases where [ʁ] surfaces as another segment, the coronal preceding it surfaces as target-like, not as Dorsal. The same holds true of the examples in (10b) where the exceptional cases of Coronal-[ʁ] branching onset reduction show preservation of Coronal, not Dorsal, on the output consonant. Finally, two counter-examples of the pattern in (8a) were found in the corpus. As we can see in (10c), these examples, which surface as target-like, demonstrate that Coronal is present in the input of these words. These three arguments thus conspire against a perception-based approach to Théo's Dorsal assimilation pattern.

Another potential explanation for the pattern in (8a) would be that Théo interprets Coronal-[ʁ] clusters as affricates. Three facts, however, argue against such a possibility. First of all, Dorsal affricates are very marked cross-linguistically. Indeed, Maddieson (1984: 38-40), who discusses the most frequent types of affricates attested across languages, which are themselves far less frequently-attested than stops and fricatives, does not even mention dorsal affricates. Maddieson reports that "affricates at other places of articulation [than dental or alveolar] are relatively rare: the most common are palatal non-sibilant, but less than 10 languages have such segments” (Maddieson 1984: 39). In his segment index, however, Maddieson (1984: 225) reports dorsal affricates in three languages, namely, Chipewyan, Nama, and Tavgy. Given that children’s grammars generally reflect the unmarked case, it would be very unlikely that Théo represents target Coronal-[ʁ] clusters as affricates.

Second, if Coronal-[ʁ] clusters were analysed as affricates by Théo, we would expect one of two scenarios. One, these strings should emerge at around the same time as the target affricated consonants [t͜s] and [d͜z], which are found in front of high front vocoids in Québec French (e.g. /pəti/ → [pət͜si]), as mentioned in section 1.1.1.1; or two, given the marked status of dorsal affricates, coronal affricates should be mastered before dorsal affricates. However, neither of these patterns is found in Théo’s data: while the first [kχ / ɡʁ] strings (from input Coronal-[ʁ]) are attested at 2;06.12, [t͜s / d͜z] emerge three months later, at 2;09.12. Related to this, notice that the fact that affricated [t͜s] and [d͜z] are allophonic in Québec French is irrelevant to the point being discussed. On the one hand, the child does not necessarily know this yet. On the other, under the hypothesis that [ɡʁ / kχ] are analysed as affricates by Théo, since affrication in [t͜s / d͜z] arguably results from an assimilatory process, if anything, this should enhance early acquisition of [t͜s] relative to [kχ]. However, none of these implications finds empirical support from the data under investigation. In addition, Coronal affrication is sometimes realized as aspiration in Théo’s early outputs (e.g. *tire* [t͜sɪʁ] → [t͜sɪʁ] / [t^{h}εχ] ‘(s/he) throws’ at 2;09.12) before it is systematically realized as target-like. In contrast to this, aspiration is never attested for target Coronal-[ʁ] branching onsets, despite the fact that [χ] could be perceived as heavy aspiration (i.e. [t$^{\chi}$]). Moreover, although there are not many examples of this, the voicing mismatches observed in the examples in (8a), like those in the remainder of the data in (8), argue against an affricate analysis. Because affricates are single segments, they must agree in voicing; this holds true of target French and across languages (e.g. √[t͜s]; *[t͜z]), and is also verified in Théo’s coronal affricates (for related discussion, see Lleó and Prinz 1997).

As alluded to above, a final explanation for the pattern in (8a) could be that Coronal-[ʁ] clusters are instead represented as strongly aspirated consonants. On the one hand, this possibility does not find support from the phonetic quality of these clusters. Most importantly, on the other hand, strong aspiration would be impossible to support in the case of the voiced clusters.

From these observations, I conclude that an analysis of Théo’s [kχ / gʁ] strings as branching onsets constitutes the best approach to entertain and maintain that these derive from Coronal-[ʁ] through constituent-internal assimilation in onset clusters.

Before I turn to the details of the analysis for Théo’s data, as well as for Clara’s patterns discussed earlier, I provide, in the next section, a comparison of the observations made for both children.

5.1.4 Clara’s versus Théo’s patterns

In the preceding section, we observed a number of different behaviours in the development of target [ʁ]. In this section, I compare the various patterns described. Based on this comparison, I will propose contrasting representations for [ʁ] in Clara’s and Théo’s systems. These representations will set the ground for the analyses detailed in section 5.2. The observations for both children are summarized in (11).

(11) Behaviour of [ʁ] in Clara’s and Théo’s outputs: summary

<table>
<tr><th></th><th>Clara</th><th>Théo</th></tr>
<tr><td>a) Singleton onsets</td><td>Undergoes substitution</td><td>Target-like</td></tr>
<tr><td>b) Branching onsets</td><td>Target-like</td><td>Cor-[ʁ] → Dor-[ʁ]</td></tr>
<tr><td rowspan="2">c) Word-final position</td><td>i) During deletion stage, vowel lengthening is observed</td><td rowspan="2">Emerges during the same period as other consonants</td></tr>
<tr><td>ii) Emerges during the same period as (word-internal) codas</td></tr>
</table>

The development of Clara's [ʁ] is characterized by three main patterns. First, in singleton onsets, [ʁ] undergoes substitution until age 2;01.05, a process which does not apply when this consonant is the second member of a branching onset. Second, as of 2;01.05, [ʁ] is realized in target-like fashion in singleton onsets. Third, in word-final position, [ʁ] is systematically deleted until 2;02.06, at which point some production / deletion variation is observed. In virtually all cases where word-final [ʁ] undergoes deletion, lengthening of the final vowel is also observed. At 2;03.15-19, i.e. the period which corresponds to the mastery of codas in Clara's outputs, [ʁ] emerges in word-final position.

Théo's [ʁ], by contrast, surfaces as target-like in early words both in singleton onsets and in word-final position, as soon as word-final consonants emerge in outputs. In branching onsets, however, Théo's [ʁ] triggers assimilation of the preceding Coronal consonant.

As we can see from this recapitulation, it is striking that [ʁ] behaves asymmetrically between the two children, both in terms of when it emerges relative to other consonants and the processes that it triggers or undergoes. In order to account for these observations, I propose, in the next section, contrasting representations for [ʁ] for the two children, which will enable us to provide a coherent analysis of the facts summarized in (11).

5.2 Analysis

5.2.1 Representations

I argue that one crucial factor in the patterning of [ʁ] lies in the representation of this consonant in the two children's inputs. Following the model of segmental organization given earlier in section 2.1, I propose that Clara's [ʁ], on the one hand, lacks any place specification in its representation, as illustrated in (12a).[4, 5] On the other hand, I propose that Théo assigns a Dorsal specification to his input [ʁ], as in (12b).

(12) Representation of [ʁ]: Clara versus Théo

a) Clara's [ʁ]

Root

b) Théo's [ʁ]

Root
|
Place
|
Dorsal

The motivation for the representation in (12a) comes primarily from the observation made above that Clara's [ʁ] always acquires the place specification of a neighbouring consonant, as well as from the developmental patterns of Clara's [ʁ] in both branching onsets and word-final position. In the analysis below, we will see that assuming that Clara's [ʁ] is placeless enables us to account for all of the patterns observed. By contrast, Théo's [ʁ] must be specified for Dorsal, since this consonant constitutes the source (trigger) of the Dorsal assimilation over Coronal observed in (8a).

As mentioned in section 2.4.3, Goad and Rose (to appear) report that /r/ is considered to be placeless in a number of languages, e.g. Japanese (Mester and Itô 1989), English (Rice 1992), Québec French (Béland, Paradis, and Bois 1993), and German (Wiese 1996). Goad and Rose also provide evidence in favour of this position from the acquisition of German. I thus propose that Clara's grammar reflects the unmarked representation for [ʁ], in contrast to Théo, who adopts a marked representation.

The variability observed between the two children is not unexpected, however, given the phonetic realization of /r/ in the target language, namely, that it is uvular. I claim that this is misleading Théo into thinking that this consonant must be specified for Dorsal.

4. It is difficult to take a position on whether or not Clara's [ʁ] has a Place node in its representation, since Place, as an organizing node, has no phonetic correlate. What is crucial to the point developed here, however, is that Clara's [ʁ] is devoid of any articulator.

5. It follows from this proposal that I reject the notion of 'Richness of the Base' as initially proposed by Prince and Smolensky (1993), which states that since constraints assess the well-formedness of outputs, inputs are free to contain any type of information (modulo the maintenance of contrasts). See further Kawasaki (1998), who also challenges Richness of the Base in her discussion of the Rendaku facts.

Clara, on the other hand, is not so misled and instead abides by the unmarked option provided by UG for rhotics.

Finally, notice that Clara's other liquid ([l]) must be specified for the feature Coronal, as evidenced by the data in chapter 4, example (4c), where we can see that dorsal consonants undergo Coronal assimilation in contexts where they are followed by [l] (e.g. *couleur* [k̠ulœʁ] → [t̠ʊ̰ˈl̰œ̰ᵘ] 'colour'; *grelot* [g̠ʁəlo] → [t̠ɔˈlo] 'little bell'). Thus, placelessness cannot be assigned to the entire class of liquids in Clara's phonology; it must rather be attributed to a single segment, [ʁ], whose behaviour in analysed in the next section.[6]

5.2.2 Clara's patterns

5.2.2.1 [ʁ] substitution in singleton onsets

Regarding Clara's substitutions for [ʁ], three observations are central to the analysis. First, as mentioned above, the substitutions are attested across the board in singleton onsets, without any effect of directionality. Second, these substitutions do not apply when [ʁ] is in the dependent position of a branching onset. Third, these substitutions do not affect word-final [ʁ].

In order to account for this asymmetry between head and dependent positions within syllable constituents, I appeal to a specific version of the constraint PLACE used in chapter 4. This constraint, already defined in section 2.3.2, and repeated in (13), requires consonants which occupy head positions to bear place specifications.

(13) HEADPLACE
Head consonants must bear place features

6. As no consonant harmony is found in Théo's outputs, there are no processes which reveal anything about the place structure of his [l]. In the absence of evidence to the contrary, I assume that Théo's [l] is specified for Coronal.

In order to illustrate the proposal, I will take the period during which the patterns summarized in (11a) and (11b) are simultaneously attested, between ages 1;09.29 and 2;00.02. As a starting point, I will use the ranking in (14), which was proposed in section 3.4.4 in order to account for the emergence of Clara's first branching onsets, keeping only the constraints relevant to the present discussion.

(14) Clara's constraint ranking at 1;09.29 (abbreviated from chapter 3, example (39))
MAXHEAD(Foot) » MAXHEAD(Onset) » *COMPLEX(Onset)

In order to account for the patterns in (11a) and (11b), I will supplement the abbreviated ranking in (14) with two highly-ranked constraints, namely, HEADPLACE and DEP(Place), the latter of which was introduced in section 2.3.1. I will also add to this ranking the lowly-ranked constraint FAITH([ʁ]), which represents a collection of constraints responsible for [ʁ] faithfulness. This constraint, which will be violated in any instance of [ʁ] substitution, is invoked in order to encode the fact that [ʁ] surfaces in target-like fashion in the dependent position of an onset when branching onsets emerge in the child's outputs. The proposed ranking is given in (15).

(15) Clara's constraint ranking
MAXHEAD(Foot), HEADPLACE, DEP(Place) » MAXHEAD(Onset) » FAITH([ʁ]) »
*COMPLEX(Onset)

In order to illustrate the effects of this ranking, I will begin with the [ʁ] substitution pattern in singleton onsets, exemplified with the word *robe* [ʁɔb], which surfaces as [wɔb] '(a) dress' at 1;10.10. Consider the tableau in (16).[7]

7. For the sake of clarity, the segmental substitutions affecting segments other than Clara's [ʁ] will be ignored in the evaluation tableaux.

(16) Clara's [ʁ] substitution pattern in singleton onsets

Input: O N O N ʁ ɔ b Ø Lab	MAXHD (Foot)	HEAD PLACE	DEP (Place)	MAXHD (Onset)	FAITH ([ʁ])	*CPLX (Onset)
i) [ʁɔb]: O N O N [ʁ ɔ b Ø] Lab		*!				
ii) [rɔb]: O N O N [r ɔ b Ø] Cor Lab			*!		*	
iii) [ʁɔb]: O N O N [ʁ ɔ b Ø] Dor Lab			*!		*	
iv) [ɔb]: N O N [ɔ b Ø] Lab	*!			*		
☞ v) [wɔb]: O N O N [w ɔ b Ø] Lab_i Lab_i					*	

As we can see in (16i), the target-like candidate fatally violates HEADPLACE, which requires that consonants in head position bear place specifications. [ʁ], as inherently placeless, cannot satisfy this constraint. Insertion of a feature which is not found in the input satisfies this constraint but fatally violates DEP(Place), as shown in candidates (16ii) and (16iii). Deletion of the placeless input [ʁ] does not constitute a viable option either; while this strategy would (vacuously) satisfy HEADPLACE, it also leads to a fatal violation of MAXHEAD(Foot), as we can see in the candidate in (16iv). Therefore, copying of the input feature Labial onto [ʁ] constitutes the only available option, as we can see with the winning candidate in (16v), which minimally violates FAITH([ʁ]).

As mentioned above, during the same period as [ʁ] in head position undergoes substitution, branching onsets are allowed in stressed syllables in Clara's outputs (see section 3.4.2). In contexts where [ʁ] appears in the dependent position of a branching onset, it surfaces as target-like. In the tableau in (17), I demonstrate how the proposed ranking is compatible with this observation, using the word *biberon* [bibʁɔ̃], which surfaces as [paˈpχɔ] 'baby bottle' at age 1;09.29.

(17) Clara's [ʁ] target-like realization in branching onsets

Input: O N O N b i ˈb ʁ ɔ̃ Lab Lab	MAXHD (Foot)	HEAD PLACE	DEP (Pl)	MAXHD (Onset)	FAITH ([ʁ])	*CPLX (Onset)
i) [biˈbɔ̃]: O N O N [b i ˈb ɔ̃] Lab Lab	*!					
ii) [biˈbwɔ̃]: O N O N [b i ˈb w ɔ̃] Lab Lab					*!	*
☞ iii) [biˈbʁɔ̃]: O N O N [b i ˈb ʁ ɔ̃] Lab Lab						*

As we can see in (17i), consistent with the analysis proposed in section 3.4.4 for the emergence of branching onsets in stressed syllables, deletion of the dependent [ʁ] incurs a fatal violation of highly-ranked MAXHEAD(Foot). The dependent position must therefore be realized in branching onsets dominated by the foot head. The shape that this position takes is governed by FAITH([ʁ]), which militates against assimilation of this consonant, as we can see (17ii). Assimilation would only be motivated by HEADPLACE but since [ʁ] appears in a dependent position in the input, HEADPLACE has no effect on its realization on the surface. Candidate (17iii), which shows target-like realization of placeless [ʁ] can thus surface as optimal, as it only violates lowly-ranked *COMPLEX(Onset).

I will now turn to the other pattern described above, namely, [ʁ]-deletion in word-final position.

5.2.2.2 Word-final [ʁ] deletion and vowel lengthening

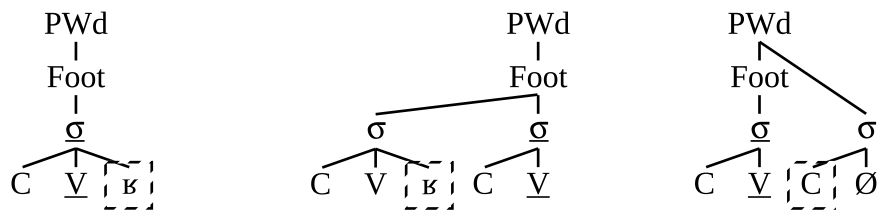
As we saw above in section 5.1.2, at the point when word-final consonants emerge in Clara's outputs, word-final [ʁ] still shows deletion, a process which is accompanied by compensatory lengthening of the vowel. Indeed, this consonant is mastered word-finally only when codas emerge in Clara's outputs. From this observation, I propose that the acquisition of Clara's word-final [ʁ] is intimately linked to the mastery of branching rhymes.

In order to account for why Clara syllabifies word-final [ʁ] in coda position instead of as the onset of an empty-headed syllable, i.e. the syllabification option used for all of the other word-final consonants, I appeal to the markedness statements given in section 2.2.7: while, in the unmarked case, word-final consonants which are specified for place features are syllabified as onsets of empty-headed syllables, word-final placeless consonants are syllabified in coda position. These statements are consistent with the cross-linguistic evidence from adult languages introduced in section 2.2.7: in languages like Diola Fogny (and target French), in which word-final consonants are not restricted to inherently placeless consonants, the consonants are syllabified as onsets; by contrast, in languages like Selayarese, in which word-final consonants are restricted to inherently placeless consonants, these consonants are syllabified in coda position. Thus, according to these two observations, and consistent with the general observation that early grammars reflect structural unmarkedness (see section 2.4.2), both Clara and Théo opt for the unmarked state of affairs for the syllabification of their word-final consonants: in Clara's outputs, all word-final consonants but placeless [ʁ] are syllabified as onsets of empty-headed syllables. Similarly, all of Théo's word-final consonants, including Dorsal [ʁ], are syllabified as onsets of empty-headed syllables.

As a consequence of Clara's syllabification of [ʁ] as a coda, input word-final [ʁ] falls within the foot head, as can be seen in (18a). This contrasts with both the word-internal coda context, as well as with her other word-final consonants, which are onsets of empty-headed syllables. As illustrated in (18b), word-internal codas appear in the dependent position of the foot. In (18c), we can see that word-final onsets are prosodified outside the foot, as was first discussed in section 2.2.7.2.

(18) Full prosodic structure of word-final coda and onset in French

a) Word-final coda [ʁ] b) Word-internal coda [ʁ] c) Onset of an empty-headed syllable



The different prosodic positions for the boxed consonants in (18) enable us to explain the fact that, at the stage where word-final coda [ʁ] is deleted from Clara's outputs, the vowel preceding [ʁ] in the input undergoes lengthening, a pattern which, as noted above, is found neither for the deletion of codas of unstressed syllables nor for the deletion of word-final onsets.

In order to account for these observations, I will appeal to the same constraint ranking as was used above for explaining the other patterns observed in the development of Clara's [ʁ]. For the sake of clarity, and in the interest of space, I will remove from this ranking the constraints which are irrelevant to the issue presently discussed, namely, Dep(Place), as well as the three lowest-ranked constraints (MaxHead(Onset), Faith([ʁ]), and *Complex(Onset)). Also, in order to account for the patterns related to input codas, I will add the constraint *Complex(Rhyme)[8] whose high ranking will prevent the

8. Recall from chapter 2, footnote #39 that I assume that long vowels do not violate *Complex(Rhyme) but only *Complex(Nucleus).

realization of codas in early outputs, as well as two lowly-ranked constraints, *COMPLEX(Nucleus) and MAX(Seg), as exhibited in (19).

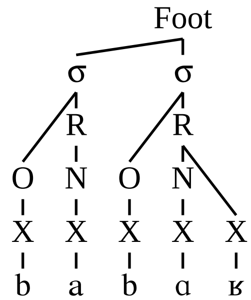
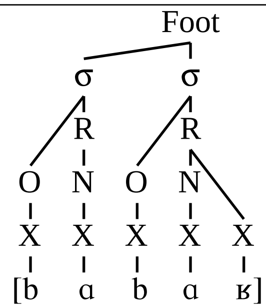
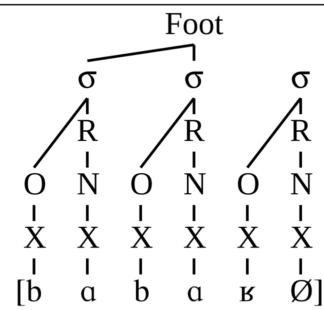
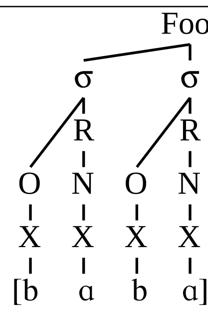
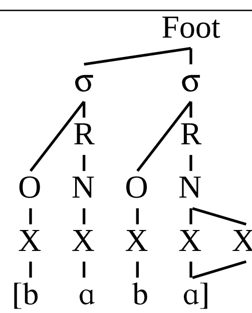
(19) Clara's ranking at the stage where word-final [ʁ] is deleted[9]
*COMPLEX(Rh), MAXHEAD(Ft), HEADPLACE » *COMPLEX(Nuc) » MAX(Seg)

Turning now to the effects of the ranking proposed for Clara's output forms, I will compare two cases of coda [ʁ] deletion, one in stressed syllables, where [ʁ] is prosodified in the head of the foot in the input, and one in unstressed syllables, where [ʁ] appears in the dependent position of the foot.

The first context is illustrated in (20), with the input word *Babar* [babɑʁ] 'Babar', which surfaces as [bɑbɑː].

9. Notice that in cases of input [ʁ] deletion, at least some of the constraints from the collection represented by the general FAITH([ʁ]), will be violated. For this reason, FAITH([ʁ]) must be ranked below *COMPLEX(Nucleus) in the ranking in (19). Consequently, since FAITH([ʁ]) outranks *COMPLEX(Onset) in the ranking provided in (15), *COMPLEX(Onset) must be ranked below *COMPLEX(Nucleus). The complete ranking is thus as follows: *COMPLEX(Rhyme), MAXHEAD(Foot), HEADPLACE, DEP(Place) » *COMPLEX(Nucleus), MAXHEAD(Onset) » FAITH([ʁ]) » *COMPLEX(Onset) » MAX(Seg).

(20) Clara's word-final [ʁ] deletion and vowel lengthening

Input: 	*CPLX (Rh)	MAXHD (Foot)	HEAD PLACE	*CPLX (Nuc)	MAX (Seg)
i) [bɑbɑʁ]: 	*!				
ii) [bɑbɑʁ]: 		*!	*!		
iii) [bɑbɑ]: 		*!			*
☞ iv) [bɑbɑː]: 				*	

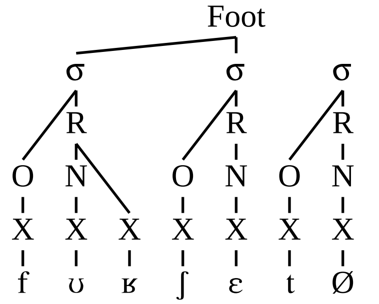
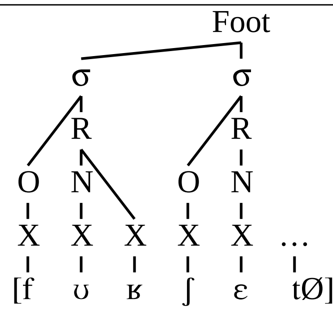
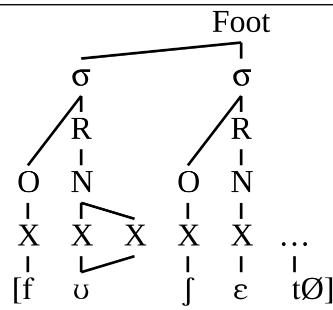
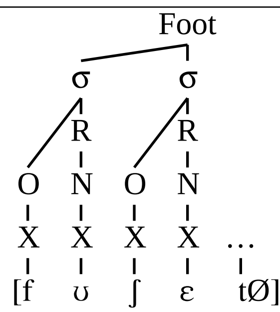
As we can see, the target-like candidate in (20i) fatally violates *Complex(Rh), consistent with the analysis already given in section 3.3.3. The second candidate, in (20ii), is identical to target-like (20i) on the surface but syllabifies word-final [ʁ] as the onset of an empty-headed syllable. Recall from section 3.2.2 that this option is available to the child at this stage, since onsets of empty-headed syllables are allowed from age 1;07.06. However, in the case of [ʁ], this option involves a fatal violation of highly-ranked MaxHead(Ft), because of the fact that [ʁ], which is prosodified in the foot head in the input, falls outside of this constituent in (20ii). This candidate also fatally violates HeadPlace, as it contains placeless [ʁ] in an onset head. The candidate in (20iii) fatally violates MaxHead(Ft) as well, through complete deletion of input [ʁ]. The candidate in (20iv) therefore surfaces as optimal. This candidate, which shows preservation of one part of input [ʁ], i.e. its timing position, satisfies MaxHead(Foot) at the expense of lower-ranked *Complex(Nuc). This timing position must be licensed in a complex nucleus, however, as a candidate showing branching at the level of the rhyme, i.e. a configuration parallel to that in (20i), would fatally violate *Complex(Rh).

Recall from the data in chapter 3, example (27aii), that Clara's [ʁ] in stressed syllables followed by the onset of an empty-headed syllable shows the same lengthening as is observed above (e.g. *parle* [paʁ̲l] → [pæːl] 'speak (3 sg.)'). The current analysis directly accounts for this context because the word-internal coda [ʁ] appears in the foot head in the input. Recall as well that, in contrast to Clara, Théo's [ʁ] deletion in the same context does not yield compensatory lengthening (e.g. *porte* [pɔʁ̲t] → [pɔt] 'door'), as we saw in chapter 3, examples (27bii)). In order to account for this contrast, it is necessary to posit that, in Théo's grammar, *Complex(Nuc) outranks MaxHead(Foot) at this stage.

Turning now to branching rhyme reduction in word-internal position, I will exemplify this context with the word *fourchette* [fʊʁʃɛt] 'fork', which surfaces as [ɸeˈdɛt^{h}]

at age 1;09.01, i.e. with word-internal coda deletion and no vowel lengthening.[10] As we can see in (21), the ranking proposed in (19) accounts for both observations.

(21) Clara's word-internal [ʁ] deletion

Input: 	*CPLX (Rh)	MAXHD (Foot)	HEADPLACE	*CPLX (Nuc)	MAX (Seg)
i) [fʊʁʃɛt]: 	*!				
ii) [fuːʃɛt]: 				*!	
☞ iii) [fʊʃɛt]: 					*

As we can see from the candidate in (21i), input-like syllabification fatally violates highly-ranked *COMPLEX(Rh), as was observed in (20i). The candidate in (21ii), showing partial

10. The analysis of coda deletion has already been discussed in section 3.3.3.

faithfulness to input coda [ʁ] through preservation of its timing unit, fatally violates *COMPLEX(Nuc), which is crucially ranked above MAX(Seg). This last constraint is minimally violated by the optimal candidate in (21iii), despite the fact that this candidate shows deletion of the entire input consonant. Such deletion is possible in this context because coda [ʁ] appears in the dependent position of the foot in the input and, thus, regardless of how this consonant behaves, the output will vacuously satisfy MAXHEAD(Ft).

I now turn to the assimilation pattern found in Théo's Coronal-[ʁ] branching onsets. As we will see in the next section, this process is analysed through a licensing relationship which takes place between the head and dependent segments within the onset constituent.

5.2.3 Théo's Coronal-[ʁ] assimilation in branching onsets

As we saw in (8a), in Théo's branching onsets, target Coronal-[ʁ] clusters surface as Dorsal-[ʁ]. In this section, I will analyse this pattern of assimilation using the representation of Théo's [ʁ], which is specified for Dorsal, as proposed in (12b), and a LICENSE constraint following the same 'template' as those which I appealed to in chapter 4 in order to account for consonant harmony.

Because Théo does not display consonant harmony, no constraint ranking was proposed in the preceding chapter for this child. I will thus briefly elaborate the ranking required for Théo's Dorsal assimilation pattern. Firstly, I will appeal to two constraints discussed in section 4.2.2.1, namely, LINEARITY and PLACE. These constraints, which we saw were undominated in Amahl's and Trevor's grammars, are also undominated in Théo's grammar. This assumption is supported by the following observations: Théo, in contrast to Clara, does not display patterns of metathesis (violates LINEARITY); and, like Clara and the English children, Théo does not display debuccalization (violates PLACE).

I will also appeal to the licensing constraint defined in (22), which requires that Dorsal be licensed by the onset head. (See section 2.3.2 for the general definition of LICENSE.)

(22) LIC(Dor, Ons)
The feature Dorsal must be licensed by the head of the onset

This constraint is motivated by the fact that Dorsal is a marked feature, and it is not usually possible to license such features in dependent positions. For example, as we saw in Lardil in section 2.2.1.1, the feature Dorsal can appear in coda only when it is licensed by a following onset. The assimilation pattern in Théo's Coronal-[ʁ] clusters is similar to the Lardil phonotactic constraint.

As already discussed in section 2.3.2, satisfaction of (22) requires that the feature targeted by the LICENSE constraint be realized in the head of the specified prosodic category. Thus, in the present case, Dorsal must appear in the onset head.

LIC(Dor, Ons) will interact with the three place faithfulness constraints already defined in section 4.2.2, namely MAX(Lab), MAX(Cor), and MAX(Dor). Since Labial consonants resist Dorsal assimilation, as we saw in (8b) (/bʁ/ → [bʁ]; *[gʁ]), MAX(Lab) must be ranked higher than LIC(Dor, Ons). The data in (8b) also permit us to determine the relative ranking of MAX(Dor): in Labial-[ʁ] branching onsets, both of the input place features are preserved in output forms, at the expense of LIC(Dor, Ons). Thus, MAX(Dor) must be ranked higher that LIC(Dor, Ons). Conversely, since Coronal undergoes Dorsal assimilation, MAX(Cor) must be ranked below LIC(Dor, Ons), following the ranking in (23).

(23) Théo's constraint ranking
LINEARITY, PLACE » MAX(Lab), MAX(Dor) » LIC(Dor, Ons) » MAX(Cor)

Notice as well that, apart from enabling us to account for the patterning observed in Théo's branching onsets, the ranking in (23) finds support on markedness grounds. Indeed, as mentioned in chapter 4, coronals are most often subject to assimilation in adult languages (see, e.g. contributions to Paradis and Prunet 1991). The low ranking of MAX(Cor) reflects this tendency.

In order to demonstrate how the ranking in (23) predicts the right output forms in Théo's branching onsets, I will compare Coronal-[ʁ] branching onsets, which display the assimilation seen in (8a), with Labial-[ʁ] branching onsets, where no assimilation is found, as was observed in (8b).

Starting with the Coronal-[ʁ] branching onsets, I exemplify this context with the word *trop* [tχo] 'too much', which is realized as [kχo] by Théo.

(24) Coronal-[ʁ] branching onsets: Dorsal assimilation

Input: O t χ o Cor Dor	LINEARITY	PLACE	MAX (Lab)	MAX (Dor)	LIC (Dor, Ons)	MAX (Cor)
i) [tχo]: O [t χ o] Cor Dor					*!	
ii) [kro]: O [k r o] Dor Cor	*!					
iii) [tχo]: O [t χ o] Cor		*!		*		
iv) [tro]: O [t r o] Cor				*!		
☞ v) [kχo]: O [k χ o] Dor						*

Candidate (24i) incurs a fatal violation of the constraint LIC(Dor, Ons), as the Dorsal specification found in this candidate is not realized on the onset head. The remaining contenders all satisfy this constraint. Two undominated constraints prevent candidates (24ii) and (24iii) from being optimal. Firstly, (24ii), which displays place metathesis in order for Dorsal to be licensed by the onset head, fatally violates LINEARITY. Secondly, the candidate in (24iii), which satisfies LIC(Dor, Ons) through deletion of input Dorsal, violates PLACE, which requires output consonants to bear place features.[11] Satisfaction of LIC(Dor, Ons) is observed in the last two candidates, through feature sharing. Because the candidate in (24iv) shows Dorsal deletion, however, it fatally violates higher-ranked MAX(Dor), leaving (24v), which minimally violates MAX(Cor), as optimal.

Turning now to Labial-[ʁ] clusters, we can observe in (25) the effect of the ranking in (23) on a word such as *pris* [pχi] 'occupied', which surfaces in target-like fashion in Théo's outputs.

11. Notice that the same prediction can be arrived at independently of PLACE because candidate (24iii) also violates MAX(Dor), which is satisfied by the optimal form.

(25) Labial-[ʁ] branching onsets: no assimilation

	Input: O p χ i Lab Dor	Linearity	Place	Max (Lab)	Max (Dor)	Lic (Dor, Ons)	Max (Cor)
	i) [kwi]: O [k w i] Dor Lab	*!					
	ii) [pχi]: O [p χ i] Lab		*!		*		
☞	iii) [pχi]: O [p χ i] Lab Dor					*	
	iv) [kχi]: O [k χ i] Dor			*!			
	v) [pwi]: O [p w i] Lab				*!		

As we saw in the preceding tableau, the fact that both Linearity and Place are ranked above Lic(Dor, Ons) prevents place metathesis and debuccalization as a way of satisfying Lic(Dor, Ons). As a result, the candidates in (25i) and (25ii) cannot surface as optimal. The real contenders are thus the last three candidates. As we can see, a violation of Lic(Dor, Ons) is preferred over violations of the higher-ranked constraints Max(Lab) and Max(Dor), which are found in (25iv) and (25v), respectively. Candidate (25iii) therefore surfaces as optimal.[12]

12. In order to avoid doubly-articulated consonants that would result from spreading Dorsal onto the input Labial consonant (yielding [k͡pχ / g͡bʁ]) and thereby satisfying both Lic(Dor, Ons) and Max(Lab), a more complete analysis would include a constraint like *Complex(Place) as undominated, following the proposals of, e.g. Goad (1997a), Kawasaki (1998).

In short, we have seen that by comparing the tableaux in (24) and (25), the constraint ranking proposed above in (23) correctly accounts for the patternings observed in Théo's branching onsets.

Recall from (9) above that Théo's Dorsal assimilation does not apply outside the onset constituent (e.g. *tortue* [tɔʁt̮sy] → [tɔʁ'ts̮y] 'turtle'; *[kɔʁ'ts̮y], *[tɔʁ'ky]). This pattern of non-assimilation is predicted by the current analysis, in conjunction with the Locality condition first introduced in section 2.2.1.4. If Dorsal assimilation applied outside the onset constituent, such a process would violate the Locality condition, as the relation entailed by LIC(Dor, Ons) can only apply within the constituent specified as the argument of LICENSE. Théo's Dorsal assimilation is thus similar to the consonant harmony patterns observed in chapter 4 in the sense that it is a consequence of a relatively high ranking LICENSE constraint targeting a specific prosodic constituent. While Théo's Dorsal assimilation is locally circumscribed within the onset, consonant harmony applies within the foot, a constituent which is higher in the prosodic hierarchy and which, therefore, may endorse relationships between segments at a greater distance.

5.3 Concluding remarks

In this chapter, I discussed the patterns of development for [ʁ] in French. From the contrasting behaviours observed, I proposed different representations for [ʁ] in Clara's and Théo's inputs. While placeless in Clara's inputs, [ʁ] is specified for Dorsal in Théo's inputs. This variability, which is attributed to the misleading uvularity of target [ʁ], is at the core of the analysis proposed for the different patterns observed in the two children's outputs.

Clara's [ʁ] displays asymmetries in two positions. In branching onsets, this consonant undergoes substitution in head position but is realized in target-like fashion in dependent position. Using the constraint HEADPLACE, I proposed that while placelessness is tolerated in dependent position, it is not permitted in head position. In word-final position, [ʁ] is mastered during the same period as word-internal codas, contrary to other word-final consonants, which emerge during an earlier stage, as onsets of empty-headed syllables. Also, at the stage where codas are not allowed by Clara's grammar, word-final [ʁ] deletion is accompanied by compensatory lengthening of the vowel, in contrast to word-internal coda deletion, where no vowel lengthening is observed. In order to account for these patterns, I proposed that [ʁ] is syllabified as a coda by Clara (in contrast to her other word-final consonants) and that the vowel lengthening observed results from high ranking of the constraint MAXHEAD(Foot), which has scope over codas in stressed syllables, in contrast to onsets of empty-headed syllables.

Regarding the dorsal realization of coronal consonants in Théo's branching onsets, I proposed that this assimilation is similar to the consonant harmony alternations analysed in chapter 4 in the sense that it results from prosodic licensing requirements. The only difference between the two processes lies in the category which acts as the licensor of the harmonic feature, which is the onset head in the former, and the foot head in the latter.

As was the case for the account of the development of syllable structure in chapter 3 and of consonant harmony in chapter 4, the approach adopted in this chapter crucially relies on highly-articulated representations as well as on constraints which make specific reference to these representations, especially to constituent heads. From this approach, a straightforward account of the asymmetries observed across each of the children could be obtained.

Chapter 6

CONCLUSION

6.0 Introduction

In this brief concluding chapter, I offer a summary of the thesis, as well as additional discussion on some of the issues investigated in this thesis. The main observations and arguments at the core of chapters 3 to 5 are summarized in section 6.1. In section 6.2, I emphasize a few aspects of the analyses proposed, as well as draw attention to issues which deserve further investigation. Concluding remarks follow in section 6.3.

6.1 Summary of the thesis

Throughout the thesis, I have discussed a number of developmental patterns observed in the outputs of French- and English-learning children. I demonstrated that an analysis based on highly-articulated phonological representations, with constraints referring specifically to headedness in constituent structure and to licensing relationships, enables us to account for the developmental patterns observed.

In chapter 3, I undertook a comparative study of the acquisition of French syllable structure. Starting from an initial ranking where markedness constraints outrank faithfulness constraints, the different types of complexity in target French were acquired through successive demotions of markedness constraints below faithfulness. At stages where a given complex structure (syllabic or segmental) is reduced, highly-ranked head faithfulness constraints ensure that the input structural head survives in the output. This generalization holds for the acquisition of complex syllable constituents (branching onsets, as required by MAXHEAD(Onset)), as well as for the acquisition of complex segments (rising diphthongs, as commanded by MAXHEAD(Seg)). We also observed that during the first stage of the emergence of branching onsets, faithfulness to input branching onsets applies only in stressed syllables. This positional faithfulness pattern was attributed to high ranking of another head faithfulness constraint, MAXHEAD(Foot).

In sum, we saw that constituent structure and headedness play a central role in the developmental patterns discussed throughout chapter 3. These patterns also provided support for the position adopted in this thesis that children's inputs are fully prosodified with headedness properly assigned. Finally, we saw that both Clara and Théo, who follow similar acquisition paths, reflect possible (adult) grammars at each stage in the course of their development of syllable structure. This observation supports the continuity assumption (Pinker 1984) according to which child and adult grammars are not formally different.

In chapter 4, the patterns of consonant harmony found in Clara's outputs were compared with those from English-learning Amahl and Trevor. I proposed that consonant harmony results from licensing constraints demanding that a given feature be licensed by the head of the foot (LICENSE(F, Foot)). This prosodic approach to consonant harmony enabled us to explain a crucial distinction between Clara and the two English children: while consonant harmony is found in both CVCV and CVC words in the latter, it fails to apply in Clara's CVC words. In order to account for this contrast, I appealed to a difference in foot headedness in French versus English, which has consequences for the prosodification of word-final onsets of empty-headed syllables. While these consonants are prosodified within the left-headed English foot, they are excluded from the right-headed French foot. Based on this structural contrast between the two languages, I proposed that only consonants which are licensed within the foot can participate in consonant harmony, a process which is bound within this prosodic domain. Finally, I discussed alternative approaches to consonant harmony and argued that only the current one permits us to explain the differences found between the French and English data.

In chapter 5, I discussed issues related to feature specification in the development of Clara's and Théo's [ʁ]. From the patterns observed in the two children's outputs, I argued that, because its phonetic place of articulation does not match its target representation as placeless, the two children have posited different segmental representations for [ʁ]. The Dorsal specification posited for Théo's [ʁ] enabled us to explain the assimilation pattern observed in his input Coronal-[ʁ] onset clusters, which surface as Dorsal-[ʁ]. In contrast to Théo, Clara represents [ʁ] as adult-like, i.e. without place specifications. While Clara's [ʁ] undergoes place assimilation when in onset head position, this consonant surfaces as target-like in dependent position. I attributed this asymmetry to another constraint referring to structural heads, HEADPLACE, which again reflects the importance of being faithful to structural heads over dependent positions.

Placelessness in Clara's [ʁ] had interesting consequences for the syllabification of word-final consonants. As we saw, Clara's [ʁ] — the sole placeless consonant observed in the French data covered in this thesis — is the only consonant which, when word-final, is syllabified in coda. By contrast, all of the other target word-final consonants found in Clara's and Théo's outputs, which do bear place specifications, are syllabified as onsets of empty-headed syllables. In order to account for this asymmetry, I proposed, based on typological evidence from adult languages, that the default syllabification of word-final consonants is determined by the presence or absence of place specifications in the representation of these consonants. A consequence of this proposal is that the child must be sensitive to the melodic content of input segments in order to determine how these segments are syllabified word-finally. This important issue will be returned to in section 6.2.1. The data from Clara's and Théo's [ʁ] thus provided additional strength for the recurring theme of this thesis, that an appeal to highly-articulated representations, at both the prosodic and segmental levels, is central to an explanation of the patterns observed in child language development.

I will now turn to some topics for further research suggested by the findings summarized above.

6.2 Discussion

In this last section, I will briefly elaborate on two of the proposals offered in the preceding chapters, as well as on some of their consequences when put in the broader context. More specifically, I discuss issues related to inherent placeless consonants and their effects on input syllabification, in section 6.2.1; and in section 6.2.2, I return to iambic footing in Québec French.

6.2.1 Inherently placeless consonants and input syllabification

As we saw in chapters 3, 4, and 5, much emphasis has been put on structural explanations for the patterns observed in acquisition. More specifically, I appealed to (a) structurally-defined markedness, (b) headedness in constituent structure, and (c) licensing relationships between segmental features and prosodic constituents.

Regarding markedness, for each structure involved in the analysis, in cases where more than one option is possible across languages, I argued that the unmarked option is the one first entertained by the child. As implied by the account of Clara's word-final [ʁ] summarized in the preceding section, the distinction between place-specified and placeless consonants is central for determining default syllabification in contexts where more than one option is available. In addition, placelessness appears to hinder mastery in head positions. One consequence of this analysis is that, as was first mentioned in section 2.2.7, the child must attend to the melodic content of the consonants before selecting among syllabification options.

Other data sets may prove useful for the investigation of this issue. For example, observation of the development of Amahl's target [h] reveals that this consonant emerges relatively late, at age 2;08.04, i.e. more that six months after Smith's (1973) first available data (2;02.01). Before it emerges, this consonant is deleted from the output. By contrast, in initial position, all of Amahl's target consonants are realized, either as target-like, in reduced form, or in forms resulting from consonant harmony at the beginning of the corpus.[1] There are arguments against a perceptual account of Amahl's [h] deletion pattern. For example, Amahl's [h] emerges with complete mastery within a single month, both word-initially and word-medially. The categorical emergence of [h] constitutes in itself an argument against a perception-based account. Moreover, if [h] deletion were caused by a perceptual problem, this consonant should emerge in these two contexts at different stages since, by virtue of it being voiced intervocalically in, e.g. *behind*, it is more perceptible in this position than in word-initial position. Thus, it seems that the fact that this consonant is inherently placeless, like [ʁ], underlies the deletion observed.

Since English does not allow for word-final [h], the data from Clara remain the sole basis for a verification of the hypothesis about the syllabification of inherently placeless consonants in word-final position. The study of longitudinal data, from French or any other language with inherently placeless consonants which appear in word-final position,[2] would help assess the robustness of the predictions made by the current proposal with regard to place specification and syllabification.

6.2.2 Iambic footing in Québec French

I turn finally to one other issue that arises from the analysis of Québec French as iambic. Recall from section 1.1.1.1 that the French data under investigation come from the Québec dialect, in which no schwa insertion is observed after word-final consonants (e.g. *raquette* [ʁaˈkɛt]; *[ʁaˈkɛtə] 'racket'). In the absence of word-final schwa insertion, there is no evidence available to the Québec French learner for trochaic footing; the fact that stress always falls on the last vowel of the word instead suggests iambic footing ([(ʁaˈkɛ)t] rather than *[ʁa(ˈkɛtə)], where edges of feet are demarcated by parentheses). Indeed, Théo

1. There are also some cases of deletion of target [s] and [ʃ].
2. As suggested by Rice (1992) and argued for by Goad and Rose (to appear), [r] is inherently placeless in English. However, because Amahl is acquiring a dialect of British English where word-final [r] deletion is observed, the data from this child cannot be used in this context. The study of other English-learning children's corpora, from North American English, for example, would prove very useful for disentangling the issue at stake here.

and Clara have both opted for iambic foot construction, as evidenced by the absence of syllable-initial truncation patterns in CVCV(C) words (e.g. *capable* [kaˈpab] → [kœˈpa] versus English *apart* → [part]; see section 2.2.2), as well as by the absence of consonant harmony in Clara's CVC outputs, because word-final consonants are licensed outside the foot in French (e.g. *debout* [(d̲əbu)] → [bɑˈbu] 'standing' versus *dame* [(d̲a)m] → [dam], *[bam] 'lady'; see section 4.3.4).

In European dialects of French where a schwa is often inserted after word-final consonants, however, schwa-final words could constitute evidence for trochaic footing. Indeed since stress falls on the penultimate vowel in words like *raquette* [ʁaˈkɛtə] in such dialects, the language may be interpreted as trochaic by the learner. This evidence, however, is contradicted by words ending with a full vowel, where stress is word-final (e.g. *papa* [paˈpa] *[ˈpapa] 'father'). An analysis of the acquisition of such dialects that takes into account the relative robustness of the [ə]-final word shapes would permit a better understanding of how foot structure is understood by the child learning an iambic language. The prediction is that if, in [ə]-final dialects, trochaic footing is the option selected by the child, then we should witness patterns of consonant harmony different from those observed in Clara's outputs. In brief, a learner of a French dialect who believes that his / her language has trochaic footing must behave in the same way as the English children analysed in chapter 4, with word-final consonants participating in consonant harmony. However, only a comparison between dialects showing word-final schwa insertion with those which, like Québec French, do not, would enable us to disentangle this issue. In the greater scheme of things, such a comparison may enable us to speak to the potential trochaic bias which has often been proposed in the literature.

6.3 Conclusion

The present thesis has demonstrated consequences of segmental and prosodic representations in the development of target Québec French. As we can conclude from the last two sections, some of the hypotheses formulated in this thesis must now be tested against data from other children. In addition to assessing the validity of the current proposals in the broader context, a comparison of the acquisition data from French and English with more target languages will contribute to a better understanding of the factors governing the shapes of early grammars, in particular concerning the inter-dependencies between constituent and segment structure, as well as the role that markedness plays in these dependencies.

REFERENCES

Alderete, John (1995). Faithfulness to prosodic heads. Paper delivered at the Derivational Residue in Phonology Conference. Tilburg University.

Allen, George D. and Sarah Hawkins (1978). The development of phonological rhythm. In Alan Bell and Joan Bybee Hooper (eds.) *Syllables and Segments*. Amsterdam: North Holland. 173-185.

Allen, George D. and Sarah Hawkins (1980). Phonological rhythm: definition and development. *Child Phonology* 1: 227-256.

Anderson, John and Colin Ewen (1987). *Principles of Dependency Phonology*. Cambridge, MA: Cambridge University Press.

Avery, J. Peter (1996). *The Representation of Voicing Contrasts*. Ph.D. dissertation. University of Toronto.

Barlow, Jessica (1997). *A Constraint-based Account of Syllable Onsets: Evidence from Developing Systems*. Ph.D. dissertation. Indiana University.

Beckman, Jill N. (1995). Shona height harmony: markedness and positional identity. In Jill N. Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.) *Papers in Optimality Theory*. Amherst: Graduate Linguistic Student Association. 53-75.

Beckman, Jill N. (1997). Positional faithfulness, positional neutralisation and Shona vowel harmony. *Phonology* 14: 1-46.

Béland, Renée, Carole Paradis, and Monique Bois. (1993). Constraints and repairs in aphasic speech: a group study. In Carole Paradis and Darlene LaCharité (eds.) *Canadian Journal of Linguistics* 38(2): Constraint-based theories in multilinear phonology. 279-302.

Bernhardt, Barbara H. and Joseph P. Stemberger (1998). *Handbook of Phonological Development from the Perspective of Constraint-based Nonlinear Phonology*. San Diego: Academic Press.

Blevins, Juliette (1995). The syllable in phonological theory. In John A. Goldsmith (ed.) *The Handbook of Phonological Theory*. Cambridge, MA: Blackwell Publishers. 206-244.

Booij, Geert (1983). Principles and parameters in prosodic phonology. *Linguistics* 21: 249-280.

Booij, Geert (1989). On the representation of diphthongs in Frisian. *Journal of Linguistics* 25: 319-332.

Booij, Geert (1995). *The Phonology of Dutch*. Oxford: Oxford Clarendon Press.

Brown, Cynthia A. (1997). *Acquisition of Segmental Structure: Consequences for Speech Perception and Second Language Acquisition*. Ph.D. dissertation. McGill University.

Brown, Cynthia A. and John Matthews (1993). The acquisition of segmental structure. *McGill Working Papers in Linguistics* 9: 46-76.

Brown, Cynthia A. and John Matthews (1997). The role of feature geometry in the development of phonemic contrasts. In S. J. Hannahs and Martha Young-Sholten (eds.) *Focus on Phonological Acquisition*. Amsterdam: John Benjamins. 67-112.

Carreira, Maria (1992). The representation of rising diphthongs in Spanish. In Christiane Laeufer and Terrell A. Morgan (eds.) *Theoretical Analyses in Romance Linguistics. Selected Papers from the Nineteenth Linguistic Symposium on Romance Languages*. Amsterdam: John Benjamins. 19-35.

Casagrande, Jean (1984). *The Sound System of French*. Washington, DC: Georgetown University Press.

Charette, Monik (1991). *Conditions on Phonological Government*. Cambridge, MA: Cambridge University Press.

Chin, Steven B. and Daniel A. Dinnsen (1992). Consonant clusters in disordered speech: constraints and correspondence patterns. *Journal of Child Language* 19: 259-285.

Chomsky, Noam (1981). *Lectures on Government and Binding*. Dordrecht: Foris.

Chomsky, Noam and Morris Halle (1968). *The Sound Pattern of English*. New York: Harper & Row.

Clements, George N. (1976). Palatalization: linking or assimilation? In Salikoko S. Mufwene, Carol A. Walker, and Sanford B. Steever (eds.) *Papers from the Chicago Linguistic Society*. Chicago: Chicago Linguistic Society. 96-109.

Clements, George N. (1985). The geometry of phonological features. *Phonology* 2: 225-252.

Clements, George N. (1990). The role of the sonority cycle in core syllabification. In John C. Kingston and Mary E. Beckman (eds.) *Papers in Laboratory Phonology 1: Between the Grammar and Physics of Speech*. Cambridge: Cambridge University Press. 283-333.

Clements, George N. and Elizabeth V. Hume (1995). The internal organization of speech sounds. In John A. Goldsmith (ed.) *The Handbook of Phonological Theory*. Cambridge, MA: Blackwell. 245-306.

Clements, George N. and Samuel Jay Keyser (1983). *CV Phonology: a Generative Theory of the Syllable*. Cambridge, MA: MIT Press.

Compton, Arthur J. and Mary Streeter (1977). Child phonology: data collection and preliminary analyses. *Papers and Reports on Child Language Development* 7: 99-109.

Costa, João and M. João Freitas (1998). V and CV as unmarked structures: evidence from the acquisition of Portuguese. Paper delivered at the Syllable: Typology and Theory Conference. Tübingen.

Cruttenden, Alan (1978). Assimilation in child language and elsewhere. *Journal of Child Language* 5: 373-378.

Currie Hall, Daniel (1999). Optimality without comparison. Paper delivered at the 1999 Annual Meeting of the Canadian Linguistic Association. Université de Sherbrooke.

Currie Hall, Daniel (2000). Infinity limited. Paper delivered at the First North American Phonology Conference. Concordia University.

Curtin, Suzanne (1999). Positional prominence and size restrictors in prosodic development. *Proceedings of the 5th Annual Southwest Optimality Theory Conference*. San Diego: University of California. [in press]

Davis, Stuart and Michael Hammond (1995). On the status of onglides in American English. *Phonology* 12: 159-182.

Dell, François (1984). L'accentuation des phrases en français. In François Dell, Daniel Hirst, and Jean-Roger Vergnaud (eds.) *Forme sonore du langage*. Paris: Hermann. 65-122.

Dell, François (1995). Consonant clusters and phonological syllables in French. *Lingua* 95: 5-26.

Demuth, Katherine (1995). Markedness and the development of prosodic structure. In Jill N. Beckman (ed.) *Proceedings of the North East Linguistic Society* 25. Amherst, MA: Graduate Linguistic Student Association. 13-25.

Demuth, Katherine (1996a). The prosodic structure of early words. In James Morgan and Katherine Demuth (eds.) *From Signal to Syntax: Bootstrapping from Speech to Grammar in Early Acquisition*. Hillsdale, NJ: Lawrence Erlbaum Associates. 171-184.

Demuth, Katherine (1996b). Alignment, stress, and parsing in early phonological words. In Barbara H. Bernhardt, John Gilbert, and David Ingram (eds.) *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville, MA: Cascadilla Press. 113-125.

Demuth, Katherine (1997). Variation in acquisition: an optimal approach. In Stuart Davis (ed.) *Optimal Viewpoints*. Bloomington: Indiana University Linguistics Club Publications. 77-88.

Demuth, Katherine and E. Jane Fee (1995). Minimal words in early phonological development. Brown University and Dalhousie University. Ms.

Dinnsen, Daniel A., Jessica Barlow, and Michelle L. Morrisette (1997). Long-distance place assimilation with an interacting error pattern in phonological acquisition. *Clinical Linguistics & Phonetics* 11: 319-338.

Donahue, Mavis (1986). Phonological constraints on the emergence of two-word utterances. *Journal of Child Language* 13: 191-208.

Drachman, Gaberell (1978). Child language and language change: a conjecture and some refutations. In Jacek Fisiak (ed.) *Recent Developments in Historical Phonology*. The Hague: Mouton. 123-144.

Dresher, Elan (1994). Child phonology, learnability, and phonological theory. University of Toronto. Ms.

Dumas, Denis (1981). Structure de la diphtongaison québécoise. *Canadian Journal of Linguistics* 26: 1-61.

Durand, Jacques (1990). *Generative and Non-linear Phonology*. London: Longman.

Dyck, Carrie (1995). *Constraining the Phonology-phonetics Interface*. Ph.D. dissertation. University of Toronto.

Echols, Catharine H. (1993). A perceptually based model of children’s earliest productions. *Cognition* 46: 245-296.

Echols, Catharine H. and Elissa L. Newport (1992). The role of stress and position in determining first words. *Language Acquisition: A Journal of Developmental Linguistics* 2: 189-220.

Elsen, Hilke (1991). *Erstspracherwerb: der Erwerb des deutschen Lautsystems*. Wiesbaden: Deutscher Universitäts-Verlag.

Faber, Alice and Catherine T. Best (1994). The perceptual infrastructure of early phonological development. In Susan D. Lima, Roberta L. Corrigan, and Gregory K. Iverson (eds.) *The Reality of Linguistic Rules*. Amsterdam: John Benjamins. 261-280.

Fee, E. Jane (1995). Segments and syllables in early language acquisition. In John Archibald (ed.) *Phonological Acquisition and Phonological Theory*. Hillsdale, NJ: Lawrence Erlbaum Associates. 43-61.

Ferguson, Charles A. (1986). Discovering sound units and constructing sound systems: it's child's play. In Joseph S. Perkell and Dennis H. Klatt (eds.) *Invarience and Variability in Speech Processes*. Hillsdale, NJ: Lawrence Erlbaum Associates. 36-53.

Ferguson, Charles A. and Carol B. Farwell (1975). Words and sounds in early language acquisition. *Language* 51: 419-439.

Fikkert, Paula (1994). *On the Acquisition of Prosodic Structure*. Dordrecht: ICG Printing.

Fudge, Eric C. (1969). Syllables. *Journal of Linguistics* 5: 253-286.

Gafos, Adamantios I. (1996). *The Articulatory Basis of Locality in Phonology*. Ph.D. dissertation. Johns Hopkins University.

Gerken, LouAnn (1991). The metrical basis of children's subjectless sentences. *Journal of Memory and Language* 30: 431-451.

Gerken, LouAnn (1994). A metrical template account of children's weak syllable omissions from multisyllabic words. *Journal of Child Language* 21: 565-584.

Gierut, Judith A. (1999). Syllable onsets: clusters and adjuncts in acquisition. *Journal of Speech Language and Hearing Research* 42: 708-726.

Gierut, Judith A., Mi-Hui Cho, and Daniel A. Dinnsen (1993). Geometric accounts of consonant-vowel interactions in developing systems. *Clinical Linguistics & Phonetics* 7: 219-236.

Gilbers, Dicky and Dirk-Bart Den Ouden (1994). Compensatory lengthening and cluster reduction in first language acquisition: a comparison of different analyses. In Ale de Boer, Helen de Hoop, and Henriëtte de Swart (eds.) *Language and Cognition* 4. Groningen: University of Groningen. 69-82.

Gnanadesikan, Amalia E. (1995). Markedness and faithfulness constraints in child phonology. Rutgers optimality archive. ROA-67. Ms.

Goad, Heather (1993). *On the Configuration of Height Features*. Ph.D. dissertation. University of Southern California.

Goad, Heather (1996a). Consonant harmony in child language: evidence against coronal underspecification. In Barbara H. Bernhardt, John Gilbert, and David Ingram (eds.) *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press. 187-200.

Goad, Heather (1996b). Coronals in acquisition. Paper delivered at the Workshop on Coronals. University of Toronto.

Goad, Heather (1997a). Consonant harmony in child language: an optimality-theoretic account. In S. J. Hannahs and Martha Young-Sholten (eds.) *Focus on Phonological Acquisition*. Amsterdam: John Benjamins. 113-142.

Goad, Heather (1997b). Codas, word minimality, and empty-headed syllables. In Eve Clark (ed.) *Child Language Research Forum* 28. Stanford: Center for the study of language and information. 113-122.

Goad, Heather (2000). Assimilation phenomena and initial constraint ranking in early grammars. Paper delivered at the 24th Annual Boston University Conference on Language Development. Boston University.

Goad, Heather and Kathleen Brannen (2000). Syllabification at the right edge of words: parallels between child and adult grammars. In Jeroen van de Weijer (ed.) *Issues in the Phonology-phonetics Interface*. Amsterdam: John Benjamins.

Goad, Heather and Yvan Rose (2000). Headedness versus sonority in cluster reduction. *Proceedings of the Chicago Linguistic Society* 36. Chicago: Chicago University Press. [in press]

Goad, Heather and Yvan Rose (to appear). Input elaboration, head faithfulness and evidence for representation in the acquisition of left-edge clusters in West Germanic. In René Kager, Joseph V. Pater, and Wim Zonneveld (eds.) *Fixing Priorities: Constraints in Phonological Acquisition*. Cambridge: Cambridge University Press.

Goldsmith, John (1976). An overview of autosegmental phonology. *Linguistic Analysis* 2: 23-68.

Goldsmith, John (1990). *Autosegmental and Metrical Phonology*. Cambridge, MA: Blackwell.

Greenlee, Mel (1974). Interacting proceses in the child's acquisition of stop-liquid clusters. *Papers and Reports on Child Language Development* 7: 85-100. Stanford University.

Grijzenhout, Janet and Sandra Joppen (to appear). The Lack of Onsets in German Child Phonology. In Ingeborg Lasser (ed.) *The Process of Language Acquisition*. Berlin: Peter Lang Verlag. [in press]

Haiman, John (1980). *Hua: a Papuan language of the Eastern Highlands of New Guinea*. Amsterdam: John Benjamins.

Hale, Mark and Charles Reiss (1998). Formal and empirical arguments concerning phonological acquisition. *Linguistic Inquiry* 29: 656-683.

Halle, Morris (1992). Phonological features. In William Bright (ed.) *International Encyclopedia of Linguistics* 3. Oxford: Oxford University Press. 207-212.

Halle, Morris and Jean-Roger Vergnaud (1978). Metrical structures in phonology. Massachusetts Institute of Technology. Ms.

Harris, John (1990). Segmental complexity and phonological government. *Phonology* 7: 255-300.

Harris, John (1994). *English Sound Structure*. Cambridge, MA: Blackwell.

Harris, John (1997). Licensing inheritance: an integrated theory of neutralisation. *Phonology* 14: 315-370.

Harris, James W. (1983). Syllable structure and stress in Spanish: a non-linear analysis. *Linguistic Inquiry Monographs* 8. Cambridge, MA: MIT Press.

Hayes, Bruce (1985). Iambic and trochaic rhythm in stress rules. In Mary Niepokuj, Mary VanClay, Vassiliki Nikiforidou, and Deborah Feder (eds.) *Proceedings of the 11th Annual Meeting of the Berkeley Linguistics Society*. Berkeley, CA: Berkeley Linguistics Society. 429-446.

Hayes, Bruce (1989). Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20: 253-306.

Hayes, Bruce (1995). *Metrical Stress Theory: Principles and Case Studies*. Chicago: The University of Chicago Press.

Hesse, Ronald G. (1995). Syllable structure in Imyan Tehit. *Language and Linguistics in Melanesia* 26: 101-171.

Hualde, José I. (1989). Autosegmental and metrical spreading in the vowel-harmony systems of Northwestern Spain. *Linguistics* 27: 773-805.

Hyman, Larry (1985). *A Theory of Phonological Weight*. Dordrecht: Foris.

Ingram, David (1974a). Phonological rules in young children. *Journal of Child Language* 1: 49-64.

Ingram, David (1974b). Fronting in child phonology. *Journal of Child Language* 1: 233-241.

Ingram, David (1978). The role of the syllable in phonological development. In Alan Bell and Joan Bybee Hooper (eds.) *Syllables and Segments*. New York: Elsevier-North-Holland. 59-72.

Ingram, David (1981). *Procedures for the Phonological Analysis of Children's Language*. Baltimore, MD: University Park Press.

Ingram, David (1988). Jakobson revisited: some evidence from the acquisition of Polish. *Lingua* 75: 55-82.

Ingram, David (1989). *First Language Acquisition: Method, Description, and Explanation*. Cambridge, MA: Cambridge University Press.

Ingram, David (1992). Early phonological acquisition: a cross-linguistic perspective. In Charles A. Ferguson, Lise Menn, and Carol Stoel-Gammon (eds.) *Phonological Development: Models, Research, Implications*. Timonium, MD: York Press. 423-435.

Itô, Junko (1986). *Syllable Theory in Prosodic Phonology*. Ph.D. dissertation. University of Massachusetts at Amherst. (Published in 1988, New York: Garland.)

Itô, Junko, Yoshihisa Kitagawa, and R. Armin Mester (1996). Prosodic faithfulness and correspondence: evidence from a Japanese argot. University of California at Santa Cruz. Ms.

Jakobson, Roman (1941). *Kindersprache, Aphasie, und Allgemeine Lautgesetze*. Uppsala: Almqvist & Wiksell. [Translated in 1968: *Child Language, Aphasia, and Phonological Universals*. The Hague, Mouton.]

Jakobson, Roman (1962). Typological studies and their contribution to historical comparative linguistics: report in the first plenary session of the eighth international congress of linguists, Oslo 5 August 1957. In Robert H. Whitman (ed.) *Selected Writings 1: Phonological Studies*. The Hague: Mouton.

Jakobson, Roman, Gunnar Fant, and Morris Halle (1952). *Preliminaries to Speech Analysis*. Cambridge, MA: MIT Press.

Jensen, John T. (1977). *Yapese Reference Grammar*. Honolulu: University Press of Hawai.

Jongstra, Wenckje (2000). Variability in the acquisition of word-initial consonant clusters. Paper delivered at the 2000 Annual Meeting of the Canadian Linguistic Association. University of Alberta.

Jusczyk, Peter W., Anne Cutler, and Nancy J. Redanz (1993). Infants' preference for the predominant stress patterns of English words. *Child Development* 64: 675-687.

Kager, René (1989). *A Metrical Theory of Stress and Destressing in English and Dutch*. Dordrecht: Foris.

Kawasaki, Takako (1998). *Coda Constraints: Optimizing Representations*. Ph.D. dissertation. McGill University.

Kaye, Jonathan (1985). On the syllable structure of certain West African languages. In Didier Goyvaerts (ed.) *African Linguistics: Essays in Memory of M. W. K. Semikenke*. Amsterdam: John Benjamins. 285-308.

Kaye, Jonathan (1990). 'Coda' licensing. *Phonology* 7: 301-330.

Kaye, Jonathan (1992). Do you believe in magic? The story of s+C sequences. *SOAS Working Papers in Linguistics* 2: 293-313.

Kaye, Jonathan and Jean Lowenstamm (1981). Syllable structure and markedness theory. In Adriana Belleti, Luciana Brandi, and Luigi Rizzi (eds.) *Theory of Markedness in Generative Grammar*. Pisa: Scuola normale superiore di Pisa. 287-315.

Kaye, Jonathan and Jean Lowenstamm (1984). De la syllabicité. In François Dell, Donald Hirst, and Jean-Roger Vergnaud (eds.) *Forme sonore du langage*. Paris: Hermann. 123-161.

Kaye, Jonathan, Jean Lowenstamm, and Jean-Roger Vergnaud (1985). The internal structure of phonological elements: a theory of charm and government. *Phonology Yearbook* 2. 305-328.

Kaye, Jonathan, Jean Lowenstamm, and Jean-Roger Vergnaud (1988). Rektion und Konstituentrektion in der Phonologie. *Linguistische Berichte* 114: 31-75.

Kaye, Jonathan, Jean Lowenstamm, and Jean-Roger Vergnaud (1990). Constituent structure and government phonology. *Phonology* 7: 193-231.

Kenstowicz, Michael (1994). *Phonology in Generative Grammar*. Cambridge, MA: Blackwell.

Kenstowicz, Michael and Jerzy Rubach (1987). The phonology of syllabic nuclei in Slovak. *Language* 63: 463-497.

Key, Harold (1961). The phonotactics of Cayuvaya. *International Journal of American Linguistics* 27: 143-150.

Kiparsky, Paul (1968). How abstract is phonology? In Osamu Fujimura (1973) (ed.) *Three Dimensions of Linguistic Theory*. Tokyo: TEC Co. 5-56. [Reprinted in Kiparsky, Paul. 1982. *Explanation in Phonology*. Dordrecht: Foris]

Kiparsky, Paul (1982). Lexical phonology and morphology. In I.-S. Yang (ed.) *Linguistics in the Morning Calm* 2. Seoul: Hanshin. 3-91.

Kiparsky, Paul (1994). Remarks on markedness. Paper delivered at the Trilateral Phonology Weekend (TREND) 2. Stanford University.

Ladefoged, Peter (1993). *A Course in Phonetics*, 3rd edition. New York: Harcourt Brace Jovanovich College Publishers.

Ladefoged, Peter and Ian Maddieson (1996). *The Sounds of the World's Languages*. Cambridge, MA: Blackwell.

Lebel, Caroline (1994). *Le rôle des contraintes et stratégies de réparation dans l'adaptation phonologique d'emprunts français en peul*. M.A. thesis. Université Laval.

Leopold, Werner F. (1947). *Speech Development of a Bilingual Child: A Linguist's Record, Vol. II: Sound-learning in the First Two Years*. Evantson, IL: Northwest University Press.

Levelt, Clara C. (1994). *On the Acquisition of Place*. Leiden: Holland Institute of Generative Linguistics.

Levelt, Clara C., Niels O. Schiller, and Willem J. Levelt (2000). The acquisition of syllable types. *Language Acquisition* 8: 237-264.

Levin, Juliette (1985). *A Metrical Theory of Syllabicity*. Ph.D. dissertation. Massachusetts Institute of Technology.

Lleó, Conxita and Michael Prinz (1997). Syllable structure parameters and the acquisition of affricates. In S. J. Hannahs and Martha Young-Sholten (eds.) *Focus on Phonological Acquisition*. Amsterdam: John Benjamins. 143-163.

Macken, Marlys A. (1979). Developmental reorganization of phonology: a hierarchy of basic units of acquisition. *Lingua* 49: 11-49.

Macken, Marlys A. (1980). The child's lexical representation: the 'puzzle-puddle-pickle' evidence. *Journal of Linguistics* 16: 1-17.

Macken, Marlys A. (1989). Where's phonology? Paper delivered at the National Institute of Child Health and Human Development's Conference on Phonological Development. Stanford University.

Macken, Marlys A. (1992). Where's phonology? In Charles A. Ferguson, Lise Menn, and Carol Stoel-Gammon (eds.) *Phonological Development: Models, Research, Implications*. Timonium, MD: York Press. 249-269.

Macken, Marlys A. (1995). Phonological acquisition. In John A. Goldsmith (ed.) *The Handbook of Phonological Theory*. Cambridge, MA: Blackwell. 671-696.

Macken, Marlys A. and Charles A. Ferguson (1983). Cognitive aspects of phonological development: model, evidence and issues. In Keith E. Nelson (ed.) *Children's Language* 4. Hillsdale, NJ: Lawrence Erlbaum Associates. 255-282.

Macnamara, John (1982). *Names for Things: a Study of Child Language*. Cambridge, MA: Bradford Books / MIT Press.

Maddieson, Ian (1984). *Patterns of Sounds*. Cambridge, MA: Cambridge University Press.

Marotta, Giovanna (1988). The Italian diphthongs and the autosegmental framework. In Pier Marco Bertinetto and Michele Loporcaro (eds.) *Certamen Phonologicum. Papers from the 1987 Cortona Phonology Meeting*. Turin: Rosenberg and Sellier. 389-418.

Matthews, John (in preparation). *The Neurolinguistic Basis of Phonological Representations and Constraints*. Ph.D. dissertation. McGill University.

McCarthy, John J. (1979). *Formal Problems in Semitic Phonology and Morphology*. Ph.D. dissertation. Massachusetts Institute of Technology. (Distributed by Indiana University Linguistics Club, Bloomington)

McCarthy, John J. (1989). Linear order in phonological representation. *Linguistic Inquiry* 20: 71-99.

McCarthy, John J. (1997). Faithfulness in prosodic morphology and phonology: Rotuman revisited. University of Massachusetts at Amherst. Ms.

McCarthy, John J. and Alan S. Prince (1986). Prosodic morphology. University of Massachusetts at Amherst and Rutgers University. Ms.

McCarthy, John J. and Alan S. Prince (1993a). Prosodic morphology I: constraint interaction and satisfaction. University of Massachusetts at Amherst and Rutgers University. Ms.

McCarthy, John J. and Alan S. Prince (1993b). Generalized alignment. Technical report no. 3 of the Rutgers Center for Cognitive Science. Rutgers University. Ms.

McCarthy, John J. and Alan S. Prince (1995). Faithfulness and reduplicative identity. In Jill N. Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.) *Papers in Optimality Theory*. Amherst: Graduate Linguistic Student Association. 249-384.

McDonough, Joyce and Scott Myers (1991). Consonant harmony and planar segregation in child language. UCLA and University of Texas, Austin. Ms.

Menn, Lise (1971). Phonotactic rules in beginning speech: a study in the development of English discourse. *Lingua* 26: 225-251.

Menn, Lise (1978). Phonological units in beginning speech. In Alan Bell and Joan Bybee Hooper (eds.) *Syllables and Segments*. Amsterdam: North Holland. 315-334.

Menn, Lise and Edward Matthei (1992). The “two-lexicon” approach of child phonology: looking back, looking ahead. In Charles A. Ferguson, Lise Menn, and Carol Stoel-Gammon (eds.) *Phonological Development: Models, Research, Implications*. Timonium, MD: York Press. 211-248.

Mester, R. Armin and Junko Itô (1989). Feature predictability and underspecification: palatal prosody in Japanese mimetics. *Language* 65: 258-293.

Mithun, Marianne and Hasan Basri (1986). The phonology of Selayarese. *Oceanic Linguistics* 25: 210-254.

Morgan, James L. and Jenny R. Saffran (1995). Emerging integration of sequential and suprasegmental information in preverbal speech segmentation. *Child Development* 66: 911-936.

Padgett, Jaye (1995). Feature classes. In Jill N. Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.) *Papers in Optimality Theory*. Amherst: Graduate Linguistic Student Association. 385-420.

Paradis, Claude and Denise Deshaies (1990). Rules of stress assignment in Québec French: evidence from perceptual data. *Language Variation and Change* 2: 135-154.

Paradis, Carole and Darlene LaCharité (1997). Preservation and minimality in loanword adaptation. *Journal of Linguistics* 33: 379-430.

Paradis, Carole and Caroline Lebel (1994). Contrasts from segmental parameter settings in loanwords: core and periphery in Québec French. In Carrie Dyck (ed.) *Proceedings of the Montréal-Ottawa-Toronto Conference on Contrast in Phonology*. Toronto Working Papers in Linguistics 13: 75-95.

Paradis, Carole and Éliane Lebel (1997). Centre et périphérie: comportement des segments anglais en français québécois. In Julie Auger and Yvan Rose (eds.) *Explorations du lexique*. Québec: Centre international de recherche en aménagement linguistique (CIRAL). 229-242.

Paradis, Carole and Jean-François Prunet (eds., 1991). *The Special Status of Coronals: Internal and External Evidence*. Phonetics and phonology series 2. San Diego: Academic Press.

Paradis, Johanne (2000). Do bilingual two-year-olds have separate phonological systems? *International Journal of Bilingualism*. [in press]

Paradis, Johanne, Sophie Petitclerc, and Fred Genesee (1997). Word truncation in French-speaking two-year-olds. In Elizabeth Hughes, Mary Hughes, and Annabel Greenhill (eds.) *Proceedings of the 21st Annual Boston University Conference on Language Development*. Somerville, MA: Cascadilla Press. 441-452.

Parkinson, Frederick B. and Mike Cahill (1997). Partial class behavior and feature geometry: remarks on feature class theory. In Kiyomi Kusumoto (ed.) *Proceedings of the North East Linguistic Society* 27. Amherst: Graduate Linguistic Student Association. 79-92.

Pater, Joseph V. (1996). *Consequences of Constraint Ranking*. Ph.D. dissertation. McGill University.

Pater, Joseph V. (1997). Minimal violation and phonological development. *Language Acquisition* 6: 201-253.

Pater, Joseph V. and Adam Werle (2000). Modeling variation in child consonant harmony. University of Massachusetts. Ms.

Petit Robert 1 (1990). *Dictionnaire alphabétique et analogique de la langue française*. Paris: Dictionnaire Le Robert.

Piggott, Glyne L. (1996). Reconfiguring harmony. *McGill Working Papers in Linguistics* 12: 61-98.

Piggott, Glyne L. (1997). Licensing and alignment: a conspiracy in harmony. *Phonology* 14: 437-477.

Piggott, Glyne L. (1999). At the right edge of words. *The Linguistic Review* 16: 143-185.

Piggott, Glyne L. (2000). Against featural alignment. *Journal of Linguistics* 36: 85-129.

Pike, Kenneth and Eunice Pike (1947). Immediate constituents of Mazateco syllables. *International Journal of American Linguistics* 13: 78-91.

Pinker, Steven (1984). *Language Learnability and Language Development*. Cambridge, MA: Harvard University Press.

Prince, Alan S. and Paul Smolensky (1993). Optimality Theory: constraint interaction in generative grammar. Rutgers University and University of Colorado at Boulder. Ms.

Prunet, Jean-François (1986). *Spreading and Locality Domains in Phonology*. Ph.D. dissertation. McGill University. (Published in 1992, New York: Garland.)

Pulleyblank, Douglas (1996). Neutral Vowels in Optimality Theory: A Comparison of Yoruba and Wolof. *Canadian Journal of Linguistics* 41: 295-347.

Rice, Keren (1989). On eliminating resyllabification into onsets. In E. Jane Fee and Katherine Hunt (eds.) *Proceedings of the West Coast Conference on Formal Linguistics* 8. Stanford: Stanford Linguistics Association. 331-346.

Rice, Keren (1992). On deriving sonority: a structural account of sonority relationship. *Phonology* 9: 61-99.

Rice, Keren (1996a). Phonological variability in language acquisition: a representational account. In Eve Clark (ed.) *Proceedings of the Child Language Research Forum*. Stanford: Stanford University. 7-17.

Rice, Keren (1996b). Aspects of variability in child language acquisition. In Barbara H. Bernhardt, John Gilbert, and David Ingram (eds.) *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press. 1-14.

Rice, Keren (1996c). Default variability: the coronal-velar relationship. *Natural Language and Linguistic Theory* 14: 493-543.

Rice, Keren and J. Peter Avery (1995). Variability in a deterministic model of language acquisition: a theory of segmental elaboration. In John Archibald (ed.) *Phonological Acquisition and Phonological Theory*. Hillsdale, NJ: Lawrence Erlbaum Associates. 23-42.

Rose, Yvan (1997). Sonority and the acquisition of Dutch syllable structure. In J. Peter Avery and Carolyn Smallwood (eds.) *Proceedings of the Montréal-Ottawa-Toronto Phonology Workshop*. Toronto Working Papers in Linguistics 16: 133-143.

Rose, Yvan (1998). On h-aspiré in French: external evidence. Paper delivered at the Montréal-Ottawa-Toronto Phonology Workshop. University of Ottawa.

Rose, Yvan (1999a). Licensing and head-dependent relations in explaining partial deletions in loanword phonology. *McGill Working Papers in Linguistics* 14: 155-192.

Rose, Yvan (1999b). Perception, representation, and correspondence relations in loanword phonology. In Steve S. Chang, Lily Liaw, and Josef Ruppenhofer (eds.) *Proceedings of the 25th Annual Meeting of the Berkeley Linguistics Society*. Berkeley: Berkeley Linguistics Society. 383-394.

Rose, Yvan (1999c). Quand la structure métrique impose son accent au trait harmonique. Paper delivered at the 1999 Annual Meeting of the Canadian Linguistic Association. Université de Sherbrooke.

Rose, Yvan (to appear). A structural account of Root node deletion in loanword phonology. *Canadian Journal of Linguistics*.

Sagey, Elizabeth (1986). *The Representation of Features and Relations in Non-linear Phonology*. Ph.D. dissertation. Massachusetts Institute of Technology.

Sapir, J. David (1965). *A Grammar of Diola-Fogny*. London: Cambridge University Press.

Schane, Sanford (1987). The resolution of hiatus. In Anna Bosch, Barbara Need, and Eric Schiller (eds.) *23rd Annual Regional Meeting of the Chicago Linguistic Society. Part Two: Parasession on Autosegmental and Metrical Phonology*. Chicago: Chicago Linguistic Society. 279-290.

Schwartz, Richard G. (1988). Phonological factors in early lexical acquisition. In Michael Smith and John Locke (eds.) *The Emergent Lexicon*. San Diego: Academic Press. 151-222.

Schwartz, Richard G. and Larry B. Leonard (1982). Do children pick and choose? An examination of phonological selection and avoidance. *Journal of Child Language* 9: 319-336.

Scullen, Mary Ellen (1993). *The Prosodic Morphology of French*. Ph.D. dissertation. Indiana University.

Selkirk, Elisabeth O. (1980a). The role of prosodic categories in English word stress. *Linguistic Inquiry* 11: 563-605.

Selkirk, Elisabeth O. (1980b). Prosodic domains in phonology: Sanskrit revisited. In Mark Aronoff and Mary-Louise Kean (eds.) *Juncture. A Collection of Original Papers*. Saratoga, CA: Anma Libri. 107-129.

Selkirk, Elizabeth O. (1982). The syllable. In Harry van der Hulst and Norval Smith (eds.) *The Structure of Phonological Representation* 2. Dordrecht: Foris. 337-385.

Siegel, Dorothy (1974). *Topics in English Morphology*. Ph.D. dissertation. Massachusetts Institute of Technology.

Smith, Neilson V. (1973). *The Acquisition of Phonology, a Case Study*. Cambridge: Cambridge University Press.

Smolensky, Paul (1996). On the comprehension/production dilemma in child language. *Linguistic Inquiry* 27: 720-731.

Spencer, Andrew (1986). Towards a theory of phonological development. *Lingua* 68: 3-38.

Stampe, David L. (1969). The acquisition of phonetic representation. *Papers from the 5th Annual Regional Meeting of the Chicago Linguistic Society*: 433-444.

Stemberger, Joseph and Carol Stoel-Gammon (1991). The underspecification of coronals: evidence from language acquisition and performance errors. In Carole Paradis and Jean-François Prunet (eds.) *The Special Status of Coronals: Internal and External Evidence*. San Diego: Academic Press. 181-199.

Stoel-Gammon, Carol and Judith A. Cooper (1984). Patterns of early lexical and phonological development. *Journal of Child Language* 11: 247-271.

Suzuki, Seiichi (1982). Phonetic values of Old English digraphs. *Linguistics* 20: 323-338.

Tesar, Bruce and Paul Smolensky (1998). Learnability in Optimality Theory. *Linguistic Inquiry* 29: 229-268.

Tesar, Bruce and Paul Smolensky (2000). *Learnability in Optimality Theory*. Cambridge, MA: MIT Press.

Topping, Donald M. (1973). *Chamorro Reference Grammar*. Honolulu: University of Hawaii Press.

Tranel, Bernard (1981). *Concreteness in Generative Phonology: Evidence from Modern French*. Berkeley, CA: University of California Press.

Trigo, Loren (1988). *On the Phonological Derivation and Behavior of Nasal Glides*. Ph.D. dissertation. Massachusetts Institute of Technology.

Trommelen, Mieke and Wim Zonneveld (1989). *Klemtoon en Metrische Fonologie*. Muiderberg: Coutinho.

van der Hulst, Harry G. (1984). *Syllable Structure and Stress in Dutch*. Dordrecht: Foris.

van der Hulst, Harry G. and Jeroen van de Weijer (1995). Vowel harmony. In John A. Goldsmith (ed.) *The Handbook of Phonological Theory*. Cambridge, MA: Blackwell. 495-534.

Velleman, Shelly S. (1996). Metathesis highlights feature-by-position constraints. In Barbara H. Bernhardt, John Gilbert, and David Ingram (eds.) *Proceedings of the UBC International Conference on Phonological Acquisition*. Somerville: Cascadilla Press. 173-186.

Velten, Harry de Veltheyme (1943). The growth of phonemic and lexical patterns in infant language. *Language* 19: 281-292.

Vihman, Marilyn May (1978). Consonant harmony: its scope and function in child language. In Joseph H. Greenberg (ed.) *Universals of Human Language, vol. 2: phonology*. Stanford: Stanford University Press. 281-334.

Whitney, William D. (1889). *Sanskrit Grammar, Including both the Classical Language and the Older Dialects, of Veda and Brahmana*, 2nd edition. Cambridge: Harvard University Press.

Wiese, Richard (1996). *The Phonology of German*. Oxford: Clarendon Press.

Wijnen, Frank, Evelien Krikhaar, and Els den Os (1994). The (non)realization of unstressed elements in children's utterances: evidence for a rhythmic constraint. *Journal of Child Language* 21: 59-83.

Wilkinson, Karin (1986). Syllable structure and Lardil phonology. University of Massachusetts. Ms.