The Italian ‘mobile diphthongs’
A test case for experimental phonetics and phonological theory

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The Italian 'mobile diphthongs' A test case for experimental phonetics and phonological theory

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Transcription and abbreviations

Transcription

Phonemic and phonetic transcriptions are based on the standard of the International Phonetic Association. Syllable boundaries are indicated by a dot (.). If the Italian data are presented in their orthographic forms, lexical stress is indicated by means of a grave accent mark (`) for all vowels, except for closed *e* and *o*, in which case an acute accent (´) represents their closed quality, in keeping with common practice in Italian dictionaries. Thus, *pésca* 'fishing' and *dótto* 'duct' are distinguished from *pèsca* 'peach' and *dòtto* 'well-read'. Note that, according to Italian spelling rules, the orthographic accent mark is required only when stress falls on the last vowel of polysyllabic words (as in *città* 'city', *caffè* 'coffee', *felicità* 'happiness') or to distinguish monosyllabic homographs, e.g. *dà* '(s)he gives' as opposed to *da* 'from'.

Abbreviations

AUG	augmentative
C	consonant
D	duration
DIM	diminutive
FUT	future tense
G	glide
GEN	genitive
IMP	imperative
IMPERF	imperfect
IND	indicative
INF	infinitive
μ	mora
OP	Optimal Paradigms
OT	Optimality Theory
PRES	present tense
σ	syllable
SUBJ	subjunctive
V	vowel
1SG	1st person singular
3SG	3rd person singular
1PL	1st person plural
3PL	2nd person plural

1 Introduction

1.1. Scope and aims

"It is a rule that could never find peace in the Italian language and that finally, so it seems, has found it in death."[1] With these words, Fochi, in his normative guide to writing and speaking Italian, describes the fate of the *regola del dittongo mobile*, the 'mobile diphthong' rule. Since the 17th century, Italian grammarians and lexicographers have been using the term *dittongo mobile* to refer to the rising diphthongs [jɛ] and [wɔ], which are historically related to the Late Latin mid-low stressed vowels [ɛ] and [ɔ] and alternate with corresponding monophthongs as a result of stress-shifting morphological operations, e.g. *sediamo* [seˈdjamo] 'we sit' vs *siedi* [ˈsjɛdi] 'you sit' and *movimento* [moviˈmento] 'movement' vs *muovo* [ˈmwɔvo] 'I move'.[2] However, written sources provide evidence that, ever since the 16th century, these particular diphthongs have hypercorrectly been extended to unstressed syllables, e.g. *siederò* [sjedeˈrɔ] 'I shall sit' and *muoviamo* [mwoˈvjamo] 'we move'. This analogical change has led to a great deal of variation, in some cases the alternations are maintained while in others they have been eliminated. Still in the early 20th century, an author as renowned as Grazia Deledda wrote both *moveva* and *muoveva* (IMPERF IND/3SG of *muovere* 'to move'), in her novels, or *scoteva* next to *scuoteva* (IMPERF IND/3SG of *scuotere* 'to shake'), and inconsistent use of the forms was found in many other literary works of that period (see van der Veer 2001). In spite of this chaotic situation, a number of purists have defended the 'mobile diphthong' rule until this very day. For instance, according to Gabrielli (1956:204), it would be a "vero e proprio errore" ('a serious mistake') to neglect the rule. In 1976, the same Gabrielli published his language guide *Si dice e non si dice*, in which, to his great disappointment, he had to conclude that the 'mobile diphthong' rule, although "simple even for a child who goes to primary school"[3], is often violated. He regrets even more that there are grammarians who, with pleasure, encourage language users to disobey the rule: "I also said that language users are often pretty slipshod with the 'mobile diphthong'; but it seems paradoxical to me that I should welcome this with pleasure and wish that this miserable diphthong would drown as soon as possible."[4]

In the phonological literature, the 'mobile diphthongs' have received little attention. The first phonological formalization of the phenomenon was provided by Saltarelli (1970), who accounts for the monophthong–diphthong alternation by adopting the underlying diphthongs /iɛː/ and /uɔː/, from which simplex vowels are derived by

[1] "È una regola che non è mai riuscita a trovar pace nella lingua italiana, e che finalmente, la trova, come pare, nella morte." Fochi (1969:86).
[2] In modern Italian, [ɛ] and [ɔ] are raised to [e] and [o] in unstressed positions.
[3] "(...) semplice anche per uno scolaretto delle elementari (...)" (Gabrielli 1976:42).
[4] "Che l'uso spesso s'infischi del dittongo mobile, l'ho detto anch'io; ma che poi io debba addirittura goderne, e augurarmi che al più presto questo infelice dittongo s'affossi, mi sembra paradossale." (Gabrielli 1976:42).

means of a monophthongization rule. The only phonological analysis that goes beyond description and claims to account for the monophthong–diphthong alternation is Sluyters (1992). According to Sluyters, the diphthongs [jɛ] and [wɔ] arise through a diphthongization process that, just like vowel lengthening, has the stressed open syllable as its domain and aims at creating well-formed binary feet. Thus, in a sense, the 'mobile diphthongs' are considered as the equivalents of phonetically long vowels. However, the author does not address the analogical changes that, as we may conclude from written sources, affected the monophthong–diphthong alternation, i.e. the extension of the diphthongs to the unstressed syllables. The phonological analyses are discussed in detail in § 2.5.2.

If, following Sluyters, [jɛ] and [wɔ] should be considered as the diphthongal equivalents of long vowels, we can hypothesize that there is also a durational equivalence. Furthermore, Sluyters' proposal predicts durational discrepancies between the 'mobile diphthongs' [jɛ] and [wɔ] and the other rising diphthongs in Italian, which did not arise as a consequence of diphthongization. Therefore, the first aim of this dissertation is to experimentally scrutinize these assumptions by way of phonetic measurements. Secondly, I carried out a series of elicited production experiments investigating to what extent the analogical levelling of the monophthong–diphthong alternation, attested in written sources, occurs in contemporary spoken Italian. The final aim of the present work is to present a phonological analysis of the insights provided by the experiments within the framework of Optimality Theory (Prince and Smolensky 1993/2002). Thus, while offering an analysis of an interesting phenomenon in the Italian language, this dissertation is also intended to make a contribution to the development of experimental phonetics and phonological theory, in particular Optimality Theory.

1.2. Outline of the chapters

Chapter 2 sets out to give a general diachronic overview of the Italian 'mobile diphthongs', from their origin until today. We shall focus in particular on the various approaches to Romance diphthongization as a general phenomenon found in different Romance languages. In addition, this chapter is concerned with the way the 'mobile diphthongs' are discussed in traditional handbooks and in the phonological literature.

The production experiment, which I carried out to test the hypotheses predicted by Sluyters' theory, is reported on in chapter 3. This experiment involves acoustic analysis, specifically measurements of the duration of Italian vowels and diphthongs (both 'mobile' and 'non-mobile') in stressed and unstressed syllables. Therefore, the results of this experiment may be considered as complementary material to previous experiments, such as those undertaken by Salza (1986, 1988, 1991*a*,*b*), which investigated the durations of vowel sequences and diphthongs in Italian, with the exception of those of the diphthongs [jɛ] and [wɔ]. The new data show that the durations of monophthongs and rising diphthongs – whether 'mobile' or not – depend on word length rather than on syllable position and that relative durations (relative to the total word duration) of monophthongs and diphthongs are strikingly parallel.

In chapter 4, I present a new tool in the field of language-variation research, which presents various challenges to the methodologies used in experimental phonetics. The application of the on-line speech shadowing technique, combined with a phoneme restoration task, will be seen to provide a valuable elicitation technique that allows us to record spontaneous speech production while subjects remain unaware of the purpose of the experiment and, importantly, are not influenced by orthographic information. The results of this experiment are complemented by those of an additional task, which aims at eliciting vowel production data with printed stimuli for non-words. Both experiments, reveal the absence of the monophthong–diphthong alternation in 70% of the target word pairs (on average) and in 90% of the non-word pairs.

The results of the duration experiment and the variation experiments serve as the basis for the phonological analyses presented in chapters 5 and 6, respectively. The duration experiment allows us to propose an analysis of the phonological structure of Italian rising diphthongs, focusing on the synchronic sources of prevocalic glides and their syllabic affiliation (chapter 5). The results of the variation experiments are presented as a test case for phonological approaches to allomorphy and paradigm uniformity effects which have recently been developed (chapter 6). Following Rubach and Booij (2001), I posit multiple input allomorphs for opaque morphophonological alternations such as the monophthong–diphthong alternation. Opaque alternations are often subject to analogical levelling. I shall not analyze these paradigm uniformity effects under McCarthy's (2005) Optimal Paradigms model, because it proves to be problematic when applied to diachronic changes. Instead, I propose an analysis in terms of Lexicon Optimization, a mechanism which allows learners to simplify the lexicon by reanalyzing multiple inputs as a single input.

The main results of this dissertation are summarized and evaluated in chapter 7. Quotations from languages other than English are translated; the original source texts are presented in footnotes, except for the longer fragments cited in chapter 2, which are listed in Appendix A. In addition to the tables in the body of the text, Appendix B contains seven additional tables that show the materials I prepared for, and the results I gained from, the experiments which were carried out for the purpose of this dissertation.

1.3. The framework

The phonological chapters of this dissertation are couched within the framework of Optimality Theory. Optimality Theory (OT) is a linguistic theory proposed in a manuscript by Prince and Smolensky in 1993. In 2002 a revised edition of this manuscript was published in the Rutgers Optimality Archive, available through the internet (http://roa.rutgers.edu), and in 2004 it became available in book form. Although initially the interest in OT was associated with phonology, the theory has been extended to other subfields of linguistics as well, such as syntax and semantics. OT is usually considered to be an innovative development of SPE generative grammar (Chomsky and Halle 1968), which shares its focus on the investigation of universal principles, linguistic typology and language acquisition. OT abandons the

concept of rewrite rules and replaces these by the idea that surface forms of the language arise from the resolution of conflicts between competing universal constraints. An essential property of OT grammar is that these constraints are violable. A universal function called GEN provides each input form with a (theoretically infinite) set of output candidates. From this set of candidates the grammar selects the *optimal* output, on the basis of a language-specific ranking of the constraints. The candidate with the least serious constraint violations is the winner. In terms of OT, then, acquisition can be roughly described as the process of (re)ranking the set of universal constraints.

Constraints can be categorized into two main types: faithfulness constraints, which require identity between the input and the output in various ways, and markedness constraints, which impose well-formedness conditions on output structures. With the advent of Correspondence Theory (McCarthy and Prince 1995), the concept of faithfulness received a new dimension. This theory, embedded within the general OT framework, determines correspondence relations between two structures, their similarity being evaluated by faithfulness constraints. Correspondence relations no longer hold between inputs and outputs, but also between bases and reduplicants, or between two output forms. These extensions of correspondence provide the basis of the OT treatment of phenomena such as opacity or paradigm uniformity. The Optimal Paradigms model (McCarthy 2005), which is discussed in chapter 6, is an example of a theory based on output-to-output correspondence.

For detailed background reading, the reader is referred to the original presentation of Optimality Theory in Prince and Smolensky (1993/2002) or textbooks such as Archangeli and Langendoen (1997), Kager (1999), Dekkers, van der Leeuw and van de Weijer (2000) and McCarthy (2002). The premises of Correspondence Theory, originally proposed by McCarthy and Prince (1995), are carefully explained in van Oostendorp (2005).

2 The Italian *dittonghi mobili*

2.1. Introduction

With the term *dittonghi mobili* ('mobile diphthongs'), Italian grammarians and lexicographers refer to the rising diphthongs [jɛ] and [wɔ] in stressed open syllables, which alternate with the corresponding monophthongs [e] and [o], due to some stress-shifting morphological operation, as illustrated by the following examples:

(2.1)

sederò	[sedeˈro]	'I shall sit'	siedo	[ˈsjɛdo]	'I sit'
veniamo	[veˈnjamo]	'we come'	vieni	[ˈvjɛni]	'you come'
movimento	[moviˈmento]	'movement'	muovo	[ˈmwɔvo]	'I move'
soniamo	[soˈnjamo]	'we play'	suono	[ˈswɔno]	'I play'
decina	[deˈtʃiːna]	'ten or so'	dieci	[ˈdjɛtʃi]	'ten'
omino	[oˈmiːno]	'little man'	uomo	[ˈwɔmo]	'man'

The alternation above is historically motivated: considering the development from Latin to Italian, the mobile diphthongs are the result of a diphthongization process that affected the low mid vowels in stressed open syllables only, as will be explained in more detail in § 2.4.

Similar alternations occur in other Romance languages, e.g. in Castilian: *movemos* 'we move' vs *muevo* 'I move', *negamos* 'we deny' vs *niego* 'I deny',[5] or French: *venons* '(we) come' vs *viens* '(I/you) come' (see § 2.5). However, only in Italian grammars and dictionaries is specific terminology used to refer to this phenomenon. In fact, by virtue of the alternating pattern, the two diphthongs involved are called *mobili*; the alternation itself is presented as a grammatical rule which affects the morphology of a group of verbs, nouns and adjectives: *la regola del dittongo mobile*. The Italian adjective *mobile* literally means 'able to be moved from place to place' – cf. English *mobile* – but used metaphorically it has the value of 'unsteady, inconstant, fickle'.[6]

The term *dittonghi mobili* was proposed in 1623 by Benedetto Buommattei, as opposed to *dittonghi fermi* or 'steady diphthongs'. In his grammar *Delle cagioni della lingua toscana*, an entire section is dedicated to the distinction between these two types of diphthongs. The translation of this section – as it appeared in a later reprint of the work, entitled *Della lingua toscana* – is presented below:

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[5] In Castilian, the alternation also occurs in closed syllables, e.g. *pienso* 'I think' vs *pensamos* 'we think'.

[6] In the twentieth century, similar terminology was used in Dutch to describe processes of syncope, apocope, metathesis, epenthesis, assimilation and dissimilation of /r/ in Dutch dialects, /r/ being labelled *wispelturig* ('capricious, fickle'), see Pauwels (1936) and Elemans (1998).

Steady and mobile diphthongs. Chapter III
For a better understanding of this subject we make another distinction among the diphthongs and refer to them either as STEADY or as MOBILE.

Steady I call those diphthongs which are always diphthongs, e.g. PIEGO, QUESTO, AURORA, VEEMENZA, which always maintain the diphthongs, although the syllables change, and we write PIEGARE, PIEGAVANO, and PIEGO' with a diphthong, as in the smaller form PIEGO.

Mobile I call those diphthongs which change and are removed when the syllables change, e.g. PRIEGO, TRUOVA, CIECO, TUONA, in which (*a*) the diphthong, when these words get longer, is removed and we say PREGARE, TROVARE, CECONE, TONARE, without a diphthong.

The steady diphthong is not related to stress, because, if (*b*) PIEGO has stress on the first syllable, PIEGARE on the second and PIEGHEREI on the third, the diphthong always occurs.

The mobile diphthong, however, is always stressed. And when stress shifts, the diphthong is removed. For instance, BUONO and BONISSIMO, PRIEGO and PREGARE and even more visible in PREGO', TRUOVA, SIAMO, SUONO, VUOGLI and MUORE versus TROVERAI, SAREMO, SONERO', VORRESTI and MORREBBE, which remove the diphthong when stress shifts.

[footnotes]
(*a*) We say *Fuoco* with the Tuscan diphthong, but *Infocate*. And *Tuona*, but *Tonare*, because we cannot have both strength and primary stress on two different places simultaneously and when stress shifts, the diphthong is, as it were, pared-down, to give strength and support to a further syllable in the word. Therefore *Fiede* from *Fedire*, *Riede* from *Reddire*, hence *Fedita*, *Reddita*.
(*b*) *Piego* is a steady diphthong, because it is derived from Latin *plico*; but *precor* gave way to *prego* and later *priego*, because of elegancy and fullness of grace, but it can be removed, whereas in the other form *piego* the *i* is, so to speak, deeply embedded in the language. [Buommattei 1729:67-68][7]

The chief points of Buommattei's observations may be recapitulated as follows:

- steady diphthongs occur in both stressed and unstressed syllables, e.g. *piego* [ˈpjɛgo] 'I fold', *piegare* [pjeˈgaːre] 'to fold';
- mobile diphthongs occur in stressed syllables only, e.g. *cieco* [ˈtʃɛko] 'blind', *tuona* [ˈtwɔna] 'it is thundering';
- when a word "grows" (i.e. is morphologically altered) and stress shifts to one of the following syllables, the mobile diphthongs "disappear" (i.e. alternate with the corresponding monophthongs), e.g. *cecone* [tʃeˈkoːne] 'blind AUG', *tonare* [toˈnaːre] 'to thunder';

[7] For the original source text in Italian, see Appendix A.1.

- the alternation is phonetically accounted for in that it is held impossible to have two different "strength" peaks within one word: both a diphthong in one syllable and primary stress in another (footnote *a*);
- the alternation is historically motivated: the mobile diphthongs are related to Latin monophthongs (the first being merely considered as the "elegant and graceful filling" of the latter) and can therefore smoothly turn back into monophthongs, whereas steady diphthongs are not related to Latin monophthongs and are considered as fixed elements of the word stems, e.g. Latin *plico* > *piego* 'I fold' (footnote *b*).

Thanks to the publication of *Della lingua toscana*, Buommattei acquired fame as a grammarian. In 1627 he was admitted to the prestigious Crusca Academy, which is the national language academy of Italy still today (founded in Florence in 1582, it was the first such institution in Europe). The term *dittongo mobile* became firmly established in Italian linguistics and is still used, although no longer in contrast to *dittongo fermo*.

This chapter is intended to review the available literature on the two Italian *dittonghi mobili* [jɛ] and [wɔ] and closely related topics. Both diachronic and synchronic approaches are presented and discussed. This overview of the literature, which in the end will provide a number of hypotheses to be tested and discussed in the remaining chapters of this dissertation, is preceded by a more detailed definition of the notions 'diphthong' and 'diphthongization'.

2.2. Diphthongs and diphthongization

2.2.1. Definition

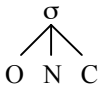
Giving an accurate definition of the term *diphthong* (derived via Latin *diphtongus* from Ancient Greek δίφθογγος, 'double voice, double sound') may prove a tall order, as is demonstrated in Marotta (1987) and Sánchez Miret (1998), who present an extensive overview of various attempts made by linguists from the early twentieth century onwards until more recent times. In order to clarify the notion of diphthong, it seems useful to adopt both a phonetic and a phonological point of view, which reflects precisely the way in which the case of the Italian mobile diphthongs is approached in this thesis. Acoustically and perceptually, diphthongs can be characterized as "movements from one vowel to another" (Ladefoged 1975:76), an idea which we also encounter in Peeters (1991). Thus, following Peeters, the German diphthong /au/ is a combination of a relatively steady short [ɑ] in onset position and a relatively steady short [o] in offset position joined by an upgliding movement of the tongue. From a phonological perspective, diphthongs are also analysed as sequences of two vocalic segments but in addition reference is made to syllable structure: only tautosyllabic vowel sequences are considered as diphthongs, whereas heterosyllabic sequences are considered to be two separate monophthongs, e.g. Italian [pja.no] 'plain, flat' with a diphthong vs [pi.aː.no] 'of pope Pius' with hiatus.

In practice, however, mismatches occur between phonologically interpreted vowel sequences and the way they are realized phonetically. Weeda (1983:147) rightly observes that "it is possible for a sound to be complex at one level, but simple on another" and illustrates this idea with several examples. For instance, he observes that in Eskimo underlying diphthongs correspond to monophthongs at the phonetic level, whereas the reverse is found in certain English dialects. Besides, from a phonetic point of view, it is not always easy to differentiate between monophthongs and bivocalic sequences (either diphthongs or hiatus). Chapter 4, for example, reports on an experiment which illustrates how the same sound is interpreted by different listeners as either a diphthong or a monophthong. Marotta (1987) describes the difficulties involved in discriminating between diphthongs and hiatus in Italian. Along with Marotta and Sánchez Miret (1998), I assume that the phonetic distinction between monophthong, diphthong and hiatus is not categorical but gradient or scalar, with diphthongs occupying a position somewhere in between monophthongs and hiatus.

2.2.2. Falling and rising diphthongs

The internal organization of diphthongs is determined by principles of sonority and is therefore related to the organization of the syllable in general. Kager (1999:91) defines the syllable as "a prosodic category organizing segments according to their sonority values."[8] High sonority segments (vowels or vowel-like sounds) constitute the syllable peak (or nucleus), whereas low sonority segments (consonants) constitute the onset or the coda of the syllable. The structure of a syllable can be visualized schematically as follows:

(2.2) Syllable structure (slightly simplified)[9]



σ: syllable; O: onset; N: nucleus; C: coda

A syllable can thus be interpreted as a phonological unit with a rising and/or falling sonority. This has an impact on the internal organization of the diphthong: in a syllable containing a diphthong, the most sonorous element will commonly be detected as the diphthongal peak or nucleus, whereas the least sonorous element is predicted to be the nonpeak or *glide*. Thus, vowel sequences such as /ia/ and /ua/ will gener-

[8] This implies that segments are subject to a sonority hierarchy, captured by Prince and Smolensky (2002:136) as "Segmental Sonority Prominence": α > i > ... > t (α is more sonorous than i; t is least sonorous). See also Selkirk (1984) and Clements (1990).

[9] For references on different internal syllable structure theories, see e.g. Zhang (2006).

ally result in diphthongs with a rising sonority profile, [ja] and [wa], whereas sequences like /ai/ and /au/ tend to be diphthongs with falling sonority, [aj] and [aw].[10]

Vowel sequences with a schwa in second position tend to be realized as falling diphthongs, as in West Frisian *foet* [fuət] 'foot', *flier* [fliər] 'floor', *sleat* [slɪət] 'ditch' (see Visser 1997), since the schwa, being produced with less expiratory intensity, has a lower sonority than other vowels.[11] However, as Sánchez Miret (1998) points out, these diphthongs may be unstable and occasionally convert into their rising counterparts, for instance, in Swiss German [uə] > [we] as in [guət] > [gwet] 'good'.[12] In this context, it seems interesting to observe that West Frisian features a process through which falling diphthongs ending in a schwa are converted to the corresponding rising diphthongs if followed by a syllable or consonant cluster, a process known as West Frisian breaking (see Booij 1988, 1989). As a result, the plurals of the words mentioned above are [fwotən] 'feet', [fljɪrən] 'floors' and [sljɛten] 'ditches'. Visser (1997:30) notes that there is "phonetic evidence which seems to indicate that the centrali[z]ing and corresponding rising diphthongs must be assigned one and the same abstract underlying form, from which both phonetic variants are concrete manifestations". The alternating pair [iə]/[jɪ], for instance, is represented as /iɪ/ at the underlying level. This phonetic evidence comes from, among others, de Graaf and Tiersma (1980:118), who proved that "when more and more segments of 12.8 msec are cut off from the beginning of a diphthong such as [ɪə] in [slɪət], the observer at a particular point begins to hear the rising diphthong [jɛ]."

Sánchez Miret (1998:39) observes that processes of the type falling diphthong > rising diphthong frequently occur, whereas the reverse is not likely to happen. He explains this in terms of sonority by pointing out that a prenuclear glide (or *onglide*) has a shorter duration than a postnuclear glide (or *offglide*) (cf. Marotta 1987). Consequently, the conversion falling diphthong > rising diphthong results in a diphthong with a shorter glide, for which it is much more difficult to acquire higher sonority values. Simply stated: an onglide tends to be a better, more stable glide than an offglide.[13]

2.2.3. Sources of diphthongs

Generally, a distinction can be made between three different sources of diphthongs:

- a diphthong in the input: /jɛ/ > [jɛ];
- two adjacent vowels in the input: /iɛ/ > [jɛ];

[10] The fact that the glide is the least sonorous segment within a diphthong does not mean that it is automatically excluded from the syllable nucleus. In chapter 5, I will show that the glide in Italian rising diphthongs is syllabified into the syllable nucleus.

[11] Diphthongs with a schwa in second position are also called *centralizing* or *centering*, terms which capture the idea that the diphthong makes a movement from the periphery towards the centre of the vowel space.

[12] Cf. the pronunciation of English *bear*, [bɛə] in RP vs [bɛ:] in Modern English, which also points at the instability of diphthongs ending in a schwa.

[13] Cf. Marotta (1987:866), who observes that glide-vowel sequences are more easily perceived as diphthongs than vowel-glide sequences.

- one single vowel in the input: /ɛ/ > [jɛ].[14]

I assume that in Modern Italian, diphthongs are either present in the input or correspond to two adjacent input vowels of which one undergoes glide formation, a process which is elaborated on in chapter 5. Historically, however, the Italian mobile diphthongs [jɛ] and [wɔ] are related to the Latin stressed mid vowels /ĕ/ and /ŏ/, respectively; i.e. somewhere in the history of the language, these vowels must have diphthongized. Before exploring this phenomenon, known as the Romance Diphthongization, I will first discuss some general aspects of diphthongization.

Diphthongization can be expressed as the fission, polarization or dissimilation of the (distinctive) features of a vowel (cf. Andersen 1972, Sluyters 1992, Schane 1995, Weeda 1983, Sánchez Miret 1998, among others). Drawing on Sánchez Miret (1998:72), two types of dissimilation are distinguished: a dissimilation of sonority, resulting in diphthongs where one half is more open and the other more closed (e.g. /e/ > [jɛ]) and a dissimilation of position, where one part palatalizes and the other labializes (e.g. /y/ > /ju/). If we simplify matters, diphthongization can be visualized as either a vertical or horizontal movement within the vowel space. Following Sánchez Miret, diphthongization affects stressed vowels, mostly in open syllables, which have a greater duration and intensity than unstressed vowels, so that speakers have greater difficulty to maintain equal sonority and/or position along the total duration of the vowels.[15]

As for the two mobile diphthongs in Modern Italian, a debate has been going on for more than a century on the question whether these diphthongs are the result of a spontaneous (i.e. context-free) diphthongization process or of a process conditioned by vowel harmony (in Romance linguistics generally referred to as 'metaphony'). This issue will be addressed in section 2.4. The following section presents an overview of the diphthongs occurring in Modern Italian.

2.3. Diphthongs in Modern Italian

In Modern Italian, stressed syllables may contain any of the seven vowels occurring in the Italian vowel inventory: /i e ɛ a ɔ o u/. In unstressed syllables, the distinction between low mid and high mid vowels is neutralized and only five vowels occur: /i e a o u/. According to Schmid (1999), 90% of the syllables contain a monophthong whereas the remaining syllables contain either a diphthong or a triphthong, i.e. sequences including a vowel and one or two glides.

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[14] Diphthongs may also be created by glide insertion, as in Dutch /ze+ən/ > [ze:jən] 'seas'; cf. Sluyters (1992:47-55) and Sánchez Miret (1998:30).

[15] A similar explanation of diphthongization was given in the late fifties, by Straka (1959:294-295): "diphthongization, a physiologically much simpler phenomenon than it is sometimes thought to be, is explained by the incapacity of holding the organs in place during the articulation of a long vowel, i.e. to maintain the long vowel at the same aperture (and sometimes even the same place of articulation) for as long as that vowel is sustained." [original text: "(...) la diphtongaison, phénomène beaucoup plus simple du point de vue physiologique qu'on ne le croit quelquefois, s'explique par l'inaptitude à tenir les organes en place pendant l'articulation d'une voyelle longue, c'est à dire à garder à une voyelle longue le même degré d'aperture (parfois le même lieu d'articulation) pendant toute sa tenue."]

(2.3) Diphthongs and triphthongs in Modern Italian

(a) 12 rising diphthongs (approx. 5% of all syllables):

[ji]	–		[wi]	guida	‘guide’
[je]	piegare	‘to fold’	[we]	quercia	‘oak’
[jɛ]	pieno	‘full’	[wɛ]	querra	‘war’
[ja]	bianco	‘white’	[wa]	guanto	‘glove’
[jɔ]	pioggia	‘rain’	[wɔ]	cuore	‘heart’
[jo]	tempio	‘temple’	[wo]	vuotare	‘to empty’
[ju]	fiume	‘river’	[wu]	–	

(b) 9 falling diphthongs (approx. 2% of all syllables):

[ej]	dei	‘gods’	[ew]	eufemismo	‘euphemism’
[ɛj]	sei	‘six’	[ɛw]	euro	‘euro’
[aj]	mai	‘never’	[aw]	pausa	‘pause’
[ɔj]	poi	‘then’	[ɔw]	–	
[oj]	voi	‘you PL’	[ow]	–	
[uj]	lui	‘he’	[uw]	–	

(c) triphthongs (approx. 1% of all syllables):

[jej]	–		[wej]	quei	‘those PL’
[jɛj]	miei	‘my PL’	[wɛj]	–	
[jaj]	–		[waj]	guai	‘trouble’
[jɔj]	–		[wɔj]	tuoi	‘your PL’[16]

In the development of the Italian sound system from late spoken Latin,[17] a considerable number of rising diphthongs with a palatal onglide arose due to the palatalization of /l/ in the consonant clusters /pl/, /bl/, /kl/, /gl/ and /fl/. Thus, **planu* gave *piano* ‘flat’ and **blancu* (< Germanic **blank*) became *bianco* (cf. Tekavčić 1972*a*:243-244, Vennemann 1988:19-20 and van der Torre 2003:163-166). In other words, the Latin diphthongs were preserved, as is the case in the latinisms *Ital*[ja] ‘Italy’, *scrutin*[jo] ‘ballot, poll’.

Labial-initial rising diphthongs occurring after /k/ find their source in the Latin labiovelar consonant /k^{w}/ (e.g. **quercea* > *quercia* ‘oak’), whereas those occurring after /g/ are the result of an Early Romance fortition (i.e. strengthening) process affecting syllable-initial glides of mostly Germanic words (e.g. *guerra*, < Germanic **werra* ‘scuffle’).

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[16] Triphthongs with two initial glides are extremely marked, e.g. /wje/ in *quieto* ‘quiet’.

[17] In this dissertation, reconstructed late spoken Latin forms – instead of Classical Latin forms – are used to illustrate sound changes in the development from Latin to Italian. These postulated forms are signalled by means of an asterisk.

The inventory of rising diphthongs does not include the diphthongs [ji] and [wu], containing two front palatals and two back labials, respectively. Although these diphthongs do occur in other languages, they are considered to be marked sounds, given their low perceptibility rates. Diphthongs are predicted to be perceived more easily when either the sonority distance between both halves increases or when the two parts differentiate their positions (front vs back). This corresponds to Weeda's (1983:149) constraint on diphthong perception, according to which "diphthongs should utilize the articulatory extremes of the vowel space based on maximum perceptual differentiation of endpoints". Diphthongs such as [ji] and [wu] are characterized by endpoints which differ only minimally in sonority and position and are therefore less optimal diphthongs than diphthongs with endpoints that are maximally distinct from each other (cf. Zhang 2006 for a discussion of the sequence [ɑɒ] in Chinese, in which [ɑ] and [ɒ] only differ in the feature [±round]).

Falling diphthongs in word-final position are the result of sound changes: **magis* > *mai* 'never', **sex* > *sei* 'six', **post* > *poi* 'then', **illui* > *lui* 'he', **cantavi* > *cantai* 'I have sung' etc. (see Tekavčić 1972*a*:49). Although Latin *au* monophthongized to /ɔ/ (e.g. **auru* > *oro* 'gold'), it is conserved in so called *voci dotte* ('learned words'), such as *cauto* 'cautious', *lauto* 'lavish'. Other falling diphthongs are loans from foreign languages, such as [ɛw] from Ancient Greek ευ 'good, well'.

The only diphthongs in Italian that are historically related to a monophthong and are therefore the result of a genuine diphthongization process are the mobile diphthongs [jɛ] and [wɔ]. The diphthongization of stressed vowels, especially those related to the Classical Latin mid vowels *ĕ* and *ŏ*, is one of the most salient transformations in the history of the vowel system of Italian and other Romance languages. The next section summarizes the widely studied phenomenon of these diphthongization processes in Romance and, of course, in particular in Italian.

2.4. Diphthongization of /ɛ/ and /ɔ/ (< *ĕ*, *ŏ*)

2.4.1. Introduction to the data

Romance linguists generally agree on the assumption that the low mid vowels [ɛ] and [ɔ] in everyday Latin spoken during the Roman Empire correspond to the short mid vowels *ĕ* and *ŏ* in Classical Latin.[18] The evolution of a large number of the Romance vowel systems is characterized by diphthongization of these low mid vowels in stressed syllables. Figure 2.1 suggests the widespread character of the outcome of this phenomenon:

[18] According to Tekavčić (1972*a*:20-27) and Lepschy and Lepschy (2000:40), the classical Latin vowel system with a quantity distinction was associated with a quality distinction in late spoken Latin. The long vowels were realized as more closed and the short vowels as more open: *ī* > [iː], *ĭ* > [ɪ], *ē* > [eː], *ĕ* > [ɛ], *ŏ* > [ɔ], *ō* > [oː], *ŭ* > [ʊ], *ū* > [uː]. Subsequently, the vocalic length correlation, was lost and vocalic height became a distinctive feature. (Cf., among others, Straka 1959:§§ 12-14; Hall 1976:10, Lahiri, Riad and Jacobs 1999:389; for phonological approaches, see, among others, Otero 1988, Prieto 1993, Holt 1997).

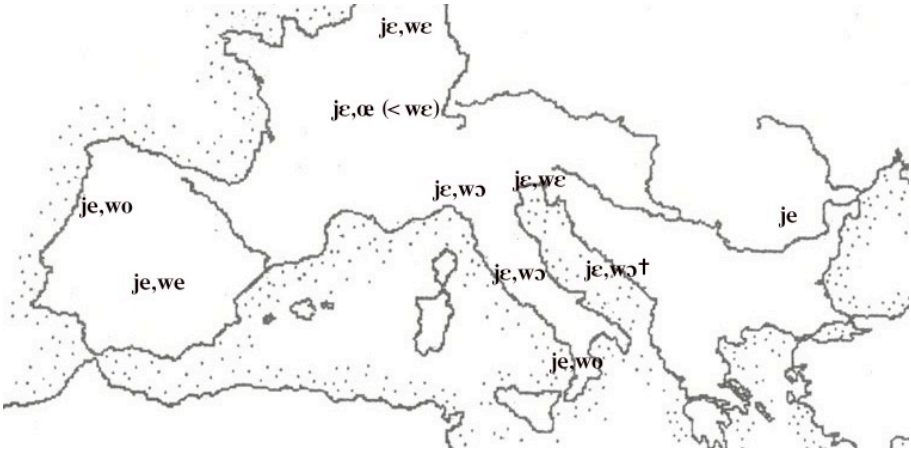

Figure 2.1: Map displaying diphthongization of [ɛ] and [ɔ] in Romance.

In Italian, French and Franco-Provençal, [ɛ] and [ɔ] diphthongized only in open syllables. In Castilian, Wallonian, Friulian, Romanian and Dalmatian (now extinct), diphthongization took place in both closed and open syllables – with the exception that in Romanian only the front vowel diphthongized.[19] In some languages, diphthongization was triggered by a specific context, either exclusively (Catalan: before palatals; Provençal: before palatals and velars; southern Italian: before word-final *–i*/*–u*) or additionally (e.g. French, Franco-Provençal and Rhaeto-Romance: before palatals). No diphthongization took place in Sardinian and Portuguese (except in some Portuguese dialects, see Spore 1972:185-188).

The earliest evidence for [ɛ]/[ɔ] diphthongization is provided through some inscribed words – listed in Straka (1953:264) – which date back to the first centuries AD. The examples are the proper name *Niepos* (Rome, 120 AD), the words *Dieo* (approx. 400 AD, Algeria) and *uobit* (< Latin *obiit*) (Algeria, 419 AD) and possibly *meeritis* (Algeria, first half of the 4th century). To these examples, Schürr (1970:6) adds a more recently discovered verbal form *puosuit* (< Lat. *posuit*) (Lower Moesia, 157 AD).

The oldest Italian examples are provided by Castellani (1961:88ff). Castellani discusses two forms attested in a Tuscan charter of the year 761 AD:[20] "Gudaldo q*uo*cho" and "Aurulu russu nepote Uuidaldi de Q*uo*sa" and concludes that

> we cannot be completely sure that the "notitia" of 761 really provides us with the very first evidence of [ŏ] in open syllable > *uo*; however, there are strong arguments to assume that this is a valid hypothesis. [Castellani 1961:89][21]

[19] Schürr (1970:67-68) claims that back diphthongization did occur in Romanian, given the presence of [wo] in some modern Romanian dialects; for a discussion see Sánchez Miret (1998:161ff).
[20] *Codice Diplomatico Longobardo* 2, edited by L. Schiaparelli, 1929-33; the text of the charter can also be consulted on the website of the Austrian Academy of Sciences, www.oeaw.ac.at.
[21] "(...) non si può esser del tutto sicuri che la "notitia" del 761 ci offra realmente le prime attestazioni di [ŏ] in sillaba libera > *uo*; esiste, però, una forte presunzione in favore di tale ipotesi."

The collection of medieval Lucchese documents edited by Bertini and Barsocchini[22] contains a form *Tiefuli* (887 AD), which, according to Castellani, may have been derived from the Longobardian anthroponym *Teufolo*, in which the Germanic diphthong *eu* was interpreted as [ɛ]. Aebischer (1944) cites two further examples from the same collection, *aqua buona* (983 AD) and *duomui* (999 AD), but Castellani disqualifies the first form (the original document has *aqua bona*) and expresses his doubts about the second form (see Castellani 1961:n. 75). After 1000 AD, the examples of mid-low vowel diphthongization are more frequent (see Castellani for the 11th century and Aebischer for the 12th century).

Castellani also offers an interesting attempt to calculate more precisely the *terminus ante quem* for the diphthongization of [ɛ] and [ɔ] in Tuscan, taking into account the fact that the oldest example of the monophthongization of Latin *au* > [ɔ] dates from 726 AD. The diphthongization of [ɔ] > [wɔ], and most probably also [ɛ] > [jɛ], is therefore claimed to have been completed at least before 726, since otherwise we would expect to find [wɔ] instead of [ɔ] in words that are related to a Latin base *au*, such as *poco* 'a little' (< **paucu*), *povero* 'poor' (< **pauperu*) and *toro* 'bull' (< **tauru*) (cf. Tekavčić 1972*a*:§ 55).[23] In addition, the presence of Longobardian loans with diphthongized low mid vowels leads Castellani to the conclusion that

> the diphthongization of [ɔ], and, as can be plausibly assumed, that of [ɛ], were concluded in a period that we can demarcate with an almost unsettling precision: after the first decades and before the last quarter, i.e. towards the middle of the 7th century. [Castellani 1961:95][24]

As stated above, in Italian the diphthongs [jɛ] and [wɔ] appear only in stressed open syllables. Some examples are listed in (2.4); for a more complete list, see table B.1 (Appendix B).

(2.4) Diphthongization in Italian

*p[ɛ]de	>	p[jɛ]de	'foot'	*b[ɔ]nu	>	b[wɔ]no	'good'
*p[ɛ]tra	>	p[jɛ]tra	'stone'	*n[ɔ]vu	>	n[wɔ]vo	'new'
*m[ɛ]le	>	m[jɛ]le	'honey'	*[ɔ]vu	>	[wɔ]vo	'egg'
*l[ɛ]tu	>	l[jɛ]to	'glad'	*r[ɔ]ta	>	r[wɔ]ta	'wheel'

[22] *Memorie e documenti per servire all'istoria del ducato di Lucca*, edited by D. Bertini, vol. 4, 1-2 (1818-1836) and D. Barsocchini, vol. 5, 1-3 (1837-1841), Lucca.

[23] In some northern and southern Italian dialects, however, we do find a diphthong in words that are related to Latin bases with *au*: e.g. **puoco*, **puovro* in Venetian dialects, *tuoro* in Arcevia; see Rohlfs (1966:§§ 42-43).

[24] "(...) il dittongamento di [ɔ], e così pure, è lecito pensarlo, il dittongamento di [ɛ], si sono conclusi in un periodo che s'arriva a delimitare con precisione quasi inquietante: dopo i primi decenni, avanti l'ultimo quarto, dunque verso la metà del VII secolo."

Diphthongization principally took place in prefinal syllables of disyllabic words, as illustrated by the examples in (2.4). The [jɛ] in trisyllabic *insieme* 'together' is related to *ĕ* in disyllabic Latin *sĕmel* 'once', and *int*[jɛ]*ro* (or *int*[je]*ro*) is a less frequently used variant of *int*[e]*ro*. The suffix *-[ɔ]*lu* also underwent diphthongization, as in *figliuolo* 'son', *spagnuolo* 'Spanish', words which as early as the 13th century were also realized with the corresponding monophthong: *figliolo*, *spagnolo* (cf. Castellani 1962). Somewhat more recent is the elimination of the onglides [j] and [w] after consonant clusters ending in *r*, e.g. *brieve* vs *breve* 'brief', *priego* vs *prego* 'I beg', *truova* vs *trova* 'he finds', *pruova* vs *prova* 'he tries'.[25] Exceptions to the regular pattern of diphthongization in prefinal syllables are the words *bene* 'well', *nove* 'nine' and *era* 'he was'.[26]

Occasionally, we find diphthongs in pre-prefinal syllables:[27]

(2.5) Diphthongization in pre-prefinal syllables

*l[ɛ]vitu	>	l[jɛ]vito	'yeast'	*t[ɔ]rulu	>	t[wɔ]rlo	'yolk'
*t[ɛ]pidu	>	t[jɛ]pido	'tepid'	*s[ɔ]cera	>	s[wɔ]cera	'mother-in-law'[28]

In other pre-prefinal syllables we find the monophthongs [ɛ] and [ɔ], for instance in *pecora* 'sheep', *popolo* 'people' and in latinisms such as *medico* 'doctor'.

To conclude this section, I would like to point at the asymmetry of Romance diphthongization. In several Romance languages the front diphthong [jɛ] exists, but not the back diphthong [wɔ], whereas the reverse is never attested. Hardly any attempt has been made to account for this asymmetry, but personally I believe this fact is best served by a phonetic explanation. This issue is dealt with in the next section, in which different theories about Romance diphthongization are presented and discussed.

2.4.2. Romance diphthongization: different theories

Given the extent of diphthongization in almost all Romance languages, it is not surprising that there have been attempts to provide a 'pan-Romance', or, as Hall (1976) puts it, 'monogeneticist', account of the data. The relevant research of the 20th century was dominated by the view that diphthongization of [ɛ] and [ɔ] must be explained as a conditioned development. The idea is that this process was triggered by a following unstressed high vowel *i* or *u*, i.e. a coarticulation effect which romani-

[25] See Castellani (1967:18-24): diphthongization after consonant + *r* was not general in Tuscany; it was attested in Siena and Florence but never in Pisa and Lucca, whereas in Pistoia *prego* was opposed to *truovo*. As from the the 15th/16th centuries, the forms without diphthongs after consonant + *r* became the norm in the (Florentine) literary language and therefore still are in the modern language.

[26] The absence of the diphthong in *bene*, *nove* and *era* is ascribed to the proclitic use of these words (cf. Patota 2002:55-56 and Castellani 1962).

[27] We do not take into account words that are paradigmatically related to disyllabic words, such as *muove* – *muovere* 'he moves – to move', *uomo* – *uomini* 'man – men', *or siedo* – *siedono* 'I sit – they sit'.

[28] Also attested: **c*[ɔ]*phinu* > *cuofino*, *cuofano* next to *cofano* 'hood'; **r*[ɔ]*tulu* > *ruotolo* 'roll' (according to Castellani (1965:953), the modern form *rotolo*, without diphthong, is not attested before the appearance of Luca Pulci's chivalric poem *Ciriffo Calvaneo* in 1514).

cists generally call 'metaphony' and is also referred to as 'vowel harmony'. This hypothesis, first put forward in the late 19th century by Schuchardt (1872), is defended, on several occasions, by Schürr (1936, 1970, 1972) and championed by Weinrich (1958), Lausberg (1969), Rohlfs (1966), Tekavčić (1972*a*), van Coetsem and Buccini (1990) and Maiden (1991, 1995).

In the definitive version of his theory, Schürr (1970:3) describes conditioned diphthongization as "caused by an anticipation of the tension of the openness of following palatal and velar elements"[29], in most cases word-final *–i/–u*, and as such it is simply "a particular instance of the general phenomenon referred to as metaphony or inflection (Umlaut)."[30] According to Schürr, metaphony was a general phenomenon in spoken Latin, given the large number of nouns and adjectives ending in *–ī* and *–ŭ*. Evidence for the existence of a relation between diphthongs and the presence of word-final high vowels may be found in the phonological structure of many southern Italian dialects. In different zones in Sicily, we find for instance [bieɖɖu] and [bieɖɖi] (corresponding to Standard Italian *bello* and *belli* 'beautiful'), with a diphthong preceding the marker *–u* for male singular and *–i* for male plural, but [bɛɖɖa] (*bella* in Italian), with a monophthong, because of the female singular ending *–a*. Similarly, in Calabria, we find [bwonu] next to [bɔna], corresponding to Standard Italian *buono* and *buona* 'good' (see Rohlfs 1966:127, 153).

Schürr, being a monogeneticist, asserts that the conditioned diphthongization – [ɛ, ɔ] > [jɛ, wɔ] – affected the entire Romance territory, as opposed to the 'spontaneous' diphthongization – due to lengthening – of [e, o], resulting in the falling diphthongs [ei, ow] in several Romance languages only (French, Franco-Provençal, Rhaeto-Romance, the majority of the Italian dialects and Dalmatian). However, the dialect of Tuscany, in which Modern Italian has its roots, does not seem to have been influenced by any metaphonic conditions. The medieval Tuscan diphthongs do not show any systematic relation with a following high vowel and occur only in open syllables.

To account for the presence of diphthongs preceding other vowels than *–i/–u* in Tuscan (and in the literary language), Lausberg (1969:171) assumes that here the original vowel harmony conditions became blurred: "diphthongization was restricted exclusively to open syllables and in these positions it was generalized – regardless of the word-final vowel."[31] Thus, the diphthong in the masculine singular noun *piede* 'foot' is explained as being analogous to the one in the plural form *piedi* and the feminine singular adjective *nuova* as analogous to the masculine *nuovo*, whereas no diphthongs occur in *closed* syllables as in *grosso*/*grossa* 'large'. Lausberg, on the other hand, sees traces of the original metaphonic process in the Tuscan language as well: several morphologically isolated words, such as *nove* 'nine' and *bene* 'well', do not have diphthongs since the conditions for metaphony were not present. Maiden (1995:38) is right, however, when he points out the presence of diphthongs in similar lexically isolated words, such as *dietro* (< **de r*[ɛ]*tro*) 'behind' or words

[29] "(...) née d'une anticipation dans la tension de la fermeture d'éléments palataux ou vélaires suivants."
[30] "(...) un cas particulier du phénomène général de métaphonie ou inflexion (Umlaut)."
[31] "die Diphtongierung wurde hier auf die freie Stellung beschränkt und in dieser – ohne Rücksicht auf den Auslautvokal – verallgemeinert."

where analogical extension is excluded due to the lack of *–i/–u* in their paradigms, e.g. *ruota* (< **r*[ɔ]*ta*), 'wheel'.

Besides, Lausberg's theory does not explain *why* diphthongs were banned from closed syllables. Schürr (1970, 1972) claims that from the very beginning metaphony was independent of syllable structure until the distinction between closed and open syllables became phonologically relevant, with short vowels restricted to closed syllables and long vowels and diphthongs (counting as long vowels) to open syllables. He believes that this "new sense of syllabic quantity must have spread in Tuscany through loans from neighbouring northern dialects",[32] among which the rising diphthongs [jɛ] and [wɔ] (Schürr 1970:38, following Rohlfs 1966), but two years later, in Schürr (1972), he concludes that metaphonic diphthongization, instead of being a direct import from the north, must have been an autochthonous process in Tuscany which collided with the new model of syllable quantity. To support his argument he adduces two peripheral zones in Tuscany, central Garfagnana and the areas Arezzo and Sansepolcro, where he locates the presumed last traces of an intermediate stage of metaphony.

The fact that there does not seem to be any dialect in Italy, – nor, presumably, in the rest of the *Romania* – in which metaphony is restricted to closed syllables and excluded from open syllables, leads Maiden (1995:39) to the conclusion that "the diphthongs are indeed of metaphonic origin, but are restricted to open syllables because metaphony was itself originally restricted to open syllables". Maiden argues that the originally metaphonic diphthongs subsequently expanded into closed syllables (except in Tuscany) and in positions outside the metaphonic environment. For him, the question remains open whether the diphthongs [jɛ] and [wɔ] developed in Tuscany itself or were imported from outside the region.

This is not the case for Castellani, who in several articles reacted against Schürr and Rohlfs, and claimed that diphthongization in Tuscany arose through an indigenous process of vocalic lengthening (Castellani 1961, 1965, 1970a, 1970b, 1977). Whereas Schürr always excluded the possibility of an early lengthening of [ɛ] and [ɔ] resulting in the rising diphthongs [jɛ] and [wɔ], Castellani intended to demonstrate that his Austrian colleague had no grounds to maintain this position. Interestingly, his arguments draw support from the results of an experimental study conducted by Straka (1959), which can be summarized as follows:

> (...) the longer a vowel's duration, the more its open or closed characteristics manifest themselves towards the end of its utterance. (...) these differences are perceptible when they exceed a certain limit, in which case they result in a real diphthongization of the open vowel through the opening of its final part or through the closing of the last part of a closed vowel. [Straka 1959:296][33]

[32] "(...) nouveau sentiment de quantité syllabique doit s'être répandu en Toscane avec les emprunts faits aux dialectes limitrophes septentrionaux."

[33] "(...) plus la voyelle gagne en durée, et plus son caractère ouvert ou fermée s'affirme vers la fin de sa tenue. (...) ces différences (...) peuvent devenir perceptibles si elles dépassent une certaine limite, et alors, elles peuvent aboutir à une véritable diphtongaison de la voyelle ouverte par l'ouverture de son segment final et à celle de la voyelle fermée par la fermeture de ce segment."

According to Straka, these facts explain the diphthongization of closed vowels, such as [eː] > [ej], [oː] > [ow], and that of open vowels, e.g. [ɛː] > [ɛa], [ɔː] > [ɔa] or, if we assume intermediate stages and a subsequent 'differentiation' of the first halves, [ɛː] > [ɛɐ̯] > [jɛ], [ɔː] > [ɔo̯] > [wɔ].[34] It is certainly one of Castellani's merits to make his theory plausible by providing experimental evidence, even though Schürr (1965) rejects the use of experimental phonetics in historical linguistics. In fact, the metaphonic approach, which Castellani also adopts to account for the rising diphthongs in other dialects, such as those spoken in southern Italy, is phonetically questionable, as pointed out by Sánchez Miret (1998).

Sánchez Miret (1998:178-185) explains how Schürr's premises conflict with the principles of assimilation and coarticulation. In Schürr's theory, the metaphonic effect of unstressed *–i/–u* is apparently discontinuous: it affects *only* the initial part of the articulation of the preceding stressed vowels [ɛ, ɔ], leaving the final part of the vocalic articulation unaltered. This idea is schematically represented by Sánchez Miret as in figure 2.2, in which the shaded parts symbolize the assimilatory effects of word-final /i, u/ on preceding segments.

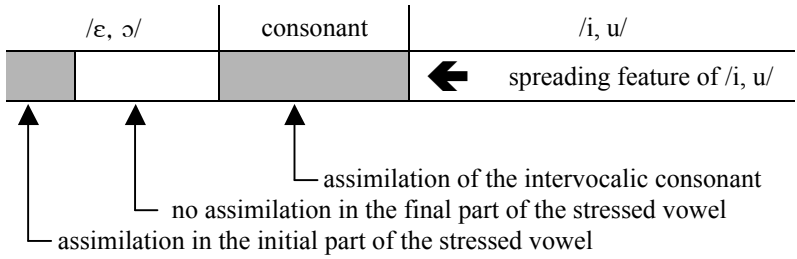

Figure 2.2: Schürr's hypothesis (after Sánchez Miret 1998:185).

As figure 2.2 shows, Schürr's theory supposes that metaphony can function as an interrupted regressive coarticulation effect: the height features of unstressed *–i/–u* spread backwards to the preceding consonant and further back to the onset of the preceding stressed vowel, jumping over the offset of the latter.

Sánchez Miret, drawing support from experimental studies, provides credibility to the idea that metaphony does not operate in this way. Instead, it must be conceived of as an uninterrupted coarticulation process that primarily affects a preceding consonant or consonant cluster but may also affect a preceding vowel, as is demonstrated in figure 2.3.

[34] To account for this 'differentiation', Straka invokes the closing effect of preceding consonants, as suggested by Séguy (1954), but in light of what we know now, the conversion falling > rising diphthong is quite common (see § 2.2.2).

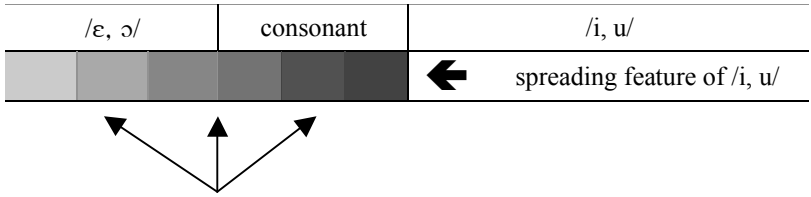

Figure 2.3: Sánchez Miret's model (after Sánchez Miret 1998:184).

Following Sánchez Miret, there are languages featuring authentic metaphonic diphthongization. An example of such a language is Romanian, in which word-final –*a,* –*e* and –*ă* may affect the articulation of a preceding vowel, but only its offset, which is in perfect harmony with Sánchez Miret's model in figure 2.3, e.g. **sēra* > *seară* 'evening', but not with that of Schürr's.

The central idea of Sánchez Miret's alternative proposal – embedded in the framework of Natural Phonology (see Dressler 1984) – is that Romance diphthongization is a spontaneous process. According to the author, diphthongization of [ɛ, ɔ] originally resulted in falling (or centralizing) diphthongs, which is assumed to be typical for low mid vowels: [ɛe̯, ɔo̯]. Subsequently, these falling diphthongs underwent dissimilation between glide and nucleus: [eo̯ > ie̯, oe̯ > ue̯]. Diphthongs of this type are preserved in different areas of the Romance territory, but – still following Sánchez Miret – frequently converted to rising diphthongs [jɛ, je, wɔ, wo], following the principles of sonority, as explained above in § 2.2.2.[35]

Another important aspect of Sánchez Miret's theory is that spontaneous diphthongization is governed by different contextual hierarchies, all depending on factors that have an influence on the duration of the vowels involved. One of these factors is the presence or absence of stress: stressed syllables – being relatively long – constitute an optimal context for diphthongization, whereas relatively short unstressed syllables are less favourably disposed to diphthongization. The *stress hierarchy* is represented by the author as follows:

(2.6) Stress hierarchy (after Sánchez Miret 1998:50)

+	–
stressed	**unstressed**

Other hierarchies refer to intrinsic vowel length, syllable structure (open vs closed), stress position (final and prefinal vs pre-prefinal), speech style (hyperarticulated vs hypoarticulated), etc.: all these aspects are duration-related. It is therefore claimed that in some Romance dialects, diphthongization is favoured in the context of a fol-

[35] Cf. Einarsson (1945:11): similar diphthongization processes occur in Modern Icelandic, where "the lax vowels (...) all tend to be diphthongized when long. The resulting diphthongs begin with a closer position and end with a more open (or at least equally open) position than the corresponding short vowels. Thus (...) [ɛː] becomes [iɛː, ɛæː], (...) and [ɔː] becomes [uɔː, ɔaː]."

lowing *–i* or *–u*, not because of their metaphonic effects but because of reasons strictly related to vowel duration. The author hypothesizes that diphthongization in these specific contexts functions as a form of compensation effect in that the stressed vowel is shortened if it precedes a vowel with an intrinsically longer duration *(–a, –e, –o*) and lengthened if it precedes a vowel with an intrinsically shorter duration (*–i, –u*). The hierarchy is schematized by Sánchez Miret as in (2.7):

(2.7) Vowel context hierarchy (after Sánchez Miret 1998:202)

+		–
(-i, -u)	**(-e, -o)**	**(-a)**

Although there are no experimental data available to support this particular compensatory mechanism, the effect of word duration on the duration of (stressed) vowels is well documented: the duration of (stressed) vowels decreases as the number of syllables in the word increases (see our own experiment in chapter 3; Lehiste 1970, Lindblom and Rapp 1973, Marotta 1985). Given this knowledge, it is not surprising that Romance diphthongization is a far more regular and stable process in prefinal syllables of relatively short disyllabic words than in pre-prefinal syllables of longer words. Sánchez Miret captures this effect by proposing a *stress position hierarchy* (diphthongization is related to the position of the stressed syllable within the word), but the hypothesis that word duration instead of syllable position is the decisive factor seems extremely convincing and is at least corroborated for the Modern Italian data by our experiment described in the following chapter.

The hierarchies are presented as a set of universal language properties. However, some hierarchies seem to conflict with others. For instance, the *intrinsic vowel duration hierarchy* captures the idea that low vowels are longer than high vowels, which has an effect on processes, such as diphthongization, that are sensitive to vowel duration. This hierarchy implies that [ɛ, ɔ] are more prone to diphthongization than [e, o], which reflects the outcome in most Romance languages. On the other hand, the *tenseness hierarchy* is based on the assumption that tense vowels are generally longer than lax vowels, leading to an opposite result: e.g. in the Modern English *Great Vowel Shift*, [e] diphthongized whereas [ɛ] remained intact. Moreover, the implications of the *stress hierarchy* in (2.6) seem to hold for Italian: diphthongs appeared in stressed syllables only; but the *vowel context hierarchy*, which would predict the absence of diphthongs in the context of a following *–a, –e* and *–o*, is untrue for Italian, because diphthongs did appear in these contexts.

Sánchez Miret (1998:52) acknowledges that "each hierarchy refers to one of the different factors that have turned out to play a role in diphthongization processes, but there is no reason to assume that all factors manifest themselves in all languages with the same relevance."[36] However, he does not provide a mechanism which regulates these different degrees of relevancy. Stating that, within a given language, a universal property A is less relevant than a universal property B, amounts to the assumption that the hierarchies themselves are hierarchically ranked in a language-

[36] "Cada jeraquía se refiere a uno de los diversos factores que han demostrado tener un papel en la [diptongación], pero nada nos hace suponer que todos actúen en todas las lenguas con la misma relevancia."

specific way. This notion comes close to the optimality-theoretic definition of grammar as a language-specific ranking of a set of universal and, importantly, violable constraints. As a matter of fact, Optimality Theory could deal very well with the diphthongization hierarchies as proposed by Sánchez Miret and in a far more elegant way. The hierarchies can easily be reformulated in terms of violable constraints that interact with other phonological and morphological constraints within a language-specific constraint ranking. Differences between languages could then be attributed to different constraint rankings. Thus, we may suppose that a constraint which disfavours diphthongization in unstressed syllables is undominated and therefore satisfied in the grammars of all Romance languages. On the other hand, a constraint banning diphthongization in the context of a following high vowel is violated in a language such as Italian, where it is lower-ranked in the constraint hierarchy (hence a violation of this particular constraint in this particular language is not immediately fatal). In chapter 5, I will pursue this issue as I will propose an optimality-theoretic analysis of the diachronic aspects of diphthongization in Romance.

Analysing Romance diphthongization as the result of a spontaneous process favoured in contexts that increase vowel duration, as Sánchez Miret does, certainly seems appealing and preferable to the phonetically implausible theory of metaphony. Nonetheless, a shortcoming of Sánchez Miret's theory – and most other theories – is that it does not account for the asymmetry between the diphthongization of [ɛ] and of [ɔ]. Yet, it is a fact that a number of the Romance languages feature, principally or exclusively, front diphthongization, but not back diphthongization. Romanian is such a language, just like a large number of the Tuscan dialects (see Maiden 1988, 1995).[37] To the best of my knowledge, only Fouché (1927) made an attempt – albeit preliminary – to provide a phonetic account for these asymmetries. Fouché, discussing a particular asymmetry in French (**tĕrtiu* > *tiers* 'third', **nĕptia* > *nièce* 'niece' vs **nŏptia* > *noce* 'wedding', **fŏrtia* > *force* 'strength'), observes that

> this inconsistency between *tiers, nièce*, on the one hand, and *force, noce*, on the other, is difficult to explain. Diphthongization may very well have affected *ĕ*, but not *ŏ*. The vowel *o*, which requires two clear articulatory movements, is more resistant than *e*, as long as the two movements are perfectly coordinated and balanced. In Spanish, *ŏ* has diphthongized in *fuerza* and in Castillian *nuepças*. In French, where the labial articulation is particularly pronounced, the vowel was maintained as it was : the two movements, labial and lingual, were clear enough and the coordination was perfect. [Fouché 1927:42-43][38]

This asymmetrical behaviour of front vs back diphthongization is of particular interest to the issue of the mobile diphthongs in Modern Italian. As will be discussed in

[37] The absence of back diphthongization [ɔ] > [wɔ] in large part of Tuscany is for Maiden (1988, 1995) reason to suspect that the [wɔ] of the literary (Tuscan) language was not indigenous to this part of the Italian peninsula, but was imported from outside. Conversely, Castellani (1965) believes that Tuscan [ɔ] originally diphthongized to [wɔ] and much later, in the 18th century, re-monophthongized to [ɔ]. Both theories are attempts to deal with the apparent instability of back diphthongization, but fail to provide a compelling account for it.

[38] For the original source text in French, see Appendix A.2.

the next section, the written language features a predominating tendency to eliminate the alternation between stressed mobile diphthong and corresponding unstressed monophthong in favour of the diphthong in both stressed and unstressed position, thus violating the 'mobile diphthong rule' (see § 2.1). However, front and back vowels are not equally affected, rising front diphthongs being far more generalized in unstressed positions than rising back diphthongs. One of the aims of this thesis is to discover experimentally to what extent these facts are reflected by the spoken language. It will turn out that there are strong reasons to believe that the asymmetry between [jɛ] and [wɔ] must indeed be explained phonetically: whereas Fouché discusses the issue from an articulatory point of view, I shall focus on the acoustic properties of the diphthongs and demonstrate that front diphthongs are perceived far more easily than back diphthongs, which may explain the smaller degree of expansion and the instability of the latter (see chapter 4).

2.5. The *dittongo mobile* in early and contemporary Italian

Since the term *dittongo mobile* was introduced by Buommattei in 1623, it has kept its place in most traditional grammars and dictionaries; an overview of these grammars and dictionaries, both early and modern, is given in § 2.5.1. Some relatively recent phonological theories on mobile diphthongs are discussed in § 2.5.2 whereas § 2.5.3 presents new data collected from twentieth century written sources.

2.5.1. Grammars and dictionaries

The Romance diphthongization process resulted in alternations which, during the history of the Italian language, were lexicalized, i.e. the original phonological effects of diphthongization ceased to be productive and were memorized by the speaker (see chapter 6 for more details). Not only in Italian, but also, for example, in Castilian, the alternation between stressed diphthong and unstressed monophthong characterizes the conjugation of a group of verbs (e.g. the present indicative of *pensar* 'to think': *pienso* ['pjenso], *piensas* ['pjensas], *piensa* ['pjensa], *pensamos* [pen'samos], *pensáis* [pen'sajs], *piensan* ['pjensan]) and some derivational processes (e.g. *hierro* ['jerro] 'iron' vs *herrero* [e'rrero] 'black-smith'). Since the seventeenth century, Italian grammarians have been using the term *dittongo mobile* to refer to alternations of this type between diphthongs and monophthongs, generally capturing them in a grammatical rule: *la regola del dittongo mobile*.

Already by the early sixteenth century, the monophthong–diphthong alternation was recognized as a morphological feature in Italian grammar. In light of the so-called *questione della lingua*, the ongoing debates on which vernacular should constitute the standardized language of Italian prose and poetry, the Venetian humanist Pietro Bembo published his *Prose della volgar lingua* (1525), where he proposed fourteenth-century Florentine as the model for the literary language. The third book of this manifesto is a survey of the most important aspects of Italian grammar, based mainly on Boccaccio's *Decamerone* and Petrarch's poetry. Especially relevant for the purposes of this thesis is the section that deals with verbal morphology. In § 28,

Bembo discusses the paradigms of some verbs ending in *–ere* (such as *dolere* 'to ache', *tenere* 'to hold', *sedere* 'to sit', *volere* 'to want'), which have an additional vowel in the second and third persons singular only:

> (...) in *Doglio Tengo* etc., we do not say *Dogli Tenghi*, but *Duoli Tieni*. In the latter forms, the final part is not only dissimilar to that of the former ones, but it also happens that a new vowel is added to make the form fuller: *Doglio Duoli*, *Voglio Vuoli*, *Soglio Suoli*, *Tengo Tieni*, *Seggo Siedi*, *Posso Puoi*, etc. (...). Likewise, this practice is continuously applied in the third person singular, but it is not extended any further (...). [Bembo, *Prose*, § 28 in Bembo 1967:135-136] [39]

Importantly, Bembo observes that the additional vowel is always *i* or *u* and does not affect stems which contain the vowel *a*.

> Here we can only give the following rules: the only two vowels involved are *I* and *U* and neither of these vowels are inserted in forms that have *A* in the prefinal syllable; thus forms such as *Vaglio* do not get longer as a result of this. [Bembo, *Prose*, § 28 in Bembo 1967:136][40]

Noteworthy is that Bembo avoids any technical-linguistic terminology: his grammatical observations refer to orthographic notions – the letters *i* and *u* – instead of phonological or phonetic concepts such as diphthongs, open and closed syllables etc.[41] Half a century later, Leonardo Salviati adopts an almost identical approach in his *Regole della toscana favella* (1575 or 1576), in which attention is also drawn to the monophthong–diphthong alternation in the conjugation of some verbs in *–ere*: stem vowels may constitute a single unit with an additional *i* or *u* within the same syllable, for reasons "which would take too long to touch upon":

> Also irregular, although not as much, are a handful of verbs of the second conjugation of which the stem vowels take (before them and in the same syllable, nestling together), take, I said, in the stem either *i* or *u*, which do not appear in the infinitive; and instead of *sole* and *tene*, which *solere* and *tenere* would have generated, they get *suole* and *tiene* for reasons which would take too long to explain here. But we must realize that, according to our definitions presented above, *sole* and *tene* are the stems. [Salviati, *Regole*, 24,18-26 in Salviati 1991:173][42]

Of particular interest are the remarks made by Benedetto Varchi in his unpublished *Gramatica toscana* (±1540) and *L'Hercolano* (published posthumously in 1570).

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[39] For the original source text in Italian, see Appendix A.3.
[40] For the original source text in Italian, see Appendix A.3.
[41] Formal linguistic terminology is avoided throughout the *Prose*; other examples: *il numero del meno* 'singular', *il numero del più* 'plural', *voce che in vece di nome si pone* 'pronoun', *tempo che a venire è* 'future tense'.
[42] For the original source text in Italian, see Appendix A.4.

Not only does he stipulate that the superlative of *buono* 'good' must be *bonissimo* without "*u* liquida", but he also judges *buonissimo* to be a barbarism:

> Those who add letters or transpose them and say *buonissimo* instead of *bonissimo*, still speak barbarically. [Varchi, *Gramatica toscana*, 185r in Maraschio 2002:120][43]

> The positive form *buono* is written with a liquid *u* before *o*, but we do not pronounce nor write the superlative as *buonissimo*, as do many strangers, but we have to write and pronounce *bonissimo* without liquid *u*. [Varchi, *L'Hercolano*, *Ques.* VII, 169 in Varchi 1995:726][44]

These normative comments in Varchi's grammar are significant since they point at the hypercorrect extension of the mobile diphthongs in unstressed syllables in both written and spoken language. Although the first dictionary published by the Crusca Academy in 1612 exclusively gives *bonissimo*, it is noteworthy that an author such as Bembo (who has left his indelible stamp on the first edition of this *Vocabolario*) writes *buonissimo* in his *Prose*. Hence, by the time Buommattei introduced the term *dittonghi mobili* in 1623 (see § 2.1), the historically motivated monophthong–diphthong alternation was already competing with the effects of allomorphy reduction (under the pressure of paradigm uniformity). Through the centuries, the latter won more and more ground, both in and outside Tuscany, the diphthongs being hypercorrectly extended to unstressed syllables, as exemplified by Migliorini (1963:467, 537, 626, 702), e.g. *giuocare* 'playing', *risuonare* 'to resound', *muoveva* 'he was moving', *suonata* 'sonata', *tuonare* 'to thunder', *infuocato* 'red-hot, burning', *presiedeva* 'he was chairing'. However, grammars and dictionaries persisted in presenting the *regola del dittongo mobile* as a particular feature of Italian morphology, even if they admitted – or regretted – that the rule was often violated.

Luigi Fornaciari (1851, 1858), for instance, explains the phenomenon of the *dittongo mobile* but acknowledges that "the use of our classics regularly departs from this grammatical rule, to which a large number of exceptions could be made" (Fornaciari 1851:36-37, n.7).[45] Raffaello Fornaciari (1872:27) assumes that the diphthong is often preserved in unstressed syllables to avoid homonymy (e.g. *notare* 'to note' vs *nuotare* 'to swim') or "per pienezza di suono", which literally means 'fullness of sound' and may be interpreted as the tendency to maintain the full value of the stressed syllable also in the corresponding unstressed syllable. In his normative work with the significant title *Lessico dell'infima e corrotta italianità*, first published in 1881, the author Costantino Arlìa wonders why even linguists disrespect "this most easy and simple rule of the 'mobile diphthong'" (Arlìa 1911:172).[46]

The treatment of the *dittongo mobile* in twentieth-century grammars and dictionaries is extensively discussed in van der Veer (2001). It appears that this treatment

[43] For the original source text in Italian, see Appendix A.5.
[44] For the original source text in Italian, see Appendix A.6.
[45] "(...) l'uso de' nostri classici non rade volte discorda da questa regola de' gramatici, alla quale molte più eccezioni si potrebbero fare."
[46] "(...) [q]uesta regola facilissima e semplicissima del 'dittongo mobile' (...)"

was far from uniform. On the one hand, the rule was more or less rigorously defended by a number of purists, such as Gabrielli (1956, 1980), Cappuccini and Migliorini (1962) and Migliorini, Tagliavini and Fiorelli (1969). On the other hand, several descriptive grammars and dictionaries pointed – and still point – at the numerous exceptions to this rule, although these works are characterized by a striking lack of coherence. Consequently, one single form, e.g. *scoteva*, is considered by different authors as either the only possible or the recommended or a non-existent 3rd person singular of the imperfect tense of *scuotere* 'to shake'. This lack of coherence may be attributed to the fact that the subject has hardly ever been fully researched before. In fact, van der Veer (2001) is the first attempt to compile a corpus of data in order to illustrate the use of the mobile diphthongs in the written language: it includes more than 900 pieces of data collected from modern Italian texts (see § 2.5.3). Sporadically, the phenomenon has been analyzed from a phonological point of view; these theories are dealt with in the next section.

2.5.2. Phonology

2.5.2.1. Saltarelli (1970)

The first phonological formalization within the framework of generative grammar that explicitly refers to the term *dittonghi mobili*, is presented in Saltarelli (1970:83). He accounts for the monophthong–diphthong alternation by adopting the underlying diphthongs /iɛː/ and /uɔː/, from which simplex vowels are derived by means of a monophthongization rule. This rule applies after a rule which turns high vowels into glides when they are adjacent to a vowel:

(2.1) Saltarelli's gliding rule

$$\begin{bmatrix} \text{–consonantal} \\ \text{–length} \end{bmatrix} \rightarrow \begin{bmatrix} \text{–vocalic} \\ \text{–sharpness}^{47} \end{bmatrix} / \quad \underline{\quad} \; [\text{–consonantal}] \; \underline{\quad}$$

In a second cycle, the monophthongization rule deletes the glides before unstressed, long, open vowels:

(2.2) Saltarelli's monophthongization rule

$$\begin{bmatrix} \text{–vocalic} \\ \text{–consonantal} \end{bmatrix} \rightarrow \varnothing \; / \quad \underline{\quad} \begin{bmatrix} \text{–consonantal} \\ \text{+vocalic} \\ \text{–tense} \\ \text{+length} \\ \text{–stress} \end{bmatrix} \; [\text{–}[\text{+Derivative}]]$$

Saltarelli explains how these rules work making use of an example, presented below in (2.3) in a slightly adapted version:

[47] This feature covers affricated and palatalized consonants, which are [–sharp].

(2.3) Monophthongization according to Saltarelli

Cycle I		kuɔːr+aːdʒ+o
Cycle I	gliding + stress rule	ˈkwɔːr+aːdʒ+o
Cycle II	stress rule	kwɔːr+ˈaːdʒ+o
Cycle II	monophthongization rule	kɔːr+ˈaːdʒ+o

A later rule – not given – will tense the unstressed mid vowel into [o]. The extra condition [-[+Derivative]] ensures that the rule in (2.2) does not apply to derived nouns, e.g. a noun+suffix. Hence the occurrences of alternations such as

pedone 'pedestrian' vs *piedone* 'big foot'

are explained as

$_{N}$[pjɛːd+oːn+e] vs $_{Nd}$[$_{N}$[pjɛːd+e]+oːn] (Saltarelli 1970:77).

It is important to realize that, contrary to all other approaches, Saltarelli assumes an underlying vowel length contrast in Italian. However, it is unclear to me how the derived monophthongs are shortened in unstressed syllables. In fact, the correct output in (2.3) should be [koˈraddʒo], not *[koːraːdʒo].

The *piedino*/*pedone* example fails to clarify the distinction between the notions 'derived ' and 'derivatives'. The [–[+derivative]] condition seems to apply only to productive processes, which, according to the author, involve mainly suffixes, namely diminutives, augmentatives, pejoratives, superlatives etc. (see Saltarelli 1970:77). In that case, interpreting the monophthong–diphthong alternation in terms of monophthongization instead of diphthongization predicts the preservation of underlying diphthongs where it is not correct. For example: for *ometto* [oˈm+ett+o] – diminutive of *uomo* [ˈwɔmo] 'man' – we should adopt an underlying stem /uɔːm/. The consequence is that Saltarelli's rule incorrectly predicts that the glide is preserved in this word: *[woˈmetto].

Finally, it is not specified how the theory works for verbal forms. I suppose that for verbs such as *tenere* [teˈnere] 'to hold' and *venire* [veˈnire] 'to come' we could posit the underlying stems /tjɛːn/ and /vjɛːn/, for which Saltarelli's rules would generate inflected forms such as *tieni* [ˈtjɛni] 'you hold' vs *teniamo* [teˈnjamo] 'we hold'. Regardless of how Saltarelli would choose to account for the vocalic alternation in verbal inflection, he would still have to tackle the distinction between verbal inflections with a monophthong–diphthong alternation, such as *tenere*, and those without it, such as *piegare* 'to fold': *piego* [ˈpjɛgo], *pieghiamo* [pjeˈgjamo].

2.5.2.2. Marotta (1987, 1988)

A brief reference to the term *dittonghi mobili* is made in Marotta (1987), a study of bivocalic sequences in Italian. The term is used only to describe the monophthong–diphthong alternation, which characterizes word pairs such as *uovo~ovale*, *siede~sediamo*, *nuovo~novità*, whereas the author observes that new derivations maintain the diphthong in unstressed position, e.g. *piede~appiedare*. The study does not present a phonological formalization of this phenomenon.

The (non-)occurrence of vowel/diphthong alternations is not explained either in Marotta (1988). However, this analysis of Italian diphthongs within the autoseg-

mental framework makes some interesting claims concerning the distribution and syllabification of diphthongs in Italian.

In Marotta's proposal, a distinction is made between the palatal onglides and the velar ones, based on two sources of evidence: the distribution of the glides [j] and [w] on the one hand, and the distribution of the masculine article allormorphs [il], [l] and [lo] on the other.

The main difference between [j] and [w] is that [j] combines freely with any vocalic nucleus and can be preceded by any consonant. The distribution of [w] is restricted: it surfaces only before [ɔ] (and its unstressed phonetic allophone [o]) or after [k,g]. In other words, [j] has an autonomous phonological status, whereas [w] does not. Free variation is observed only for the combinations [wɔ] or [kw, gw]. This observation leads Marotta to conclude that the only true rising diphthong in Italian is [wɔ] and should be syllabified into the syllable nucleus. A special status is reserved for [kw, gw]. From a phonetic point of view, there seems to be evidence for the shorter duration of post-velar [w] as compared to the duration of [w] in other contexts. It is therefore suggested that the combinations [kw, gw] should be interpreted as labialized consonants, [k^w, g^w].

Summarizing, Marotta proposes the following representations of Italian rising diphthongs:

(2.4) (a) ON (b) N (c) ON ON

jV wɔ k^wV g^wV

She admits that in one specific context this analysis results in an ambiguous representation, namely in the sequence [k,g]-[w]-[ɔ], as in *cuore* 'heart'. Is [w] part of the nucleus or part of the onset? Further research is needed to answer this question, as suggested by Marotta (1988:401):

> Thus, clear criteria as well as the analysis of the phonological system of the language are needed in order to choose the right representation, namely the representation which better conforms not only to the theory, but also to the linguistic data.

In favour of the asymmetric analysis of rising diphthongs, Marotta cites evidence regarding the selection of the masculine definite article allomorphs [il], [l] and [lo]. Before word-initial [wɔ], the allomorph [l] is selected, e.g. *l'*[wɔ]*mo* 'the man'. Since [l] is selected before vowels (or syllable nuclei), this confirms the nucleus analysis of [wɔ].

On the other hand, [lo] is selected before word-initial [j], as in *lo* [j]*ato* 'the hiatus', which would confirm its onset status. Since words beginning with [j] seem to behave like words with initial consonants that are normally geminates in intervocalic positions – [ɲ, ʃ, ʎ, ts, dz] – it is argued that [j] also becomes long in intervocalic position and is doubly syllabified into the coda of the preceding syllable and the onset of the following syllable. Note that this argument is not based on any phonetic

evidence and that others claim that [j], like [w] and [z], is always short (see Lepschy and Lepschy 2000:59, 61 and Schmid 1999:169).

The striking result of the analysis above is that the two 'mobile diphthongs' have different phonological representations. The following section presents an alternative analysis.

2.5.2.3. Sluyters (1992)[48]

Sluyters (1992) analyses [jɛ] and [wɔ] analogously and keeps them apart from the other rising [jV] and [wV] diphthongs that exist in Italian. The analogy is twofold. First, the diphthongs [jɛ] and [wɔ] are homorganic rising diphthongs, because both elements of the diphthong have identical values for the features [back] and [round]. The other rising diphthongs in Italian are heterorganic since the glide does not agree in roundness and backness with the following vowel. Homorganic and non-homorganic rising diphthongs are claimed to be syllabified differently. Sluyters proposes a nucleus analysis of glides in homorganic diphthongs and an onset analysis of glides in heterorganic diphthongs. Second, it is shown how and why both diphthongs, "usually referred to as *dittonghi mobili*" (Sluyters 1992:269) are synchronically derived from underlying /ɛ/ and /ɔ/.

In Sluyters' proposal, the syllabification of rising diphthongs is determined exclusively by the principles of sonority hierarchy. In the spirit of Clements (1990), he states that the minimal sonority distance required to syllabify two segments into a subsyllabic constituent (like the onset) in Italian is 2. Starting point is the following sonority scale (of which the terminology is slightly adapted here in the interest of expository simplicity):

(2.5)

Obstruents	Nasals	Liquids	[i/j,u/w]	[e,o]	[ɛ,ɔ]	[a]
7	6	5	4	3	2	1

Sluyters concludes that the principle of minimal sonority distance automatically excludes the occurrence of liquid-glide onset clusters, which have a distance of only 1. Thus, the absence of word-initial liquid-glide onset clusters in Italian is explained. Significantly, a word-initial liquid can be followed by a homorganic diphthong, as in [ljɛto] *lieto* 'happy' and [rwɔta] *ruota* 'wheel'. This would suggest that the glide of a homorganic diphthong is not syllabified into the onset. It should be noted that word-internal liquid-glide clusters do occur, as in [italjano] *italiano* 'Italian'. Sluyters (*op.cit.*:179) admits that these clusters are "more difficult to evaluate". This problem is discussed in § 5.3.1.

Homorganic and non-homorganic rising diphthongs also manifest different behaviour with respect to the allomorphs of the masculine singular article. Sluyters argues that the allomorph [il] is selected only before consonants that belong to the onset, whereas [lo] appears before elements that do not belong to the onset. Such elements are vowels (where [lo] is chosen, after which [o] is deleted). Since vowels belong to the syllable peak (or nucleus), we must assume, according to Sluyters, that the glides in homorganic diphthongs are part of the nucleus, resulting in e.g.

[48] The chapter in Sluyters' (1992) dissertation discussed here also appeared as Sluyters (1990).

l'[wɔ]*mo* 'the man'. The allomorph [lo] is also selected before geminates and heterosyllabic consonant clusters, since the first part of word-initial geminates and heterosyllabic consonant clusters are considered as extrasyllabic, i.e. not belonging to the onset. In the analysis under consideration, the glide [j] in heterorganic diphthongs is assumed to be a geminate underlyingly and therefore triggers selection of [lo], e.g. *lo* [jːa]*to* 'the hiatus' (cf. Marotta 1988). As stated in the previous section, however, the glide [j] is presumably never a geminate, neither underlyingly nor in intervocalic position. An alternative approach of article allomorph distribution before glides will be presented in chapter 5.

In the last chapter of his dissertation, Sluyters provides a metrical account of the occurrence of the homorganic diphthongs [jɛ] and [wɔ]. It is argued that both diphthongs are the result of a synchronic diphthongization rule, which is closely related to a rule that lengthens vowels: both phonological processes have the stressed open syllable as their domain of application and are aimed at creating well-formed binary feet.

In the spirit of Kiparsky's (1985) Lexical Phonology, Sluyters argues that diphthongization of underlying /ɛ/ and /ɔ/ applies only in stressed open syllables which are derived as a consequence of a morphological operation. In forms such as *m*[wɔ]*ri* (< /mɔr/+/i/) 'you die' and *c*[wɔ]*cere* (< /kɔtʃ/+/ere/) 'to cook', a stressed open syllable is created after resyllabification of the stem-final consonants. When the stressed open syllable is not derived but stem-internal, like in *p*[ɛ]*cora* (< /pɛkor/+/a/) 'sheep', diphthongization does not apply. The fact that some stressed suffixes surface with diphthongal stems, whereas others surface with monophthongal stems is also explained, *buonissimo* 'very good' and *bonario* 'good-natured' being given as examples. In Sluyters' Lexical Phonology approach, the difference between these two forms is accounted for by assuming that certain affixes (such as *–issimo*) are attached to their bases postlexically, i.e. after the bases have been completely derived, whereas the attachment of other suffixes (such as *–ario*) is a lexical operation, i.e. they are attached to the bases at an early level in the derivation, where they attract main stress, the unstressed base vowels remaining monophthongs.

According to Sluyters, vowel lengthening and diphthongization are expected phonological processes in quantity-sensitive stress systems, where stress is preferably assigned to prominent – heavy – syllables, i.e. syllables containing elements such as long vowels and diphthongs. Sluyters hypothesizes that in Italian, which he claims is quantity-sensitive, an underlying light syllable is lengthened when stressed and the resulting heavy syllable is grouped together with a following unstressed light syllable to form an uneven binary foot. Following this theory, the diphthongs derived from underlying /ɛ/ and /ɔ/ are phonologically equivalent to lengthened vowels, in that they both surface in stressed open syllables within binary feet.

One of the concluding remarks in this chapter is that for many speakers lengthening is variable and that, therefore, lengthening rules are optional. In fact, "a quantity-sensitive binary foot is well-formed also when its dominant syllable is light" (Sluyters 1992:305). It remains unclear why in Sluyters' analysis, this notion of "metrical optionality" can apply only to vowel lengthening, since the occurrence of [jɛ] and [wɔ] in stressed syllables does not seem to be optional in standard Italian.

Crucially, diphthongization is claimed to be a synchronic rule in standard Italian. This claim is based on the attested alternations between diphthongs and corresponding monophthongs due to some stress-shifting morphological operations. However, as will be demonstrated in the following section, evidence in the written language shows that this alternation pattern is subject to a great deal of variation, which has led others to the conclusion that the diphthongization rule is no longer active in the modern language (cf. Bertinetto 1998/1999 and Turchi and Bertinetto 2000). This particular issue will be investigated and discussed in detail in the present dissertation.

2.5.3. The twentieth century

By the end of the twentieth century, there is abundant written evidence that the monophthong–diphthong alternation due to stress is subject to a great degree of analogical levelling. In numerous cases the diphthongs are found to have extended to unstressed syllables (cf. van der Veer 2001). This is particularly true for the front diphthong, whereas the back diphthong seems slightly more resistant to the process of levelling.[49] The diminutives[50] of nouns and adjectives such as *piede* 'foot', *pietra* 'stone', *cieco* 'blind', *tiepido* 'tepid' all preserve the diphthong: *piedino*, *pietrina*, *ciecolino*, *tiepidino*, whereas the diphthong seems consistently absent in the diminutives of *uomo* 'man' and *uovo* 'egg': *ometto*, *ovetto* and appears optionally in those of words such as *buono* 'good', *fuoco* 'fire', *ruota* 'wheel', *stuoia* 'mat': *b(u)onaccione*, *f(u)ocherello*, *r(u)otina*, *st(u)oina*.

Analogical levelling has also given way to the preservation of the front diphthong in transparent and productive derivations: *lieto* 'glad' vs *lietezza* 'joy', *miele* 'honey' vs *mieloso* 'honeyed', *mietere* 'to reap' vs *mietitore* 'reaper', *tiepido* vs *tiepidezza* 'warmth' (but optional alternation in *dieci* 'ten' vs *d(i)ecina* 'ten or so', *lieve* 'light' vs *l(i)evità* 'lightness'). As far as the back diphthong is concerned, vocalic alternation still occurs in e.g. *muovere* 'to move' vs *movimento* 'movement', *nuovo* 'new' vs *novità* 'novelty' and is optional in e.g. *fuoco* vs *inf(u)ocare* 'to make red-hot', *riscuotere* 'to draw, to earn' vs *risc(u)otimento* 'rancour', *suonare* 'to play, to sound' vs *s(u)onatore* 'player'. Unstressed vowels in derivatives previously imported from Latin do not exhibit this process: although these words may still be morphotactically analysable, they are often semantically opaque with respect to the (original) base words and the need for analogical levelling is therefore not felt by the speaker (cf. Bertinetto 1999*b*), e.g. *pedone* 'pedestrian' (cf. *piede* 'foot'); *focolare* 'fireside' (cf. *fuoco* 'fire'); *coraggio* 'courage' (cf. *cuore* 'heart').

The situation is more or less similar for first conjugation verbs: vocalic levelling has given way to an invariant stem in *vietare* 'to forbid' (*vieto* vs *vietate*) but is optional in verbal stems with the back diphthong: *suona* vs *s(u)onava*, *tuona* vs *t(u)onava* 'to thunder' (although there seems to be a preference for the invariant roots). Most probably the regularity of the first conjugation verbs disfavours any allomorphic alternation (cf. Maiden 1995:138). Sometimes levelling favours the

[49] Migliorini (1990:37) even claims that the alternation [jɛ]/[e] is practically "dead".

[50] In this dissertation, the term 'diminutive' covers all evaluative suffixes, such as pejoratives, augmentatives and similar suffixes (see fn. 66, chapter 4).

generalization of the monophthongal alternant, as in *levare* 'to lift' and *negare* 'to deny': *leva* vs *levava*, *nega* vs *negava*, the forms with stressed diphthongs being considered as archaic: *lieva*, *niega*. This is also true for the verbs *notare* 'to note' and *votare* 'to vote' which differ only minimally from the verbs *nuotare* 'to swim' and *vuotare* 'to empty' with generalized diphthongs.

The variation is somewhat greater in conjugation verbs of other conjugations. The front diphthong has been extended to unstressed syllables in the verbs *chiedere* 'to ask' and *mietere* but the stems of *tenere* 'to hold', *venire* 'to come' and *sedere* 'to sit' are still subject to the mobile diphthong rule: *tiene* vs *teneva*, *viene* vs *veniva*, *siede* vs *sedeva* (but the future tense is unstable: *s(i)ederà*). The back diphthong alternates optionally in verbs such as *cuocere* 'to cook', *muovere* 'to move' and *scuotere* 'to shake': *c(u)oceva*, *m(u)oveva*, *sc(u)oteva*. But in a restricted group of non-first conjugation verbs with a highly irregular present indicative, the [wɔ/o] alternation persists: *dolere* 'to ache', *solere* 'to be in the habit of', *potere* 'to be able', *volere* 'to want', *morire* 'to die': *duole* vs *doleva*, *suole* vs *soleva*, *vuole* vs *voleva*, etc. The alternation is levelled in favour of a generalization of the monophthong in the highly regular third conjugation verb *coprire* 'to cover': *copre* vs *copriva* (*cuopre* is an archaic form).

The adverbial suffix *–mente* and the superlative suffix *–issimo* seem to trigger the preservation of both front and back diphthong as in *lietamente*, *lietissimo*, *lievemente*, *lievissimo*, *buonissimo*, *nuovamente*, *nuovissimo*.[51]

In sum, on the basis of a large corpus of written sources I hypothesize that (1) levelling of the monophthong–diphthong alternation is also salient in contemporary spoken Italian**,** (2) that this process first affected words which were related to the base word (with the stressed diphthong) through highly productive and predictable morphological processes (diminutivization, inflection of regular verbs, suffixation of *–mente*/*-issimo*) and later also semantically transparent derivatives and (3) that levelling is virtually complete for words with front vowels, whereas the back diphthong is slightly more resistant to the process of levelling.

2.6. Summary

In this chapter, I presented as much background information as is required for a proper understanding of the two Italian mobile diphthongs [jɛ] and [wɔ]. From a diachronic point of view, it was shown that both diphthongs are the result of an early pan-Romance diphthongization process which affected stressed front and back mid-low vowels. As a consequence, the diphthongs are traditionally considered as 'mobile' in Italian grammars and dictionaries, since they alternate with corresponding unstressed monophthongs when stress shifts to a following syllable due to some morphological operation: the so-called *regola del dittongo mobile*.

Modern grammars emphasize that this 'mobile diphthong' rule has many exceptions. In fact, in written sources the monophthong–diphthong alternation is very much affected by analogical levelling, resulting in a generalization of the diphthongs

[51] Cf. de Bruyne (1992), who reports on findings from his study into the variation in Spanish between forms such as *bonísimo* and *buenísimo*.

in unstressed syllables. However, the information that the authors of modern grammars provide is far from coherent, which is not surprising since the phenomenon has scarcely been researched from a synchronic point of view. In phonology, attempts were made by Saltarelli (1970) and Sluyters (1992). Sluyters' analysis is unique in the sense that it not only presents a detailed description of the phonological structure of the two mobile diphthongs, but also explains the monophthong–diphthong alternation – or its absence under some conditions – and provides us with a metrical account of the occurrence of both homorganic diphthongs.

Chapter 3 in this thesis deals with a number of hypotheses following from Sluyters' analysis and focuses on durational similarities and differences between vowels and rising diphthongs. In chapter 4, I will report on the results of a variation analysis, which investigated to what extent analogical levelling occurs in contemporary spoken Italian and why it seems to affect front and back diphthongs differently, as attested in written sources. An optimality-theoretic interpretation of the results of the experiments will be proposed in the remaining chapters.

3 Experiment I: Duration

3.1. Introduction

According to Sluyters' (1992) analysis of Italian diphthongization presented in the previous chapter, the mobile diphthongs [jɛ] and [wɔ], which are said to arise synchronically as the result of diphthongization, should occur in the same environment as long vowels. In Italian, vowel length is not contrastive. However, vowels in stressed open syllables are durationally long, as shown in a number of vowel duration experiments (Fava and Magno Caldognetto 1976, Vogel 1982, Marotta 1985). Furthermore, two experiments (Farnetani and Kori 1990 and D'Imperio and Rosenthall 1999) report that prefinally stressed vowels are significantly longer than preprefinally stressed vowels.[52] In the literature, the presence of durationally long vowels in stressed open syllables is traditionally interpreted as a phonological process of vowel lengthening, which is discussed in, among others, Muljačić (1969), Tagliavini and Mioni (1974), Vogel (1982), Chierchia (1986), Nespor and Vogel (1986), Repetti (1991), Bullock (1998), Wiltshire and Maranzana (1999) and Morén (1999). Conversely, Bertinetto (1981) claims that vowel quantity does not play a role in the phonology of Italian (see fn. 76, chapter 5).

If [jɛ] and [wɔ] are to be considered as the diphthongal equivalents of long vowels, we may hypothesize that there is also a durational equivalence, i.e. that the durations of [jɛ] and [wɔ] are equal to those of long vowels. In addition, Sluyters' proposal will predict durational discrepancies between the homorganic diphthongs [jɛ] and [wɔ] and other rising, non-homorganic diphthongs, which did not arise as a consequence of diphthongization. As seen in the previous chapter, Sluyters postulates a syllabification contrast for the two types of diphthongs. While [jɛ] and [wɔ] are entirely syllabified into the nucleus, the glide of other rising diphthongs is syllabified into the onset. In stressed open syllables, the duration of the vocalic portion of the heterorganic diphthongs is therefore expected to match that of other vowels in stressed open syllables. Hence, the whole duration of heterorganic diphthongs is predicted to be longer than that of [jɛ] and [wɔ], which are claimed to be equivalent to long vowels.

In the phonetic and phonological literature, little attention has been devoted to the duration of Italian diphthongs. In this regard Salza (1986, 1988, 1991*a*,*b*) can be considered as a pioneer. His experiments on bivocalic sequences (diphthongs and vowel clusters) reveal some interesting aspects of the mutual influences occurring in contiguous vocoids. His findings are based on two different types of speech material: nonsense words embedded in sentence frames and meaningful words in normal sentences, produced by only one speaker. The materials, however, did not contain [jɛ] and [wɔ] diphthongs.

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[52] In both studies, the two stress conditions are compared in words which differ in number of syllables.

This chapter offers a new contribution to the analysis of Italian vocalic segments in that a comparison is made between monophthong duration and diphthong duration in open syllables, in order to test the following hypotheses:

(3.1) (a) The duration of long vowels is equivalent to the duration of the 'mobile diphthongs' [jɛ] and [wɔ].
(b) The duration of the 'mobile diphthongs' [jɛ] and [wɔ] is shorter than the duration of other stressed rising diphthongs.
(c) Stressed 'non-mobile diphthongs' are longer than long vowels.
(d) Stressed pre-prefinal monophthongs and diphthongs are shorter than stressed prefinal monophthongs and diphthongs.

The present chapter reports on a production experiment that allows acoustic measurements of the duration (in stressed and unstressed syllable positions) of:

- monophthongs;
- the glide portion of rising diphthongs;
- the vocalic portion of rising diphthongs;
- the complete rising diphthongs.

The method of the experiment is laid out in § 3.2, which describes the selection of speakers and speech materials, recording procedures and the instrumental analysis of the collected data. In § 3.3, the results of the acoustic analysis are presented and discussed. The final conclusions will be provided and discussed in § 3.4.

3.2. Method

3.2.1. Speakers

Recordings were made with a group of ten speakers between the ages of 20 and 27, all university students, five males and five females, who were born and/or raised in the province of Pisa and who considered themselves speakers of Standard Italian and reported no speech defects. The informants were paid a fee.

3.2.2. Material

The design of the stimuli corpus was carried out following some preliminary conditions imposed on the target words:

(3.2) (a) All items are existing words in the Italian lexicon.
(b) The relevant syllables are open.
(c) The corpus is relatively homogeneous; therefore,
- the consonants that precede and follow the target segments are preferably plosives; preceding consonant clusters are avoided;
- all target syllables are preceded by a syllable [ri]- to avoid a mix of

word initial stress and word-medial stress (with only two exceptions);
- for each type of target segment the target words should be paradigmatically or etymologically related.

The following variables in the stimulus materials were defined and motivated:

(3.3) (a) Vowel: front/back/low.
Target vowels are front: [ɛ/e], back: [ɔ/o][53], and low: [a]: [ɛ] and [ɔ] since they are part of the diphthongs [jɛ] and [wɔ], and [a] as an additional non-high control vowel.

(b) Preceding glide: [–glide]/[jV]/[wV].
Monophthongs are compared with rising diphthongs;

(c) Stress: [+stress]/[–stress].
Unstressed control vowels are needed to measure the degree of stressed vowel lengthening.

(d) Syllable position: [pre-prefinal]/[prefinal].
Some studies of Italian vowel duration report durational differences in pre-prefinal and prefinal position; final syllables fall outside the scope of this research, because stressed word-final rising diphthongs in polysyllabic words are rare.

(e) Cliticized target word: [+clitic]/[–clitic].[54]
According to D'Imperio and Rosenthall (1999), the addition of a clitic may have an effect on stressed vowel duration.

This design would result in 72 target words. However, cliticized words with prefinal stressed open syllables do not exist, so these nine options were eliminated. Besides, we restricted the variables for the unstressed vowels to pre-prefinal syllable position in non-cliticized words. Of the remaining 36 possibilities, two were not found in the lexicon. The 34 target words finally remaining were embedded in the carrier sentence *Dico* <word> *di nuovo* 'I say <word> again'. The list of stimulus materials was printed on paper. To avoid stress misplacement, the syllables that needed to be stressed were underlined. The target words are presented in table B.2 (included in Appendix B); impossible options are marked with an asterisk.

3.2.3. Procedure

The speakers, who were not informed about the purpose of the experiment, read the list of items before recording.[55] They received as few instructions as possible, in order to have them read the list in a natural way. However, they were requested to maintain the same intonation pattern for all utterances.

The recordings were made in a sound-proofed booth at the Linguistic Laboratory of the Scuola Normale Superiore in Pisa. The utterances were recorded through a

[53] Recall that, in unstressed position, [ɛ] and [ɔ] are raised to [e] and [o].
[54] Only enclitics are considered here.
[55] I am very grateful to Maddalena Agonigi (Scuola Normale Superiore, Pisa), who selected the ten native speakers.

Sennheiser MD441-u microphone on a Casio DAT-DA2 recorder which was placed outside the recording booth. After each recording session, speakers were asked, if necessary, to repeat one or more items, if these had not been produced correctly in the first session.

3.2.4. Data analysis

The 340 speech utterances (10 speakers × 34 target words) were downsampled to 16 kHz and analyzed with the Praat (version 4.0.1.) speech processing software (Boersma and Weenink 1996, Boersma and van Heuven 2001). Manual segmentation of the target segments was based on the information provided by the waveforms and wide-band spectrograms (0.005 s/5 kHz), according to standard procedures (cf. Salza 1988). When vowels were preceded and followed by a plosive, most acoustic segment boundaries were immediately evident in the waveform. A label was placed at the very first and at the very last vocal fold period with significant amplitude in the waveform. The release bursts were not included in the following vowel duration. Boundaries between glides and vowels were set at the point where the first formant asymptotes. Figures 3.1 and 3.2 are representative examples of how time boundary segmentation was performed. On the basis of the segmentation, I measured the duration in ms of the following target segments:

- 120 monophthongs (12 × 10 speakers);
- 220 diphthongs (22 × 10 speakers):
  - 220 glide portions;
  - 220 vocalic portions.

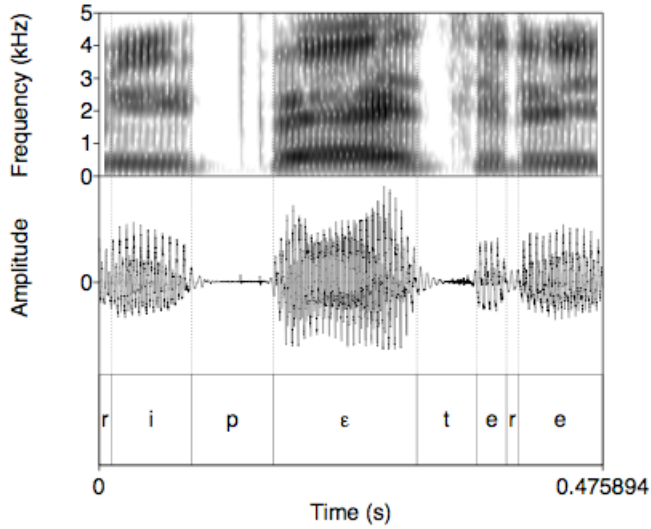

Figure 3.1: Time boundary segmentation of the target word [ripɛtere], based on waveform and spectrogram.

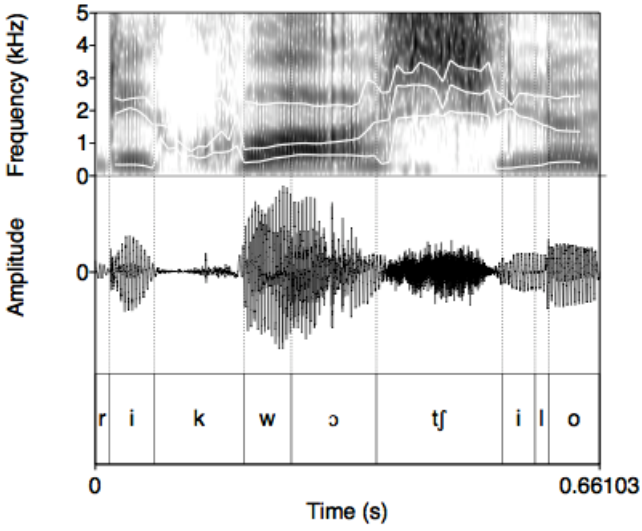

Figure 3.2: Time boundary segmentation of the target word [rikwɔtʃilo], based on waveform, spectrogram and F1.

3.3. Results

After the duration measurement, the recorded materials for one male speaker proved to be unusable: due to excessive pauses within the carrier sentence, the target word was predominantly uttered separately from the rest and with strong intonational emphasis. Another six missing values were registered for two other speakers.[56] The 696 remaining tokens (12 monophthongs + 22 glide portions + 22 vocalic portions + 22 full diphthongs = 78 × 9 speakers = 702 – 6 missing values) were submitted to a number of separate analyses of variance (ANOVA) making use of the SPSS statistics package. Standard (between-subject) ANOVAs were carried out with stress/syllable condition and vowel type as fixed factors and speaker as a random factor. Alpha was set at .05. Post-hoc tests for contrasts were run (Student Newman Keuls procedure) if the effect of stress/syllable condition was significant.

3.3.1. Monophthongal vowel duration

The data for vowel duration are presented in table 3.1. The results are summarized in figure 3.3, which plots vowel duration (milliseconds, ms) of vowels /a/, /ɛ, e/, and /ɔ, o/, broken down further by stress/syllable position.

Table 3.1: Mean (mn.) duration in milliseconds, standard deviation (s.d.) and number of cases (#) accumulated over nine speakers, broken down by vowel type, stress and syllable position in the word.

vowel	stress	pre-prefinal			pre-prefinal+cl.			prefinal			all		
		mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#
[a]	[+stress]	148	27	9	151	25	9	158	27	9	153	25	27
	[–stress]	89	15	9							89	15	9
[ɛ]	[+stress]	136	22	9	126	25	9	142	27	9	135	25	27
[e]	[–stress]	70	7	9							70	7	9
[ɔ]	[+stress]	134	20	9	141	23	9	155	20	9	143	22	27
[o]	[–stress]	77	12	9							77	12	9

[56] Speakers RB and PM failed to produce correctly the words *riquadro* and *riquadralo*, respectively (even though both had the opportunity to repeat the word once) resulting in missing values for 2 × 1 glide portion, 2 × 1 vowel portion and 2 × 1 full diphthong.

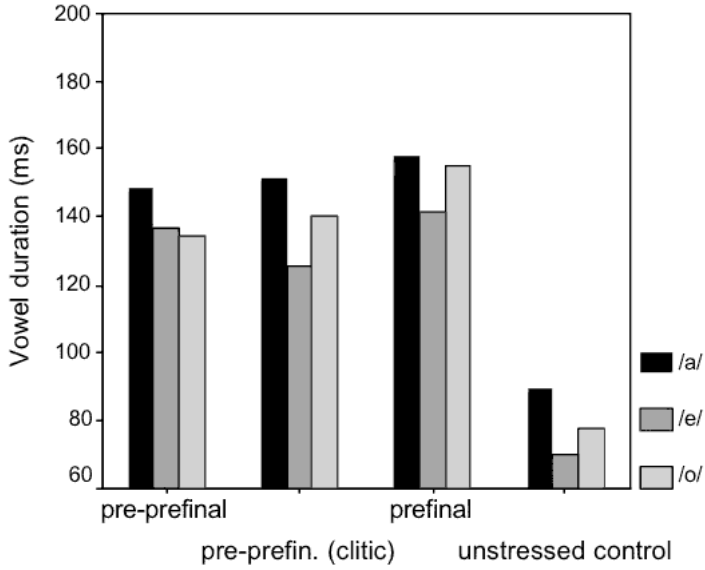

Figure 3.3: Mean duration (ms) for three vowels accumulated over nine speakers, broken down by stress and syllable position in the word.

Figure 3.3 shows that there are differences in vowel duration: [a] is longer than [ɔ/o] – 10 ms on average - and [ɔ/o] is longer than [ɛ/e] – 8 ms on average. The effect of vowel type is significant, $F(2,96) = 14.5$ ($p < .001$). Each vowel type differs significantly from the others.[57]

The figure also illustrates the effects of stress and position of the target syllable in the word on vowel duration. As claimed in the literature, stressed vowels are longer than unstressed vowels. The mean difference between the three stressed conditions and the unstressed control condition is 65 ms. In addition, there seems to be an effect of syllable position on vowel duration: prefinally stressed vowels are on average 12 ms longer than pre-prefinally stressed vowels. The overall effect of stress/position is significant, $F(3,24) = 96.8$ ($p < .001$). The stress/position conditions differ from each other, with the exception of the two pre-prefinal stress conditions (i.e. whether the word-final syllable is a clitic or not has no effect on vowel duration). The vowel type × stress/position interaction is not significant, $F(6,48) = 1.05$, ins.)

The difference in duration between stressed and unstressed vowels is considerably greater than among the three stressed syllable positions. The effect of syllable position may in fact be interpreted as a compensation effect of word duration. The target words are not equal with respect to their number of syllables: pre-prefinal vowels were measured in quadrisyllabic target words, whereas prefinal vowels were measured in trisyllabic words. I shall discuss this issue in detail in § 3.3.4.

[57] The SNK procedure was run as a sequel to a one-way ANOVA performed on the vowel durations after Z-normalization by speaker.

3.3.2. Diphthong duration

The diphthong durations are presented in tables 3.2 ([jV] diphthongs) and 3.3 ([wV] diphthongs). A graphical summary of these data, presenting diphthong duration (in ms) broken down by stress/position and by vowel type, is given in figures 3.4a-b for /j/ and /w/-glides, respectively.

Table 3.2: Mean (mn.) duration in milliseconds, standard deviation (s.d.) and number of cases (#) accumulated over nine speakers, broken down by diphthongal segment, stress and syllable position.

diph.	segm.	stress	pre-prefinal			pre-prefinal+cl.			prefinal			all		
			mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#
[ja]	[j]	[+stress]	36	7	9	37	13	9	40	9	9	38	10	27
		[−stress]	18	7	9							18	7	9
	[a]	[+stress]	114	21	9	111	24	9	113	16	9	113	20	27
		[−stress]	54	16	9							54	16	9
	[ja]	[+stress]	150	25	9	148	28	9	153	23	9	150	24	27
		[−stress]	72	16	9							72	16	9
[jɛ/je]	[j]	[+stress]	39	11	9	32	10	9	38	11	9	36	11	27
		[−stress]	16	7	9							16	7	9
	[ɛ]	[+stress]	114	16	9	108	15	9	119	17	9	114	16	27
	[e]	[−stress]	62	15	9							62	15	9
	[jɛ]	[+stress]	154	17	9	140	22	9	157	25	9	150	22	27
	[je]	[−stress]	78	19	9							78	19	9
[jɔ/jo]	[j]	[+stress]	48	15	9	47	12	9	53	15	9	49	14	27
		[−stress]	21	8	9							21	8	9
	[ɔ]	[+stress]	125	26	9	113	16	9	126	23	9	121	22	27
	[o]	[−stress]	56	9	9							56	9	9
	[jɔ]	[+stress]	172	35	9	160	26	9	179	33	9	171	32	27
	[jo]	[−stress]	77	12	9							77	12	9

Table 3.3: Mean (mn.) duration in milliseconds, standard deviation (s.d.) and number of cases (#) accumulated over nine speakers, broken down by diphthongal segment, stress and syllable position.

diph.	segm.	stress	pre-prefinal			pre-prefinal+cl.			prefinal			all		
			mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#
[wa]	[w]	[+stress]	59	11	9	64	14	8	62	11	8	61	11	25
		[−stress]	33	12	9							33	12	9
	[a]	[+stress]	105	22	9	105	22	8	112	19	8	107	25	25
		[−stress]	71	15	9							71	15	9
	[wa]	[+stress]	164	23	9	169	28	8	174	26	8	169	25	25
		[−stress]	104	17	9							104	17	9
[wɛ/we]	[w]	[+stress]	61	15	9							61	15	9
		[−stress]	38	11	9							38	11	9
	[ɛ]	[+stress]	121	19	9							121	19	9
	[e]	[−stress]	73	19	9							73	19	9
	[wɛ]	[+stress]	182	29	9							182	29	9
	[we]	[−stress]	111	22	9							111	22	9
[wɔ/wo]	[w]	[+stress]	59	11	9	60	14	9	58	14	9	59	13	27
		[−stress]	26	8	9							26	8	9
	[ɔ]	[+stress]	105	13	9	105	13	9	117	21	9	109	16	27
	[o]	[−stress]	63	6	9							63	6	9
	[wɔ]	[+stress]	164	16	9	164	20	9	175	24	9	168	20	27
	[wo]	[−stress]	89	6	9							89	6	9

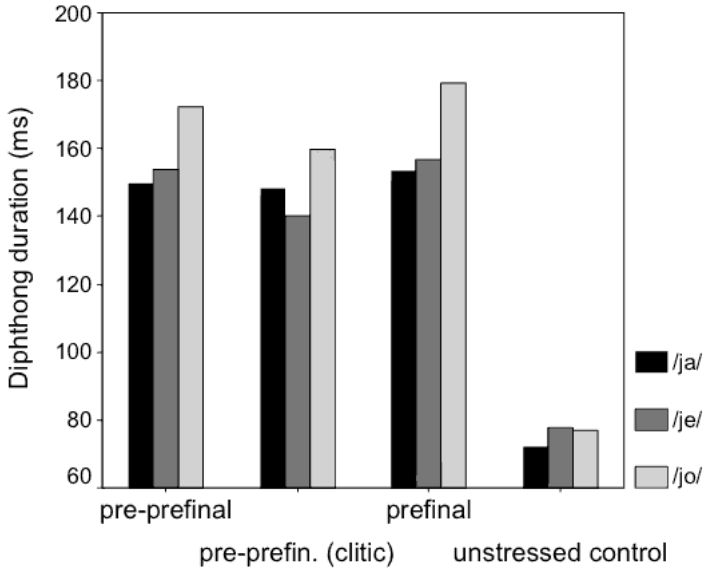

Figure 3.4a: Mean duration (ms) for three /jV/-diphthongs accumulated over nine speakers, broken down by stress and syllable position in the word.

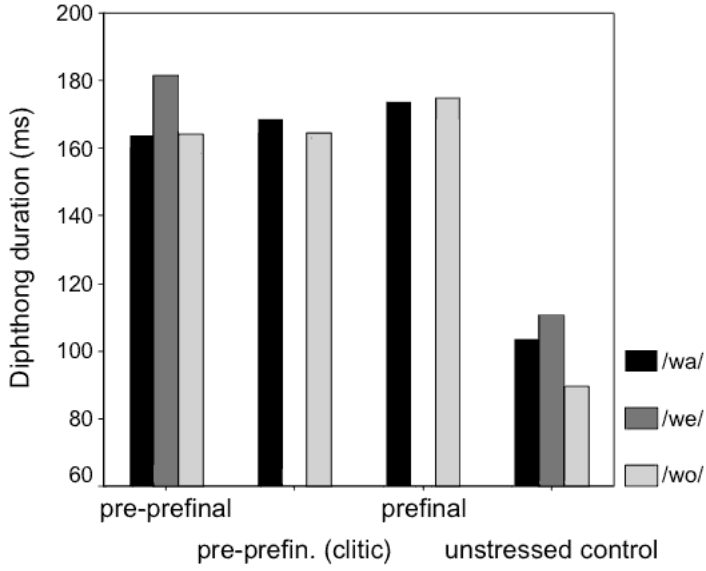

Figure 3.4b: Mean duration (ms) for three /wV/-diphthongs accumulated over nine speakers, broken down by stress and syllable position in the word.

In general, the duration of diphthongs is affected by stress in the same way as monophthongs. Stressed diphthongs (across all positions) are on average 74 ms longer than unstressed diphthongs. This effect is also visible (not shown in figure 3.4, but cf. tables 3.3-4) in the constituent elements of the diphthongs: glide portions in stressed diphthongs are longer than in unstressed diphthongs – 24 ms on average – while the stressed vocalic portions are on average 50 ms longer than the unstressed ones.

The overall effect of stress/position is significant, $F(3,24) = 129.6$ ($p < .001$). All stress/position conditions differ from each other, except the pair pre-prefinal (without clitic) and prefinal. Whether the presence versus absence of a clitic here really has an effect on diphthong duration, remains to be seen. As noted in the previous section, there may be an effect of word duration.

Importantly, the results do not support the hypothesis of a durational difference between the 'mobile diphthongs' [jɛ] and [wɔ] and the other rising diphthongs in stressed position. The mean values for [jɛ] are equal to those for [ja] and values for [wɔ] match those for [wa].[58] Consequently, the hypothesis that 'mobile diphthongs' should be distinguished from other rising diphthongs, is not supported by these empirical data where their duration is concerned.

Figure 3.5 presents the durations of glide and vowel portions of the diphthongs separately for diphthongs beginning with /j/ and those with /w/.

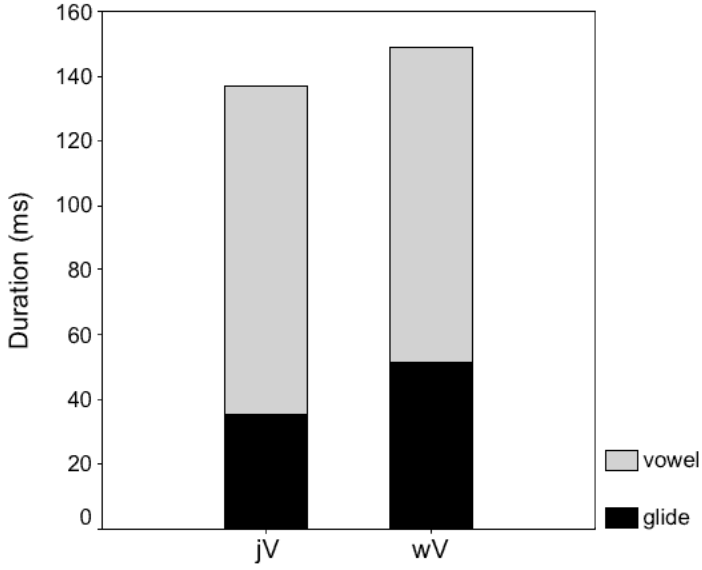

Figure 3.5: Mean duration (ms) of glide and vowel portions in diphthongs, accumulated over nine speakers, broken down by type of glide element.

[58] Within the group of [jV] diphthongs, stressed [jɔ] is surprisingly long (on average 21 ms longer than stressed [ja] and [jɛ]). Note that for [wɛ] only nine pre-prefinal cases were included.

Focusing on the two glides, we see that [w] is on average 52 ms long, i.e. 17 ms longer than [j]. This effect is significant by an ANOVA with glide type and stress/position as fixed factors and speaker as a random factor, $F(1,8) = 71.5$ ($p < .001$). Moreover, a longer glide duration is not compensated for by a shorter duration of the vocalic portion, since the mean durational difference between both types of diphthongs is 13 ms. Indeed, the vocalic portions following [w] are on average only 4 ms shorter than those following [j], which difference is totally insignificant, $F(1,8) < 1$. Predictably, the effect of glide type on the total duration of the diphthong is significant, $F(1,8) = 52.7$ ($p < .001$). Expressed in relative values, the glide-to-diphthong ratio within [jV] diphthongs is 1:3 and within [wV] diphthongs it is 1:2 on average.

3.3.3. Comparing monophthongs and diphthongs

The experiment allows us to compare the durations of monophthongs with those of diphthongs. Figure 3.6 plots the overall mean duration of monophthongs, diphthongs and post-glide vocalic portions, broken down by stress/syllable position. The comparison is based on quadrisyllabic words, except the words with prefinal stress on the relevant target segment, which are trisyllabic.[59]

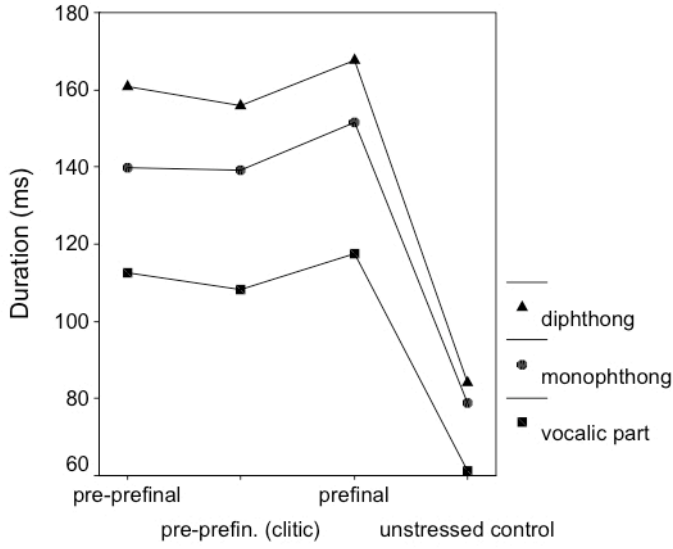

Figure 3.6: Mean durations of monophthongs, diphthongs and vocalic portions accumulated over nine speakers, broken down by stress and syllable position in the word (all words are quadrisyllabic except those with prefinal stress, which are trisyllabic).

[59] Concretely, this means that the two trisyllabic target words with [wɛ, we], *querulo* and *querela*, are not included in the comparison.

First, monophthongs, whether stressed or unstressed, are shorter than diphthongs: 16 ms on average. On the other hand, monophthongs are longer than the vocalic portions in rising diphthongs, by 23 ms on average.

Second, as seen in the previous section, the durations of both monophthongs and diphthongs are affected by stress. Stressed monophthongs are on average 1.85 times longer than the corresponding unstressed monophthongs; whereas stressed diphthongs are on average 1.96 times longer than unstressed diphthongs.

Third, both stressed monophthongs and stressed diphthongs are longest in prefinal syllable position. However, it is questionable whether this effect should be attributed to the syllable position in the word, since prefinal target segments were measured in trisyllabic words and all other segments in quadrisyllabic target words. It could very well be the case that the lengthening degree of stressed vowels and diphthongs decreases as the number of syllables increases. In that case there is an effect of word duration on vowel and diphthong duration.

The effect of word duration may also be invoked to account for the diverging values found for the 'mobile diphthongs' and stressed vowels: the mean duration of [wɔ] is 168 ms, of [jɛ] 150 ms and of stressed vowels 143 ms. This effect is discussed in the following section.

3.3.4. Relative duration of monophthongs and diphthongs

In order to decide whether there is a significant effect of word duration on the duration of monophthongs and diphthongs, I decided post-hoc to measure the relative durations of the vowels and diphthongs, i.e. related to the total durations of the words in which they occur.[60] The relative values are presented in tables 3.4 (vowels), 3.5 ([jV] diphthongs) and 3.6 ([wV] diphthongs).

Table 3.4: Mean (mn.) relative duration in percentage of word duration, standard deviation (s.d.) and number of cases (#) accumulated over nine speakers, broken down by vowel, stress, syllable position and number of syllables (σ) per word.

vowel	stress	pre-prefinal/4σ			pre-prefinal +cl./4σ			prefinal/3σ		
		mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#
[a]	[+stress]	26	4	9	27	4	9	33	5	9
	[−stress]	15	2	9						
[ɛ]	[+stress]	25	4	9	23	4	9	31	4	9
[e]	[−stress]	13	2	9						
[ɔ]	[+stress]	23	1	9	23	4	9	31	3	9
[o]	[−stress]			9						

[60] The notion of 'word' also refers to verbal forms with clitics; cf. Monachesi (1996:83), who suggests that single clitics in Italian behave like "certain affixes" and form a new Prosodic Word with a host as in $[[\text{telefona}]_{pw}\ \text{mi}]_{pw}$ 'call me'.

Table 3.5: Mean (mn.) relative duration in percentage of word duration, standard deviation (s.d.) and number of cases (#) accumulated over nine speakers, broken down by diphthongal segment, stress, syllable position and number of syllables (σ) per word.

diphthong	**segm.**	**stress**	**pre-prefinal/4σ**			**pre-prefinal +cl./4σ**			**prefinal/3σ**		
			mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#
[ja]	[j]	[+stress]	6	1	9	6	2	9	8	2	9
		[−stress]	3	1	9						
	[a]	[+stress]	19	3	9	19	3	9	23	3	9
		[−stress]	9	2	9						
	[ja]	[+stress]	25	4	9	25	4	9	31	3	9
		[−stress]	12	2	9						
[jɛ/je]	[j]	[+stress]	7	2	9	6	2	9	8	2	9
		[−stress]	3	1	9						
	[ɛ]	[+stress]	20	3	9	19	3	9	24	3	9
	[e]	[−stress]	11	2	9						
	[jɛ]	[+stress]	26	3	9	25	4	9	32	4	9
	[je]	[−stress]	14	2	9						
[jɔ/jo]	[j]	[+stress]	7	2	9	8	2	9	10	2	9
		[−stress]	4	1	9						
	[ɔ]	[+stress]	20	3	9	19	3	9	24	4	9
	[o]	[−stress]	10	2	9						
	[jɔ]	[+stress]	27	4	9	27	4	9	34	5	9
	[jo]	[−stress]	13	2	9						

Table 3.6: Mean (mn.) relative duration in percentage of word duration, standard deviation (s.d.) and number of cases (#) accumulated over nine speakers, broken down by diphthongal segment, stress, syllable position and number of syllables (σ) per word.

diphthong	**segm.**	**stress**	**pre-prefinal/4σ**			**pre-pref.+cl./4σ**			**prefinal/3σ**		
			mn.	s.d.	#	mn.	s.d.	#	mn.	s.d.	#
[wa]	[w]	[+stress]	9	1	9	10	2	8	11	1	8
		[−stress]	5	2	9						
	[a]	[+stress]	16	3	9	16	3	8	20	2	8
		[−stress]	11	2	9						
	[wa]	[+stress]	25	3	9	25	3	8	32	2	8
		[−stress]	16	2	9						
[wɛ/we][61]	[w]	[+stress]	11	1	9						
		[−stress]	8	2	9						
	[ɛ]	[+stress]	23	4	9						
	[e]	[−stress]	14	3	9						
	[wɛ]	[+stress]	34	4	9						
	[we]	[−stress]	22	2	9						
[wɔ/wo]	[w]	[+stress]	9	1	9	9	2	9	11	2	9
		[−stress]	4	2	9						
	[ɔ]	[+stress]	17	2	9	16	2	9	22	5	9
	[o]	[−stress]	10	1	9						
	[wɔ]	[+stress]	26	2	9	25	3	9	33	4	9
	[wo]	[−stress]	15	2	9						

[61] The target words containing [wɛ]/[we] are trisyllabic; cf. Table B.2 (Appendix B).

The results for monophthongs and diphthongs are strikingly analogous, as visualized in figure 3.7, which presents the overall mean relative duration of monophthongs and diphthongs broken down by stress/syllable position.

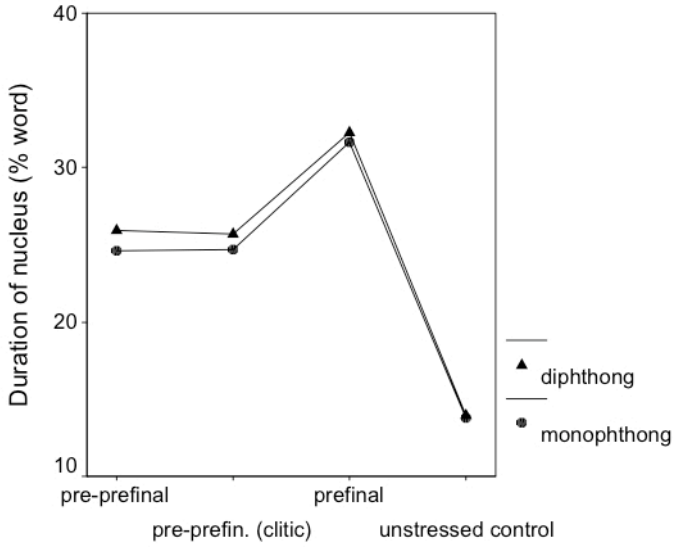

Figure 3.7: Mean relative durations of monophthongs and diphthongs accumulated over nine speakers, broken down by stress and syllable position in the word (all words are quadrisyllabic except those with prefinal stress, which are trisyllabic).

On average, the unstressed monophthongs and diphthongs take up approximately 14% of the total word duration and, when stressed, they lengthen up to roughly a quarter of quadrisyllabic (pre-prefinal) words and almost one third of trisyllabic (prefinal) words. Values for 'mobile diphthongs', other rising diphthongs and monophthongs (breakdown not provided in figure 3.7) do not deviate from these mean values.[62] Crucially, there is no significant difference between the cliticized and non-cliticized quadrisyllabic words.

The effect of stress/position is highly significant, $F(3,53) = 82.3$ ($p < .001$); the effect of nucleus type is not, $F(1,8) = 2.4$ (ins.). Also, the interaction between stress/position and nucleus type is insignificant, $F(3,24) = 2.0$ (ins.)[63].

Given that the stress/position factor is strongly correlated with word length (in number of syllables), vocalic nucleus duration may alternatively be accounted for as an effect of word length. Although the experiment was not constructed to allow us to choose between the competing explanations of (relative) nucleus duration, the data serendipitously contain a few words in the same stress/position category, which do differ in number of syllables. Post-hoc examination of the durations of pre-prefinally

[62] Again, [jɔ] is longest: on average 27% in quadrisyllabic and 34% in trisyllabic words.
[63] Inferential statistics based on a three-way Analysis of Variance with stress/position and nucleus type as fixed factors and speakers as a random factor.

stressed [wɛ] in trisyllabic *querulo* and of prefinally stresed [a] in quadrisyllabic *riposava* shows that their relative durations are approximately 1/3 and 1/4 of the total word duration, respectively – cf. table 3.7. On the strength of these data, we provisionally conclude that the nucleus duration of stressed syllables is better explained as a word-length effect than by syllable position within the word. A more definitive choice between these two accounts will be presented in the discussion section (§ 3.4.2) below.

Table 3.7: Mean (mn.) relative duration in percentage of word duration, standard deviation (s.d.) and number of cases (#) accumulated over nine speakers, broken down by vowel, stress, syllable position and number of syllables (σ) per word.

vowel	**stress**	**pre-prefinal/3σ**			**prefinal/4σ**		
		mn.	s.d.	#	mn.	s.d.	#
[wɛ]	[+stress]	34	4	9			
[a]	[+stress]				23	4	9

Figure 3.8 below, which plots the relative duration of glide elements against the relative duration of the vocalic portions within rising diphthongs, shows that there is a general tendency to keep the glide/vowel ratio constant within rising diphthongs. When the duration of the glide element increases, the vowel portion gets longer as well. The correlation between glide and nucleus duration is stronger for /j/-glides ($r = 0.709$) than for /w/-glides ($r = 0.548$) but both coefficients are highly significant.

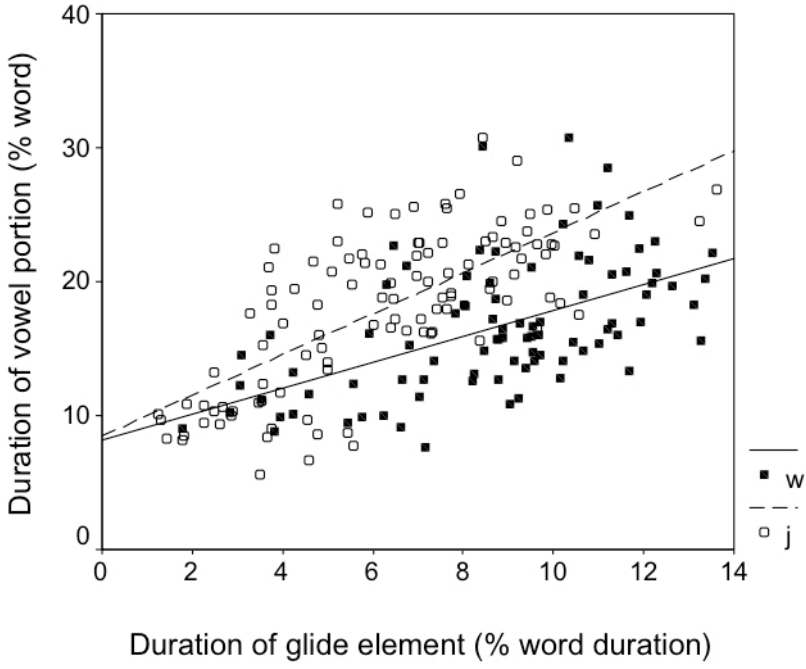

Figure 3.8: Relative durations (in % of word duration) of elements within rising diphthongs (glide duration horizontally, vocalic portion vertically) across nine speakers.

3.4. Conclusion and discussion

3.4.1. Conclusion

The results of the acoustic duration analysis can be summarized as follows. The effects of stress (stressed vs unstressed), syllable position (pre-prefinal vs prefinal), cliticization (clitic vs no clitic) and word duration were investigated for the duration of monophthongs and (the elements composing) rising diphthongs. All these durations varied significantly as a function of stress/position and word length, irrespective of whether the word-final syllable is a clitic or not. Although rising diphthongs are longer than monophthongs, their durations relative to the total word duration are strikingly parallel. Within the diphthongs, the glide/vowel ratio is kept virtually constant in all conditions.

The objective of this chapter was to test the four hypotheses following from former studies of Italian vowel length, presented in (3.1). The first hypothesis was that the duration of long (i.e. stressed) vowels is equivalent to the duration of the 'mobile diphthongs' [jɛ] and [wɔ]. Their diverging absolute durations seem to converge remarkably once converted to relative durations (percentage of word duration), but the

same observation could be made comparing stressed vowels with other stressed diphthongs. Hence, where the first hypothesis is borne out by the empirical data, no evidence was found in support of the second and third hypothesis, stating that the durations of the 'mobile diphthongs' [jɛ] and [wɔ] and those of long vowels are shorter than the durations of the non-mobile diphthongs. Long vowels and the two types of diphthongs are of equal relative duration. These findings are supported by the fact that the distributional patterns of vowels and rising diphthongs (including the 'mobile diphthongs') are virtually identical (contra Sluyters, see § 5.3.1). As for the fourth hypothesis, we shall claim in the next section that the predicted durational differences (antepenult vs penult syllables) do not depend on syllable position but rather on word length.

3.4.2. Discussion

The new empirical data presented in this chapter demonstrated that under certain conditions both vowels and rising diphthongs – whether 'mobile' or not – show similar behaviour. This similarity is captured in a (simplified) algorithm, which computes the durational values of monophthongs and diphthongs in stressed syllables:

(3.4) (a) $$D = \frac{DW\ (ms)}{\#\sigma}$$

(b) [jV] = 1:3
[wV] = 1:2

Part (a) of formula (3.4) allows a rough computation of D (the absolute duration of stressed monophthong or diphthong) by dividing DW (the duration of the word in milliseconds) by #σ (number of syllables in the word). Part (b) regulates the glide/vowel ratio within rising diphthongs.

The adequacy of the duration model captured by (3.4) was tested by computing the (product-moment) correlation coefficient between estimated nucleus duration and actual nucleus duration. The correlation coefficient is r = .691, indicating that 47.7% (i.e. r^2) of the variance in the actual nucleus duration is accounted for by the formula. This result should be compared with the r^2-value that is yielded by the competing account of nucleus duration based on just the linear position of the stressed syllable within the (prosodic) word. The optimal prediction here is based on the main effects of syllable position and speaker, as well as the interaction between these two factors. This simple linear model accounts for 34.3% of the variance, indicating the superiority of formula (3.4), which is based on phonetic word duration and number of syllables.

The effect of word duration on vowel duration has often been interpreted in terms of 'word-size compression' or 'polysyllabic shortening effect'. The phenomenon is extensively documented and discussed in Lehiste (1970), Lindblom and Rapp (1973) and Marotta (1985). For example, Lindblom and Rapp propose a num-

ber of mathematical formulas to compute these shortening effects.[64] They distinguish between anticipatory compensation effects and backward compensatory effects, depending on the number of syllables that follow, respectively precede the target segment. For Italian, a similar distinction pertaining to trisyllabic and quadrisyllabic words is not needed, because syllable position proved to have no effect on vowel/diphthong duration.

More research is needed to check whether the formula proposed in (3.4) also applies in other contexts. For instance, further experiments are needed in order to investigate whether the formula also pertains to shorter or longer word durations. Besides, it would be interesting to find out if it is applicable to closed syllables, presuming that 'D' may also denote the duration of a stressed vowel plus a following coda consonant. Italian vowels in closed syllables, whether stressed or unstressed, are generally claimed to be short. However, experiments carried out by McCrary (2004) show that Italian vowels in stressed closed syllables do lengthen.[65] Finally, a comparison with falling diphthongs, which occur abundantly in Italian, would complete the data set presented in this chapter.

In phonology, a synchronic approach should take into account the parallelisms between Italian vowels and rising diphthongs. In chapter 5 I shall propose a phonological reanalysis of Italian glides, vowels and diphthongs, which respects these similarities.

[64] Lindblom and Rapp's conclusions pertain to Swedish reiterated speech.
[65] McCrary (2004) claims that (stressed) vowel duration is affected by the quantity and duration of following consonants, irrespective of syllable structure.

4 Experiment II: Variation*

4.1. Introduction

As explained in chapter 2, the Italian mobile diphthongs are the rising diphthongs [jɛ] and [wɔ], which are historically related to Late Latin mid-low stressed vowels, and which alternate with corresponding monophthongs as a result of stress-shifting morphological operations, e.g. *siedi* ['sjɛdi] 'you sit' vs *sediamo* [se'djamo] 'we sit' and *muovo* ['mwɔvo] 'I move' vs *movimento* [movi'mento] 'movement'. However, written sources provide evidence that this monophthong–diphthong alternation is subject to a great degree of analogical levelling. In numerous cases the diphthongs are reported to have extended to unstressed syllables (cf. van der Veer 2001), e.g. *siederò* [sjede'rɔ] 'I shall sit' and *muoviamo* [mwo'vjamo] 'we move'. It was also shown in chapter 2 that this levelling is almost complete for words with front vowels, whereas unstressed back vowels, predominantly those in derivatives and in irregular verbs, are slightly more resistant to the change.

In the present chapter, I report on an experiment carried out under laboratory conditions, in order to investigate to what extent this analogical levelling occurs in contemporary spoken Standard Italian and why it affects front and back diphthongs differently. Two separate tasks were used: a phoneme restoration task using the speech shadowing technique and an elicited production task with 6 items, all pseudo-words (i.e. non-words that respect the phonotactics of the language, e.g. *blik* but not **bnik* in English, Chomsky and Halle 1968).

The shadowing task that we used allows us to record spontaneous vowel production while subjects remain unaware of the purpose of the experiment and, importantly, are not influenced by orthographic information (since we want to test spoken-language variation). In a speech shadowing task, subjects repeat ('shadow') speech (being delivered over headphones) as soon as they hear it, i.e. without waiting for the end of the stimulus utterance. By replacing the target vowel (e.g. [wo]/[o] in *c(u)ocevo* 'I was cooking') by noise, the technique allows us to combine on-line shadowing with a restoration task (see van Heuven 1988). The phoneme restoration effect occurs when listeners (in this case shadowers) effortlessly and fluently 'fill in' the missing phoneme information in structures where the target is highly redundant, often without even being aware that the target is missing at all (cf. Warren 1970, Samuel 1996). The shadowing condition guarantees that restoration is performed under considerable temporal pressure, although shadowing latencies are generally less than a second, i.e. there is a time lag of less than one second between the moment the shadower hears a sound/syllable and the moment that he himself produces the same sound unit (see Marslen-Wilson 1973).

* Part of this chapter appeared as van der Veer and van Heuven (2003).

It is possible that allomorphy reduction is influenced by lexical factors (e.g. semantic information, word frequency). Therefore, it seemed crucial to include some pseudo-words in the test. However, the lexical status (i.e. word vs non-word) seems to have an effect on the outcome of restoration experiments, in that words promote more restorations than non-words, since the latter type contains little or no lexical redundancy (cf. Samuel 1996). Therefore, a second experiment was designed which aims at eliciting vowel production with printed stimuli for both words and non-words.

The experiments reveal the absence of the monophthong–diphthong alternation in 70% of the target word pairs (on average) and 90% of the non-word pairs (on average); i.e. in 70% of the target word pairs and 90% of the non-word pairs, a diphthong is perceived in unstressed syllables, which would have been 0% if the 'mobile diphthong rule' ('stressed diphthong vs unstressed monophthong') were applied without exception.

4.2. Experiment I

4.2.1. Speech shadowing

Lambert (1988), who recommends shadowing for training simultaneous interpreters, defines shadowing as

> a paced, auditory tracking task which involves the immediate vocalization of auditorily presented stimuli, i.e. word-for-word repetition in the same language, parrot-style, of a message presented through headphones (Lambert 1988:381).

As far as the physical feasibility of such a task is concerned, I refer to Marslen-Wilson (1973), who reports on the results of an experiment in which the response latency in speech shadowing tasks was measured. The experiment shows that so-called close shadowers proved capable of repeating a passage read at normal conversational speaking rate (i.e. 160 words per minute) at a mean minimal distance (or 'latency') of 250 ms, which is only a little more than the mean duration of a syllable. The majority of the shadowers ('distant' shadowers) have latencies in the order of 750 ms. A subsequent memory test and an error analysis provided evidence that the shadowers have access to syntactic and semantic information, irrespective of their shadowing latency. Since the fifties, shadowing tasks have been used in the domain of auditory word recognition by manipulating the original stimuli (see Cherry 1953, Darwin 1975, Marslen-Wilson 1975, Marslen-Wilson and Welsh 1978, van Heuven 1988, Bailly 2003). The application of the on-line shadowing technique, combined with a phoneme restoration task, is a new tool in the field of language-variation research. The following sections describe the design, procedure and results of our experiment.

4.2.2. Subjects

Subjects were the ten native Italian speakers who also produced the data for the acoustic analysis of monophthong and diphthong duration (see § 3.2.1). Although the number of subjects is relatively small, I assume that the data produced by a socially and geaographically homogeneous group of ten speakers will represent at least a substantial part of the possible variation in their variety of Standard Italian. Moreover, in retrospect, the number of ten subjects proved large enough to carry out statistical tests on the data.

4.2.3. Materials

The selection of the target words was based on the list of existing Italian words which theoretically are subject to a monophthong–diphthong alternation as a consequence of some stress-affecting morphological operation – cf. table B.1 (Appendix B). In order to make a representative selection, I defined the following variables in the stimulus materials:

(4.1)

(a)	Base:	noun
	Diphthong base:	[jɛ]/[wɔ]
	Morphological operation:	derivation/diminutivization[66]
	(Total: 6 target words)	
(b)	Base:	adjective
	Diphthong base:	[jɛ]/[wɔ]
	Morphological operation:	derivation/diminutivization/inflection[67]
	(Total: 6 target words)	
(c)	Base:	verb (with a regular present and imperfect indicative)
	Diphthong base lexeme:	[jɛ]/[wɔ]
	Morphological operation:	derivation/inflection
	(Total: 4 target words)	

This design results in 16 target words, which are presented in table B.3 (Appendix B). The target words were embedded in meaningful carrier sentences, where they were preceded by their respective bases. These 18 sentences were preceded by five "triggering" sentences and mixed with 20 filler sentences, with a structure similar to that of the target sentences but containing no potential diphthongs. Two examples are given in (4.2); the complete set is included in table B.4 in Appendix B.

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[66] The term 'diminutivization' is meant to cover the Italian concept of *alterazione*: the affixation of evaluative suffixes such as diminutive, pejorative, augmentative and similar suffixes. It is treated here as a separate morphological operation, following Scalise (1984). Cf. fn. 50, chapter 2.

[67] In this design, the category of inflection also includes the affixation of the superlative suffix *–issimo* and the adverbial suffix *–mente*.

(4.2) La pasta è buona, anzi è b(u)onissima.
'The pasta is good, it is even very good.'

Paolo suona bene, è un buon s(u)onatore.
'Paul plays well, he is a good musician.'

In an interpreter's booth at the Hoger Instituut voor Vertalers en Tolken of the Hogeschool Antwerpen, Belgium, these 43 sentences were recorded through an AKG D.880 Emotion microphone and a 4-channel ultra-di pro preamplifier on a PC with the Maxi Studio Isis software. The PC was placed outside the recording booth. The reader was a female native speaker of Italian, aged 33, born and raised in the province of Florence.[68] The 16 sentences containing the target words were recorded twice: once with and once without diphthongized syllable nuclei in the underlined words. Also recorded were a passage of continuous speech – a newspaper article – of 489 words, and a set of 14 meaningful sentences of the type presented in (4.2). These additional recordings served as practice materials in the learning stage of the experiment. The text fragment was read at an average speaking rate of 122 words per minute and the sentences were read at an average speaking rate of three words per second.

In a second phase, the original speech materials were downsampled and processed further with the Praat (version 4.0.1) speech processing software (Boersma and Weenink 1996, Boersma and van Heuven 2001) with 16 bit amplitude resolution and a 16 kHz sampling frequency. Using the information provided by the waveforms, every section containing a target nucleus was gated out and replaced by noise (Gaussian noise, high-pass filtered from 100 Hz with 50 Hz smoothing, created by Praat). An example of a waveform of a target word with noise is given in figure 4.1.

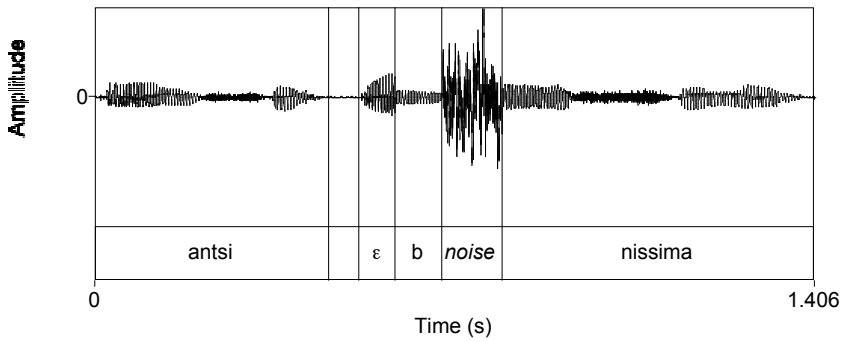


Figure 4.1: Waveform of the utterance anzi è b(u)onissima '(she) is even very good', *where a section containing the target nucleus (underlined) has been replaced by noise.*

[68] I am very grateful to Etienne Mylemans (Hoger Instituut voor Vertalers en Tolken, Antwerp) who made the recordings for this study. I also wish to thank Cecilia Casamonti (idem), our reader, for her spontaneous cooperation and her patience.

The length of the noise section was based on the mean length of a specific nucleus in a specific target word as produced by the reader – once as a monophthong and once as a diphthong. For example, in *buonissima* [wo] = 126 ms, in *bonissima* [o] = 98 ms, the mean duration = 112 ms; the noise was spliced into the recording such that it also replaced transitions from and to neighbouring consonants.

A number of syllable nuclei in the practice materials and in the filler sentences were also replaced by noise, according to the same procedure. In table B.4 (Appendix B), vowels replaced by noise are underlined. A silent pause of two seconds was added after each fragment of the text and after each sentence. The resulting materials were then recorded from the PC onto a JVC minidisc (Crystal Gold) with a Sony Portable Minidisc Recorder MZ-R700.

4.2.4. Procedure

The subjects, naive to the goal of the experiment, were first familiarized with the shadowing technique. For this purpose, they were allowed to shadow the recorded test passages outside the sound-proofed booth. The stimuli were delivered through headphones by the Portable Minidisc Recorder. The subjects were allowed to adjust the sound volume at a level they felt comfortable with, in order to perform the task. They were instructed to repeat the message as closely and fluently as possible, ignoring the noise bursts as well as they could. After the practice session, all speakers felt satisfied with their performance.

The recordings were made in the same setting and with the same equipment as used for the duration experiment (see § 3.2.3). The minidisc player was placed inside the sound-proofed booth and the subjects were asked to operate it when asked (press the 'start' and 'stop' buttons). This set-up was necessary, because it was not possible to deliver and record audio simultaneously from outside the booth; the portable minidisc player is silent enough for the purpose of this experiment. After the recording session, speakers were asked, if necessary, to repeat one or more sentences, if these had not been shadowed correctly in the first session.

4.2.5. Listening task

The corpus of 430 speech utterances (10 speakers × 43 sentences) was downsampled to 16 kHz and stored on hard disk with the Praat speech processing software. Only three relevant responses contained omissions and/or hesitations; these were excluded from further analysis. The (10 × 16) – 3 = 157 tokens were manually segmented and labelled with an identification number. The transcription of the data was organized as follows. The target words (embedded in a small section of the original carrier sentence) were presented through headphones to five listeners: two Dutch phoneticians and three Italian phonetically naive native speakers. For each target word, printed on a score form in its two possible versions (either with monophthong or diphthong), the listeners had to make a binary choice: did the word contain a monophthong or a diphthong? The listeners were allowed to listen to the tokens as often as they wanted. The task was repeated for each speaker. The results are discussed in § 4.4.

4.3. Experiment II: reading aloud

4.3.1. Method

In the second elicited production experiment, some pseudo-words were included, along with existing filler words. The test was designed according to the following variables:

(4. 3) (a) Diphthong base lexeme: [jɛ]/[wɔ]
Morphological operation: diminutivization
(Total: 2 target words)

(b) Diphthong base lexeme: [jɛ]/[wɔ]
Morphological operation: inflection
(Total: 2 target words)

(c) Diphthong base lexeme: [jɛ]/[wɔ]
Morphological operation: derivation
(Total: 2 target words)

The (3 × 2) = 6 target words (see table B.5 in Appendix B) were mixed with filler words (words as well as non-words) and printed on paper in three different lists, according to the type of morphological operation to be tested.

For each list, the subjects were instructed to read aloud the items and to apply a specific morphological operation to each individual one of them, following an example. Their responses were recorded in a sound-proofed booth (for details concerning the recording equipment, see § 3.2.3).

4.3.2. Data transcription

The (10 × 6 =) 60 target words were transcribed in the same way as the speech data produced in the previous experiment (see § 4.2.5). The results of the experiments are discussed in the next section.

4.4. Results of the experiments

Both experiments resulted in a collection of (157 + 60 =) 217 stimulus items, which were scored as either a monophthong or a diphthong by five listeners (§ 4.2.5) yielding a dataset of 1,085 responses. The full set of results are presented in table B.6 in Appendix B.

4.4.1. Agreement

Before analysing the effects of the experimental factors, we will first examine the degree of consensus among the five listeners. For each stimulus any two listeners

could score either a value 0 (monophthong) or 1 (diphthong). The kappa coefficient is used to quantify the extent to which the scores of two listeners agree. Kappa is identical to a product-moment correlation coefficient for binary scores (0,1). When kappa equals 1, two listeners agree on the monophthong-diphthong nature of all stimuli, i.e., when listener A hears a monophthong, so does listener B, and when A hears a diphthong, B does as well. When kappa equals 0 the decisions made by one listener have no relationship with those made by the other listener, i.e. the chances that listener B hears a monophthong or a diphthong are the same, irrespective of speaker A's decision.

Table 4.1: Agreement among the five listeners, expressed in kappa.

	BV (NL)	**VH (NL)**	**CB (I)**	**VM (I)**	**IF (I)**
BV (NL)	1.000				
VH (NL)	.850	1.000			
CB (I)	.439	.321	1.000		
VM (I)	.480	.390	.567	1.000	
IF (I)	.334	.272	.576	.569	1.000

It is obvious from table 4.1 that the two (Dutch-speaking) phoneticians agree quite well in their decisions, with $\kappa = 0.850$ ($p < 0.001$). However, the three Italian native listeners have poorer kappa values, ranging between $\kappa = 0.567$ ($p < 0.001$) and $\kappa = 0.576$ ($p < 0.001$). Typically, the agreement between the Dutch and the Italian listeners is strikingly low, with kappa's between $\kappa = 0.272$ ($p < 0.001$) and $\kappa = 0.480$ ($p < 0.001$). Given the rather poor correlation coefficients between the Dutch and the Italian listeners, we decided to examine the perceptual judgements in more detail.

Figure 4.2 presents the mean diphthong scores for the five listeners. The two Dutch listeners have diphthong scores of 0.58 and 0.61, whilst the scores of the three Italians range between 0.82 and 0.87. The effect of listener is highly significant by a one way Analysis of Variance, $F(4,1080) = 23.7$ ($p < 0.001$). Scheffé post hoc analyses for contrasts ($\kappa = 0.05$) show that the scores for the Dutch listeners do not differ from each other but do differ from those of each of the Italians, which do not differ amongst each other.

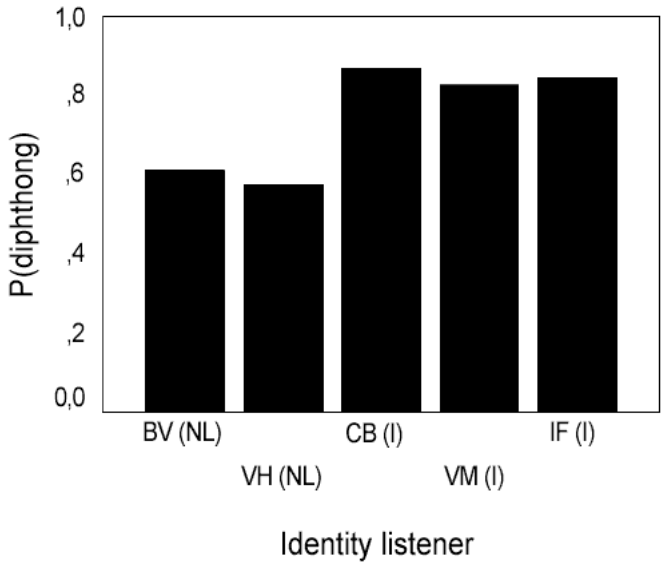


Figure 4.2: Number of diphthongs perceived (proportion), broken down by listener.

Apparently, the Italian native listeners are more prone to hear a diphthong than the Dutch phoneticians. As can be seen in table B.7a-f in Appendix B, when a Dutch listener perceives a diphthong, so do the Italians. However, the converse does not hold: there is only a small minority of stimuli that are perceived as monophthongs by both types of listeners. In roughly two-thirds of the cases where the Dutch listeners report a monophthong, the Italians perceive a diphthong (71% for VH and 65% for BV). It is unclear at this stage whether the difference between the Dutch and the Italian listeners is a matter of response bias (possibly induced by orthographic practice), or whether the Italians attend to subtle diphthongization cues that elude the Dutch phoneticians. The issue of the diphthongization cues is taken up in the discussion section (§ 4.6).

4.4.2. Effects of experimental factors

Figures 4.3a-b present the probability (proportion) of perceiving a diphthong across all five listeners for words and non-words, respectively, broken down by morphological operation (inflected forms, derivations and diminutives) for /(j)e/ and /(w)o/ forms.

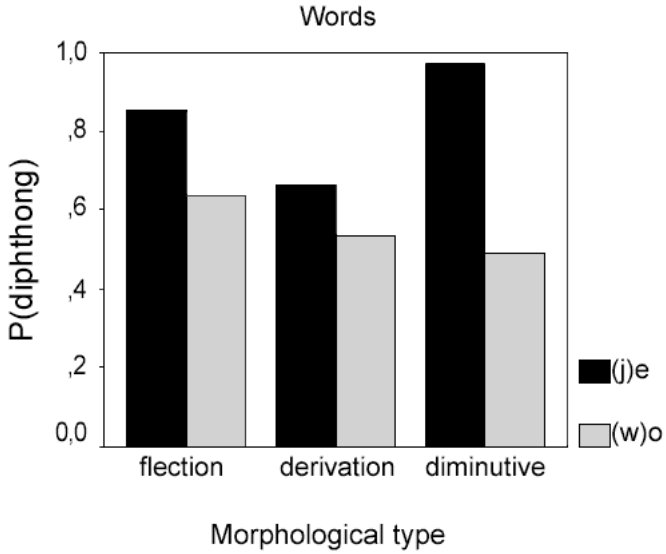


Figure 4.3a: Proportion of perceived diphthongs /je/ and /wo/ in words, broken down by three morphological operations.

A four-way ANOVA with lexical status (word vs non-word), vowel type (/e/ vs /o/) and morphological operation (inflection, derivation, diminutivization) as fixed factors, and with speakers as a random factor indicates significant effects for vowel type, $F(1,9) = 48.4$ ($p < 0.001$), and for lexical status, $F(1,9) = 46.0$ ($p < 0.001$). In non-words, the probability of listeners reporting a diphthong is much larger (90%) than in words (70%). Also, diphthongization is found much more often with front /e/ than with back /o/ (85% vs 64%). There are significant interactions between lexical status and vowel type, $F(1,9) = 6.1$ ($p = 0.036$) and between lexical status and type of morphological operation, $F(2,18) = 5.6$ ($p = 0.013$). There is a final interaction between vowel type and morphological operation, $F(2,18) = 8.2$ ($p = 0.003$). Given the large and significant effect of lexical status and the rather strong interaction between lexical status and two other factors, we will analyze the results for words and non-words separately.

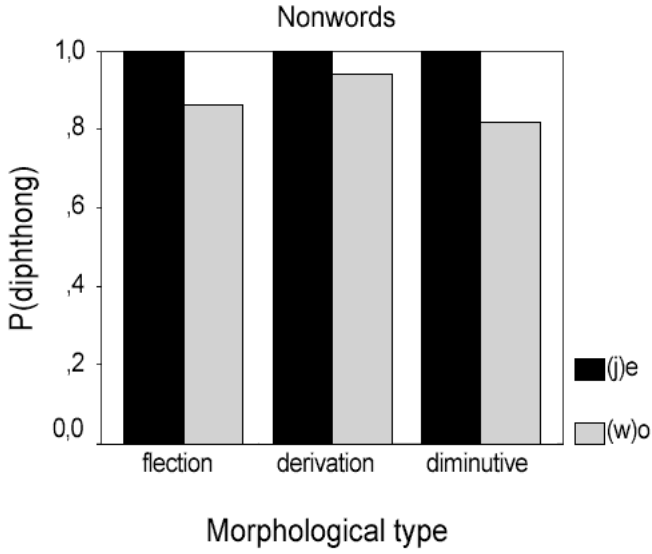


Figure 4.3b: Proportion of perceived diphthongs /je/ and /wo/ in non-words, broken down by three morphological operations.

The results for the non-words are rather straightforward. If the non-word contains a front vowel /e/ the vowel is always heard as a diphthong (100%). If the vowel is back /o/, the chances of a diphthong being reported drop to 87%. The effect of vowel type is significant, $F(1,9) = 8.4$ ($p = 0.018$). Moreover, there is no significant effect of morphological operation, $F(2,18) = 1.7$ ($p = 0.218$), nor is there any interaction between morphological type and vowel type within the category of non-words, $F(2,18) = 1.7$ ($p = 0.218$).

The results are more complex for the words. Again, the incidence of diphthongs is higher for front /e/ (79%) than for back /o/ (55%); this time the effect is large and highly significant, $F(1,9) = 49.5$ ($p < 0.001$).[69] More diphthongs are reported in inflected words (75%) than in derivations (60%), with somewhat higher diphthong scores for /e/ than for /o/. However, in diminutives the probability of perceiving a diphthong drops further (49%) when the vowel is /o/ but increases to a dramatic 97% for front vowels /e/. As a result of this, the effect of morphological operation is significant, $F(2,18) = 5.6$ ($p = 0.013$) as is the interaction between vowel type and morphology, $F(2,18) = 8.4$ ($p = 0.003$).

[69] The effect of vowel type is stronger with words than with non-words, hence the significant interaction between lexical status and vowel type. The interaction is probably due to a ceiling effect in the non-words.

4.5. Conclusion

The primary aim of this chapter was to investigate to what extent the monophthong–diphthong alternation, in Italian grammars referred to as 'the mobile diphthong rule', still occurs in spoken Standard Italian. If the rule were applied without exception, we should have obtained 0% perceived diphthongs in unstressed realizations of the vowels /e/ and /o/, as opposed to 100% diphthongs in their stressed counterparts. Our results reveal the absence of the monophthong–diphthong alternation in 70% of the target word pairs (on average) and in 90% of the non-word pairs. We conclude, therefore, that the final stage of a linguistic change has now been reached. Based on the effects of the experimental factors (vowel type and morphology) and the literature survey in chapter 2, the change can be reconstructed as follows. In late spoken Latin (or the language stage that immediately precedes Tuscan Italian), all the mid vowels were monophthongs. Towards the middle of the 7th century, a split came about such that the low-mid monophthongs were diphthongized only in stressed syllables. This change probably ended in a relatively stable situation in which the rule was applied practically without exception. From the 16th century onwards, the second stage in the change took effect. The diphthongization was analogically extended to the non-stressed vowels. The generalization first affected words with front vowels but later also words with back vowels that were related to the base word (with the stressed diphthong) through productive and predictable morphological processes (e.g. diminutivization, inflection of regular verbs, suffixation of *–mente*/*–issimo*). Unstressed vowels in semantically transparent derivatives changed in a later stage, whereas unstressed vowels in words that were opaquely related to the diphthongized base forms resisted the change as these words were lexicalized with the monophthong. By now, the second stage of the diphthongization process seems virtually complete for front vowels and almost complete for back vowels.

4.6. Discussion

Although I found substantial variation between listeners in the perception task, they clearly perceived more diphthongs in unstressed front vowels (/je/) than in back vowels (/wo/). The question arises, then, how this apparent asymmetry might be accounted for.

A first possibility is that there is a greater anatomical and/or physiological potential for diphthongization in front vowels. The type of diphthong at issue here primarily involves changing vowel height. If we accept, for the sake of the argument, that the articulatory correlate of vowel height is adequately expressed by the angular change of the mandible, then changing the degree of vowel height by increasing the angle of the mandible relative to the skull obviously produces a larger effect if the vowel is articulated more in the front of the mouth. Although this hypothesis is easily tested in principle, the effects cannot be measured directly from the recordings. Rather, I would have to run a new experiment involving physiological measurements of jaw opening and/or the extent of the vertical change of the tongue during

the articulation of the target vowels. This could be achieved by a variety of techniques, such as measuring mandible opening using a strain gauge, or tracking the surface of the tongue using EMMA (Electro-Magnetic Mid-sagittal Articulography). Unfortunately, neither the equipment nor the expertise to produce the articulatory measurements are currently available at our institute; this research will have to wait. However, it is possible, to some extent, to estimate the size of an articulatory movement from the effects of the movement on the acoustical signal generated by it. In the remainder of this section I will attempt to track the diphthongal movement, i.e. the change of the articulation point in the oral cavity by measuring its effect on the centre frequencies of the first and second formant. Our hypothesis is that, even if front and back vowels are diphthongized to the same extent, the effect will be more clearly perceived in front vowels.

It is widely accepted that the first formant (F1) provides an adequate estimate of vowel height (i.e. degree of jaw opening) and the second formant (F2) correlates well with the degree of tongue advancement (cf. Hayward 2000). Changes in formant frequencies give an auditory impression of a changing vowel quality and may therefore serve as a cue for the distinction between diphthongs and monophthongs, which produce an impression of relatively unchanging quality. Figure 4.4 plots F1 against F2 frequency for the Italian vowels and shows the approximate formant trajectories for the two (stressed) mobile diphthongs.

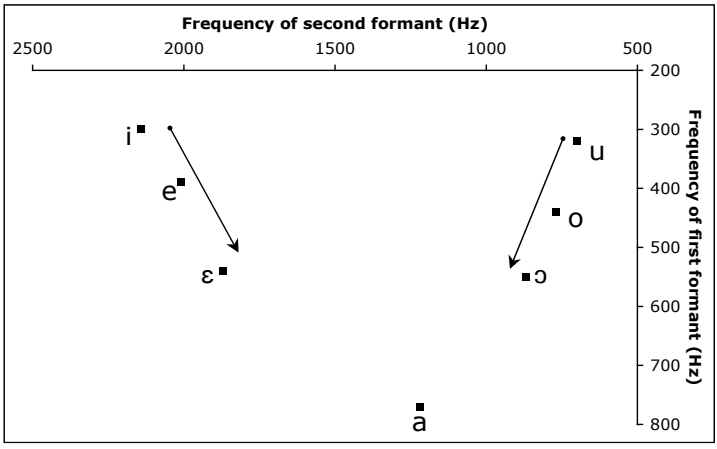


Figure 4.4: A formant chart showing the frequency in Hz of the first formant on the ordinate plotted against that of the second formant on the abscissa for the Italian vowels (data: Ferrero 1972). The arrows indicate the approximate formant trajectories for the mobile diphthongs.

The acoustical vowel space defined by F1 and F2 is basically a triangle with the vowels [i, a, u] as the corner points. The trajectories of [jɛ] and [wɔ] run parallel to the sides of the triangle, and embody the phonetic gesture of jaw opening.

For the front diphthong [jɛ] and its unstressed counterpart [je] we observe an increasing narrowing between F1, which is moving up, and F2, which is moving down. This pinching effect is best visualized in a spectrogram (figure 4.5). Especially in relatively short unstressed vowels the differences can be subtle, so that [je] may be confused with the monophthong [e].

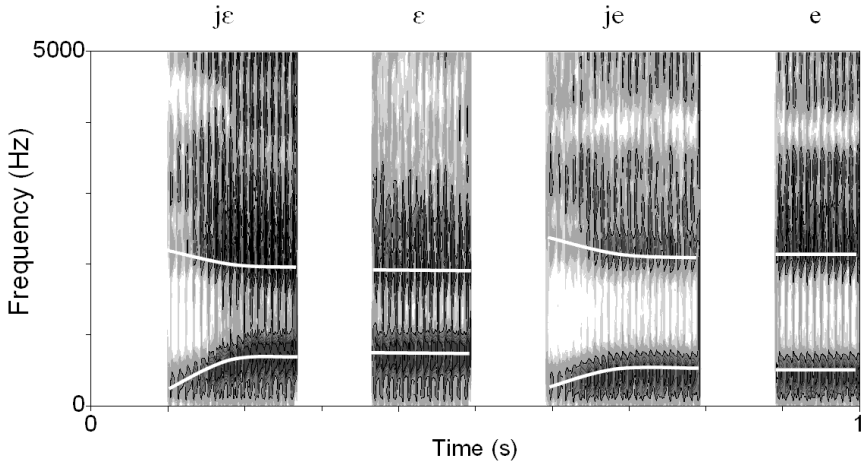


Figure 4.5: Spectrograms of rising front diphthongs [jɛ] and [je] with mid-open and mid-closed end points contrasted with corresponding monophthongs [ɛ] and [e]. First and second formant tracks are indicated in white.

The trajectories of the back diphthong [wɔ] and its unstressed counterpart [wo] also move downwards across the acoustic space. However, with respect to the front diphthongs, the back diphthongs involve a more parallel and slightly less extended movement of F1 and F2, as visualized in the spectrogram in figure 4.6. Again the problem is to distinguish these diphthongs – especially when unstressed and thus short – from their corresponding monophthongs, given the subtlety of the movement.

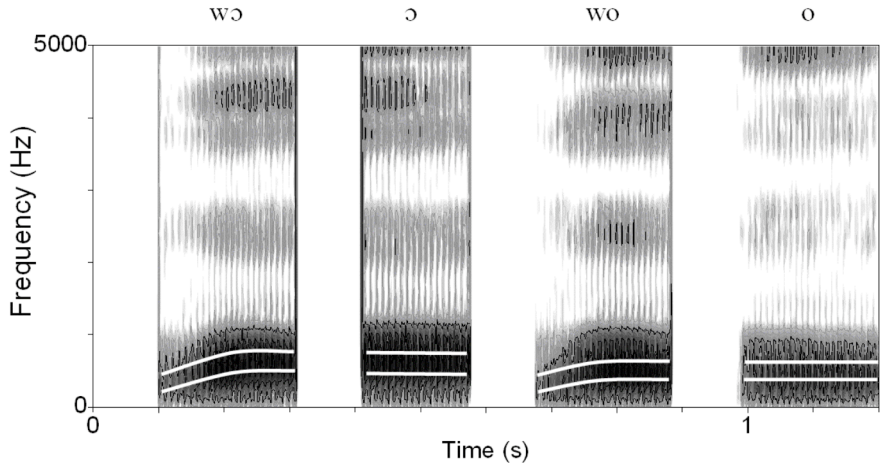


Figure 4.6: Spectrograms of rising back diphthongs [wɔ] and [wo] with mid-open and mid-closed end points contrasted with corresponding monophthongs [ɔ] and [o]. First and second formant tracks are indicated in white.

In order to establish a relationship between production and perception of diphthongs based on formant frequencies, the 217 stimulus items produced by our ten speakers were submitted to an automated formant analysis using the Praat speech processing software. First and second formant frequencies were measured at the starting-point, at 25%, 50%, 75% and at the end-point of every target vowel.

Two separate acoustic correlates were defined, one for the front and one for the back vowels:

(a) Front vowels involve an increasing narrowing between F1 and F2 if a rising diphthong [je] is produced (formant pinching). The correlate for the front vowels is therefore defined as the difference between the F2 and F1 frequency (in Bark) at the 75% point minus that at the 25% point. A positive result points at a closing diphthong, a negative result at an opening diphthong. (For back vowels this correlate does not work, since their formants do not make converging or diverging movements.) The formula in (4.6) sums up the acoustic correlate of spectral change for front vowels:

(4.6) G-index (gliding index) = $(Bk25_2 - Bk25_1) - (Bk75_2 - Bk75_1)$
$G > 0$: opening diphthong

(b) In back vowels, F1 and F2 make a parallel movement, the distance between both formants being ca. 300 Hz. Classic experiments have shown that formants which are so close together in frequency may combine into a single perceived peak (see Chistovich 1985 and Hayward 2000 and references therein). The point of gravity of this single broad formant was

determined simply by calculating the mean values of F1 and F2 (in Bark), which was done at the 25 and 75% points. In a pure monophthong, the point of gravity remains the same from the starting-point to the end-point of the vowel, whereas in an opening diphthong [wo] the point of gravity rises. The correlate of spectral change for back vowels, then, is defined as a variable which subtracts the point of gravity at the 25% point from that at the 75% point. A positive result corresponds to an opening diphthong. (For front vowels this correlate has no effect, since F1 rises while F2 falls, so the point of gravity remains more or less constant.) Formula (4.7) computes the gliding index for back vowels.

(4.7) $\text{G-index} = (.5*\text{Bk75}_2 + .5*\text{Bk75}_1) - (.5*\text{Bk25}_2 + .5*\text{Bk25}_1)$
$G > 0$: opening diphthong

In addition, a third correlate was defined, based on vowel duration. One of the conclusions of the experiment described in the previous chapter was that monophthongs, whether stressed or unstressed, are shorter than diphthongs. This correlate holds for front and back vowels alike.

Using the SPSS statistics package, we established the effect of the three correlates – pinching formants, gravitational shift and vowel duration – on the judgements of the five listeners, who had to score the 217 stimuli either as a monophthong or a diphthong.

Figure 4.7 shows that in back diphthongs, gravitational shift differentiates nicely among the more subtle degrees of diphthongization; the grosser diphthongizations, however, are lumped together, Pearson's $r = .191$ ($p = .049$). Vowel duration (as visualized in figure 4.9), on the other hand, differentiates very well in the stronger back diphthongizations, Pearson's $r = .475$ ($p < .001$). Gravitational shift and vowel duration seem to function as complementary correlates for back vowels.

In figure 4.8 we see that pinching F1 and F2 in front vowels differentiates quite well, independently of vowel duration, Pearson's $r = .597$ ($p < .001$). Of course, the pinching measure does not correlate with the perceived degree of diphthongization in back vowels. For back vowels, too, vowel duration may serve as an additional correlate, Pearson's $r = .271$ ($p = .004$) (see figure 4.9).

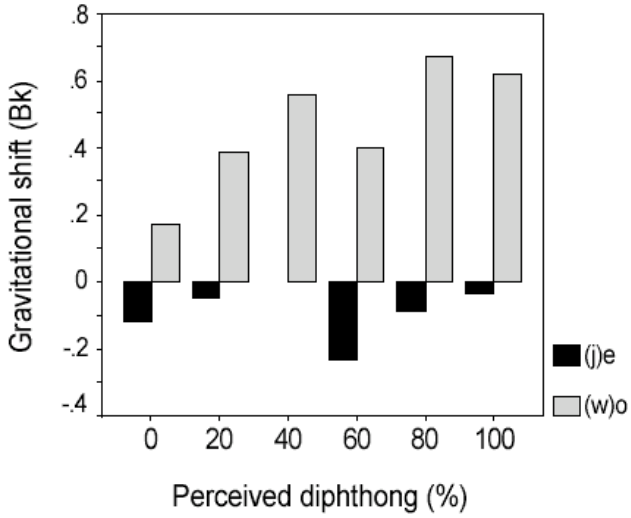


Figure 4.7: Gravitational shift (in Bark) as a function of percentage of perceived diphthongs, broken down by vowel type.

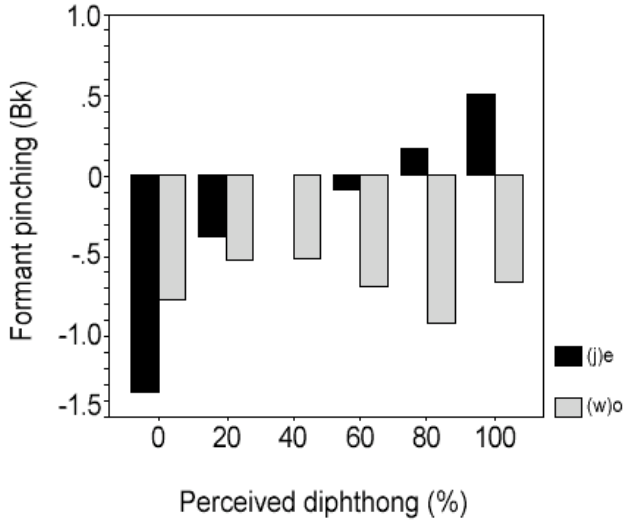


Figure 4.8: Formant pinching (in Bark) as a function of percentage of perceived diphthongs, broken down by vowel type.

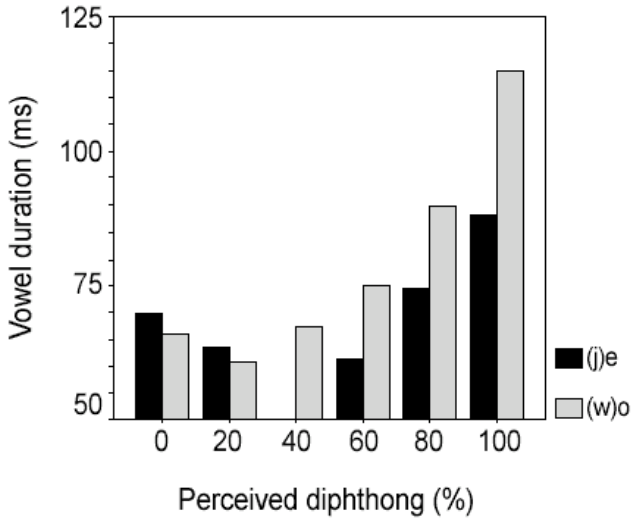


Figure 4.9: Vowel duration (in ms) as a function of percentage of perceived diphthongs, broken down by vowel type.

These three correlates allow us to predict the percentage of diphthongization for front and back vowels separately. For this purpose we computed the correlation coefficient between the three correlates and the actual listener judgments. The multiple correlation coefficient is R = .589 for front vowels and r = .499 for back vowels, indicating that 34.7% and 24.9% (i.e. R^2), respectively, of the variance in the actual judgments is accounted for by the three correlates together. The analysis is summarized in the next table:

Table 4.2: *Correlation coefficient between the three correlates and actual listener judgments.*

	pinching	**dur. grav.**	**vowel dur.**	**R**	**R^2**
front vowels	.597	-	.271	.589	.347
back vowels	-	.191	.475	.499	.249

Although the multiple regression technique does not allow us to distinguish between subtler and grosser diphthongizations, and may therefore prove not all that appropriate for our purposes, I conclude that there is a clear and significant (though moderately strong) correlation between the acoustics and the perception of diphthongization. In front vowels this correlation is stronger than in back vowels. F1 and F2 frequency values, as well as vowel duration, constitute acoustic cues of diphthongization, to which listeners (and particularly groups of listeners with different native languages) attend differently. Perceptually, however, the unstressed back opening

diphthongs are more marked than their front counterparts, in that they are more subtly distinct from and therefore more easily confused with their corresponding monophthongs.

Note that for front diphthongs, the success of the prediction is mainly due to the spectral parameters rather than to vowel duration. In the back diphthongs, the spectral difference is small (in fact, bordering on the insignificant) and the success of the prediction – which is poorer anyway – is mainly due to the vowel duration. One might even argue that the speakers of the language intuitively feel that diphthongization in back vowels is intrinsically more difficult to hear, and invoke a stronger secondary cue, viz. vowel duration.

Importantly, if front diphthongs are assumed to be less easily confused with monophthongs than back diphthongs, we may hypothesize that the two groups of listeners agree better in their perceptions of front diphthongs than in that of back diphthongs. To test this hypothesis, the collected data were submitted to an ANOVA with listener nationality and vowel type as fixed factors. Figure 4.10 plots the mean probabilities of perceiving a diphthong, broken down by front vs back vowels for Italian and Dutch listeners separately. The differences between back and front vowels are clearly visible.

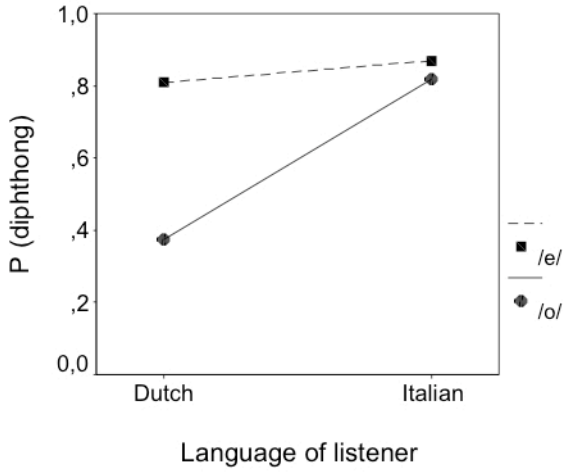


Figure 4.10: Mean numbers of diphthongs perceived (proportion) broken down by listener nationality.

This analysis indicates highly significant effects for vowel type, $F(1, 1081) = 98.2$ ($p < 0.001$), and for nationality $F(1, 1081) = 106.6$ ($p < 0.001$). Also highly significant is the interaction between nationality and vowel type, $F(1, 1081) = 61.7$ ($p < 0.001$). The probability that a rising back diphthong is perceived is .37 for the Dutch listeners against .82 for the Italians; for rising front diphthongs these values are .81 for the Dutch and .87 for the Italian listeners. These results confirm our assumption that the

Dutch subjects are much less sensitive than the Italians in their perception of diphthongization in back vowels than in front vowels.

The most likely explanation for the asymmetric generalization of diphthongization in unstressed vowels (see § 2.4.2, p. 22) is that this analogical sound change is perceptually conditioned. As long as the diphthongs in unstressed syllables are poorly identified, they will not immediately be implemented by the language learners. However, if the effect of morphological uniformity is strong enough, it is not unlikely that the allomorphs containing front diphthongs were extended in an earlier stage of the language than those containing back diphthongs, given the fact that the acoustic cues of diphthongization are stronger in front vowels than in back vowels.

In chapter 6 the levelling of allomorphic alternations is discussed in more detail from a phonological perspective.

5 Italian glides

5.1. Introduction

In chapter 3 it became clear that the mobile diphthongs do not differ from the other rising diphthongs as far as their durations are concerned. The purpose of the present chapter is to provide an analysis of the phonological structure of Italian diphthongs, focusing on the synchronic sources of glides and taking into account the results of the acoustic experiment described in chapter 3.

I will point out that Italian glides either correspond to underlying glides or to underlying vowels which are devocalized in pre- or postvocalic contexts through the process of glide formation. Although the process is usually described as affecting only high vowels (cf. Rosenthall 1994, Hamann 2003, Cabré and Prieto 2004), it will be argued here that non-high vowels can also be subject to glide formation. In § 5.4, glide formation is analysed as a stress-sensitive process that is driven by the interaction between constraints on syllable structure well-formedness and faithfulness constraints.

The analysis that is proposed holds for glides in both rising and falling diphthongs in Italian. There is no need to assume a different phonological analysis pertaining to mobile diphthongs. Hence, my analysis departs from that of previous accounts, which treated mobile diphthongs as fundamentally different from all the other diphthongs.

5.2. Preliminaries

Glides in Italian occur in pre- and postvocalic contexts at both syllable edges, as illustrated by the examples in (5.1a) and (5.1b). In these contexts they function phonetically as the first part of a rising diphthong or as the second part of a falling diphthong, respectively.

(5.1)

(a)	iato	[ˈja.to]	‘hiatus’	(b)	poi	[ˈpoj]	‘then’
	yoga	[ˈjo.ga]	‘yoga’		euro	[ˈɛw.ro]	‘euro’
	uomo	[ˈwɔ.mo]	‘man’		cairota	[kaj.ˈrɔː.ta]	‘Cairene’
	whisky	[ˈwis.ki]	‘whisky’				
	paio	[ˈpaː.jo]	‘pair’				

Prevocalic glides also occur postconsonantally. Examples are given in (5.2).

(5.2)	bianco	['bjan.ko]	'white'
	fiume	['fju.me]	'river'
	piegare	[pje.'ga:.re]	'to fold'
	guida	['gwi.da]	'guide'
	cuore	['kwɔ.re]	'heart'
	vuotare	[vwo.'ta:.re]	'to empty'
	evacuare	[e.va.'kwa.re]	'to evacuate'
	antiquato	[an.ti.'kwa.to]	'antiquated'

The words in (5.1) and (5.2) are typically pronounced with a glide, although their orthographic representations in most cases show a vowel, such as <i> or <u>. The case is different for the words in (5.3): the words in (5.3b) are commonly pronounced with a glide but these words are related to forms with a vowel (see 5.3a). Thus, these forms show that there is a productive vowel–glide alternation in the language.

(5.3)

(a)	av['vi:.o]	'start'	(b)	avv[ja]ménto	'start'
	circ['u:.i]to	'circuit'		circ[wi]tàle	'of a circuit'
	in['vi:.o]	'sending'		inv[ja]bilità	'sendability'

In (5.3a) the sequences of vocoids are pronounced in hiatus, with stress on the first vowel. The corresponding sequences in (5.3b) are realized as rising diphthongs. Because of this vowel–glide alternation, I assume that the forms in (5.3b) have an underlying high vowel that undergoes glide formation. The data in (5.3) demonstrate that glide formation is favoured when stress no longer falls on the first vowel in the sequence.[70] Additional evidence for an underlying vowel is provided by the fact that the words in (5.3b) are acceptable if pronounced with a high vowel, particularly in slow or careful speech: *avv*[ja]*ménto* vs *avv*[i.a]*ménto*, *circ*[wi]*tàle* vs *circ*[u.i]*tàle*, *inv*[ja]*bilità* vs *inv*[i.a]*bilità*, whereas the words in (5.3a) are always pronounced with hiatus. On the other hand, for the words in (5.1) and (5.2) no related forms exist with a vowel instead of a glide. Therefore, the learner has no reason to assume an underlying vowel for these words, since they are always realized with a glide (cf. Bonet and Lloret 1998:179 for a similar case in Catalan).

Hiatus also occurs when the second vowel in the sequence bears stress, as illustrated by the words in (5.4a). The vowel sequences in the words in (5.4b), which are morphologically derived from those in (5.4a) and in which stress no longer falls on the second vowel, are realized as rising diphthongs according to Sabatini and Coletti (1997), although heterosyllabic realizations of these sequences are also acceptable. The difference between the diphthongal vs hiatus realizations of the words in (5.3b) and (5.4b) will be accounted for in § 5.4.5.

[70] Cf. Sabatini and Coletti (1997:VI): "in unstressed position (if *i* or *u* are present), the diphthong prevails" (the translation is mine). See also P. Matteucci's contributions (posted under the pseudonym of *Infarinato*) to a number of discussions about diphthongs/hiatus at the discussion board hosted by the Crusca Academy (http://forum.accademiadellacrusca.it).

(5.4)

(a)	b[i.ˈɔː]logo	‘biologist’	(b)	b[jo]logìa	‘biology’
	cl[i.ˈɛ]nte	‘client’		cl[je]ntèla	‘clientele’
	tr[i.ˈo]nfo	‘triumph’		tr[jo]nfàle	‘triumphant’
	v[i.ˈaː]le	‘avenue’		v[ja.]létto	‘avenue DIM’
	cons[u.ˈɛː]to	‘usual’		cons[we]tùdine	‘habit’

In the phonological literature on Italian, the palatal glide [j] and the labiovelar glide [w] are usually considered as non-syllabic allophones of /i/ and /u/, respectively. For instance, Di Pietro’s (1967) and Saltarelli’s (1970) inventories of Italian phonemes do not include glides. Other phonologists argue that the allophonic view is problematic (cf. Castellani 1956 and Muljačić 1969). Minimal pairs such as *piano* [ˈpja.no] ‘flat’ vs *piano* [pi.ˈa.no] ‘of pope Pius’, *spianti* [ˈspjan.ti] ‘you root up’ vs *spianti* [spi.ˈan.ti] ‘those who spy’, are presented as evidence that every instance of the palatal glide [j] corresponds to underlying /j/ and that every [w] corresponds to underlying /w/. This means for (5.3a) and (5.3b) that these forms must be listed separately in the lexicon. It should be noted, however, that the mere existence of (a small number of) minimal pairs does not jeopardize the allophonic view. For instance, it could be argued that gliding is prevented at morpheme edges, as in *pi-ano* ‘of pope Pius’ and *spi-anti* ‘those who spy’, to guarantee a clear pronunciation and perception of the word stems (cf. the concept of “Alignment” in McCarthy and Prince 2001). Arce (1962) claims that the minimal pair argument is not a valid argument since homosyllabic vowel sequences are compared with heterosyllabic sequences. He concludes that [j] and [w] are allophones of the phonemes /i/ and /u/ if they occur as initial elements of monosyllabic vowel combinations. In this way, Arce’s claim is circular: the syllabification of a vowel sequence depends on the status of the high vocoid but at the same time the status of the high vocoid depends on the syllabification of the vowel sequence. Besides, Arce’s claim that all output glides correspond to input vowels does not explain why there is a glide in a word such as *b*[ja]*nco* (see the list in 5.2) but a vowel in a word such as *v*[i.ˈaː]*le* (see 5.4a). Therefore, I assume that Italian has a phonemic distinction between glides and vowels but that vowels nevertheless undergo gliding in specific contexts.

In the present study, the Italian glides are transcribed as [j] and [w], regardless of whether they correspond to the underlying glides /j/ and /w/ or to the high vowels /i/ and /u/, respectively. Different conventions are found in some earlier works on Italian phonology. Muljačić (1969) makes a surface distinction between underlying glides and vowels that underwent gliding. He distinguishes between [i̯, u̯] and [j, w], e.g. the utterances *hai odio* ‘you have hate’ and *ha iodio* ‘he has iodine’ are transcribed as [ˈai̯ˈɔdjo] and [ˈaˈjɔdjo], respectively. In this example, [i̯] corresponds to /i/ and occurs as the second segment of a falling diphthong, whereas [j] corresponds to /j/ and occurs as the first element of a rising diphthong. A similar distinction is made by Marotta (1988), who also uses the IPA symbols [i̯, u̯] and [j, w], referring to the former as semivowels and to the latter as semiconsonants. Marotta’s distinction between semivowels and semiconsonants is based on acoustic measurements carried out by Salza (1986), who reports on durational differences between the two sound types: semiconsonants in unstressed syllables are approx. 30 ms shorter than semi-

vowels. On the other hand, Salza also demonstrates that the durational differences decrease considerably in stressed syllables. Presumably, duration does not constitute sufficient phonetic evidence to assume a difference between semivowels and semiconsonants. Given the lack of other phonetic evidence, I reject the symbols [i̯, u̯] and transcribe all glides as [j] and [w].

To summarize the different theories on Italian glides discussed so far, we can distinguish three approaches: two traditional approaches and the present approach (cf. Hamann 2003 for German). In the first traditional approach (e.g. Saltarelli 1970), all glides are derived from underlying high vowels, as schematized in (5.5):

(5.5)

In the second traditional approach (e.g. Muljačić 1969), three surface distinctions are related to two underlying representations: the surface glide corresponds to the underlying glide, whereas the high vowels and the glided vowels correspond to underlying vowels; see (5.6).

(5.6)

The present approach assumes that surface glides correspond either to underlying glides or underlying vowels; see (5.7).

(5.7)

The approach in (5.7) implies that glides and vowels neutralize in the context of glide formation. What exactly this context is, will be explained in the following section, which presents an OT account of vowel gliding.

It is important, however, before moving on to the next section, to point out that Italian glide formation does not only affect the high vowels /i/ and /u/. Following Camilli and Fiorelli (1965) and Canepari (1999), it can be claimed that in normal speech vowel sequences with non-high vowels are also contracted to diphthongs when stress shifts to another syllable because of some morphological operation, as illustrated in (5.8):

(5.8)

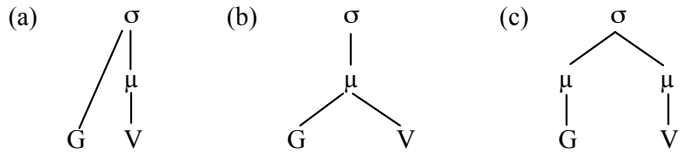
(a)	b[e.ˈaː]to	‘satisfied’	(b)	b[e̯a]tìssimo[71]	‘very satisfied’
	laur[e.ˈaː]to	‘graduate’		làur[e̯a]	‘degree’
	s[o.ˈaː]ve	‘sweet’		s[o̯a]vità	‘sweetness’
	c[o.ˈaː]gulo	‘clot’		c[o̯a]gulazióne	‘curdling’
	m[a.ˈɛ]stro	‘teacher’		m[ae̯]stràle	‘north-western wind’
	p[o.ˈɛː]ta	‘poet’		p[o̯e]sìa	‘poetry’
	al[ˈvɛː.o]lo	‘alveolus’		alv[e̯o]làre	‘alveolar’

The observations regarding the words listed in (5.3b) and (5.4b) also hold with respect to the words in (5.8b): they are equally acceptable when pronounced with hiatus, e.g. *b*[e̯a]*tìssimo* vs *b*[e.a]*tìssimo*, *s*[o̯a]*vità* vs *s*[o.a]*vità*; *p*[o̯e]*sìa* vs *p*[o.e]*sìa*. Note that in careful or slow speech, hiatus is the norm in all these words. The analysis I propose below offers a unified account of Italian glide formation in that it covers the data in both (5.3) and (5.8). To start with, in the next section I discuss the syllabification of Italian glides.

5.3. The syllabic affiliation of glides

The syllabification of diphthongal glides has often been discussed in the phonological literature, e.g. by Harris (1983) for Spanish, Davis and Hammond (1995) for American English, Booij (1989) and Visser (1997) for Frisian and by LaCharité and Paradis (2000) for French loanwords borrowed into Kinyarwanda. From a moraic perspective, onglides can belong to the onset (5.9a), to the nucleus, sharing a mora with the following vowel (5.9b), or to a bimoraic nucleus (5.9c) (falling diphthongs are discussed in § 5.3.3).

(5.9)



5.3.1. Discussion of former analyses

Two partially conflicting analyses pertaining to onglides in Italian were presented in chapter 2, namely those by Marotta (1988) and Sluyters (1992). Marotta advocates a

[71] Neither Camilli and Fiorelli (1965) nor Canepari (1999) are concerned with the question which one of the adjacent vowels undergoes glide formation. However, if we follow Weeda (1983) and Sánchez Miret (1998), we must assume that it is the least sonorant of the two vowels which is glided (see also § 2.2.2). When both vowels are of equal sonority, either of them can undergo gliding (*p*[o̯e]*sìa* or *p*[oe̯]*sìa*). Salza’s (1988, 1991*a*,*b*) duration experiments (based on only one speaker) on Italian bivocalic sequences show a shortening of the least sonorant segment when the sequence is no longer stressed, as [e] in *t*[ea]*tràntе* ‘actor’ (vs *t*[e.ˈa]*tro* theatre), but there are many exceptions, which makes additional acoustic experiments necessary.

complex nucleus analysis as in (5.9c) only in the case of [w] belonging to [wɔ], the alleged only true rising diphthong in Italian. In her analysis she invokes arguments based on segmental distribution and duration. The palatal onglide [j] is claimed to belong to the onset because of its autonomous phonological status. The labial onglide [w] which precedes a vowel different from [ɔ] is said to occur only after a velar consonant (as in [gw]*anto* 'glove' and [kw]*ando* 'when'), where it is assumed to have a shorter duration and is therefore interpreted as part of a labialized consonant, [k^w] or [g^w]. Two remarks can be made.

First, the distribution of the labial glide is not as restricted as claimed. Some counter-examples to the claim that [wV] only occurs after velars are:

(5.10)	affet['two]so	'tender'
	contìn[wo]	'continuous'
	perpe['twa]re	'to perpetuate'
	punt[wa]lità	'punctuality'

In these examples the labial glide occurs before other vowels than [ɔ] and after non-velars as well.[72]

Second, the duration argument supporting the assumption of labiovelar consonants is not confirmed by the empirical data in chapter 3. The durational interaction between glides and following vowels strongly suggests that [w] is more than just a secondary articulation on a preceding consonant. Besides, [w] is longer than [j], for which no secondary articulation status is claimed.

Sluyters, on the other hand, proposes a bimoraic nucleus analysis for [j] and [w] in [jɛ] and [wɔ] and argues that the onglides of other rising diphthongs are syllabified into the syllable onset. His analysis, which was outlined in § 2.5.2.3, is based on the sonority hierarchy, which excludes the occurrence of liquid-glide sequences in word-initial onsets, so that the glides in words as *l*[jɛ]*to* 'happy' and *l*[wɔ]*go* 'place' must be syllabified into the nucleus.

The difficulty in his analysis is that it cannot deal properly with word-internal liquid-glide clusters, as in [ita'ljano] 'Italian', [mi'ljone] 'million' or [kalen'darjo] 'calendar', since word-initially such onset clusters are claimed to be unacceptable because of sonority reasons. This is problematic because, following Green (1997:149), onset clusters permitted word-medially should always be a "subset of onsets permitted word-initially".[73] Besides, rising diphthongs do occur after word-initial liquids, albeit in uncommon words, e.g. *r*[jo]*ttàre* 'to argue', *l*[jo]*còrno* 'leocorn'. More commonly, they occur after liquids which are part of a complex word-initial onset, as in *cl*[je]*ntèla* 'clientele' and *tr*[jo]nfàle 'triumphant'.

[72] In the pronunciation of most Italians, the vowel sequences in these words are realized as a diphthong, although, admittedly, most dictionaries present them as heterosyllabic.

[73] Regarding this problem, Sluyters (1992:179) mentions the "mysterious absence" of [rl] clusters and geminate liquids before [j] (whereas in other contexts liquids do present a length contrast). However, the Italian lexicon is particularly rich in word-medial [rljV], [lljV] and [rrjV] sequences: all verb stems in –[rl], –[rr] and –[ll], for example, yield an indicative present first person plural in –[Vr'ljamo], –[Vr'rjamo] and –[Vl'ljamo], e.g. *parliamo* 'we speak', *corriamo* 'we run', *balliamo* 'we dance'.

Both Marotta and Sluyters support their theories regarding glide syllabification with additional arguments related to the distribution of the allomorphs of the masculine definite article: [il], [l] and [lo]. They argue that, since [w] in [wɔ] is preceded by the prevocalic allomorph [l], it must be syllabified as part of the syllable nucleus. Word-initial [j] in heterorganic diphthongs, preceded by [lo], is interpreted as an onset consonant and is assigned geminate status, analogous to Italian /tts, ddz, ʃʃ, ɲɲ/, which also take [lo] in word-initial position (see §§ 2.5.2.2 and 2.5.2.3).

A vast literature has appeared to discuss the problem of the masculine article allomorphy. A first approach within a generative framework, Romeo (1969), was discussed and simplified by Muljačić (1971, 1974). In these SPE approaches, the surface allomorphs of the article are reduced to a single underlying representation. In Stammerjohann (1973), the article allomorphy is related to phonotactic restrictions, more or less similar to McCrary (2004), who proposes an optimality-theoretic account of the problem. Like Marotta and Sluyters, Davis (1990*a*) argues that the selection of the article allomorph depends on the structure of the following syllable. It is not my intention to develop a new, alternative analysis of this problem here (but see van der Veer 2003). Instead, I claim that the article allomorph distribution is not necessarily an argument to make syllabification distinctions between different types of rising diphthongs. This claim is based on Marotta (1993), who argues that the selection of the allomorph is not only governed by phonological restrictions on syllable structure or segmental combinations, but also by morphological conditions. The author demonstrates that the use of the allomorph [lo] is unidirectionally reduced in favor of [il], the former being morphologically marked with respect to the latter.[74] This tendency towards morphological simplicity (or, speculatively, paradigm uniformity) can become stronger than conditions on phonological well-formedness, particularly in non-native phonological contexts of low lexical frequency. The palatal onglide [j] constitutes a word edge of low lexical frequency in Italian, just like word-initial [ɲ, pn, ps, kn, pt]. It is precisely in these opaque non-native phonological contexts that the grammatical norm is not language-internally motivated, resulting in considerable variation in allomorph selection (which is mostly neglected in existing accounts of article allomorphy, but cf. McCrary 2004).[75] Similar variation is attested before word-initial [w] in non-native words. Whereas native words such as *uomo* 'man' and *uovo* 'egg' systematically select prevocalic [l], loanwords like *uadi* 'wadi', *whisky* and *week-end* may take [l] or [lo] or – in the case of the English loanwords written with a <w> – the unmarked allomorph [il]. It seems therefore difficult to use article allomorphy as a solid phonological argument for syllabification distinctions between word-initial glides, since the con-

[74] As may be expected, not all three allomorphs occur with equal frequency. According to Bortolini, Tagliavini and Zampolli (1972) and De Mauro, Mancini, Vedovelli and Voghera (1993), the form [il] is the most diffused and [lo] is the least. Bortolini et al. found a total frequency of 9049 for *il*, 1889 for *l'* (masc.) and 493 for *lo* in a written corpus of 500,000 words; De Mauro et al. analyzed a spoken corpus of 496,335 words (57 hours) and found a total frequency of 7111 for *il*, 3120 for *l'* (masc. and fem.) and 425 for *lo*.

[75] This variation is even more conspicuous in children, as revealed by an experiment discussed in Marotta (1993). For example, in a group of 61 Pisan children around the ages of 13-14, 1.7% say *il iato*, 77.6% *lo iato* and 20.7% *l'iato*, whereas traditional grammars prescribe *lo iato*.

texts in which these glides occur belong to different parts of the lexicon, [–native] lexemes being treated differently from [+native] lexemes.

5.3.2. A nucleus analysis for onglides

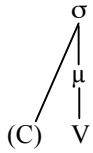
The acoustic duration analysis in chapter 3 showed that stressed monophthongs and rising diphthongs are longer than corresponding unstressed monophthongs and diphthongs. Crucially, as we have seen, the duration of glides is also affected by stress. The lengthening degree of the glide interacts with the lengthening degree of the following vowel in that

- the glide-to-vowel ratio is kept virtually constant (1:3 for [jV] and 1:2 for [wV] on average);
- the duration of the whole diphthong increases in stressed position until it reaches relative duration values similar to that of plain vowels.

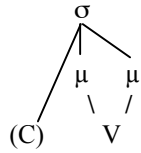
This 'nucleus-oriented behaviour' of [j] and [w] provides strong phonetic evidence for a nuclear analysis of glides in rising diphthongs.

On the basis of these phonetic facts, I argue that Italian rising diphthongs assume the structure as in (5.9c) in stressed open syllables and that in (5.9b) in all other syllables. A fortunate consequence of this proposal is that the syllable structure of rising diphthongs resembles that of plain vowels, which is not surprising given their identical phonetic behaviour under the influence of stress. Unstressed vowels and vowels in closed syllables are linked to one mora (5.11a), whereas their counterparts in stressed open syllables are bimoraic (5.11b).[76]

(5.11) (a)



(b)



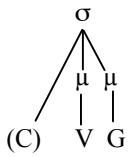
[76] Since vowel quantity is not distinctive in Italian, the question whether vowels can be assumed to surface as bimoraic is a legitimate one. Cf. Bertinetto (1981), who argues that vowel duration has no phonological repercussions in Italian, as opposed to consonant duration. His claim is based on experiments which reveal that the distinction between the members of minimal pairs such as *papa* ~ *pappa* is based on consonant duration rather than on vowel duration. However, in an output oriented approach such as OT, the occurrence of long vowels (and diphthongs) can be interpreted as a mechanism to satisfy a specific constraint. In Dutch, for instance, vowel length is a function of stress, as demonstrated by Gussenhoven (to appear), who assumes that moraic structure plays no role in underlying representations in Dutch. In this analysis, vowel bimoraicity is the result of the constraints WEIGHT-TO-STRESS and STRESS-TO-WEIGHT, which in my analysis of the Italian facts will be conflated into a single constraint $\acute{\sigma}_{\mu\mu}$ (§ 5.4.4). It might be objected that Italian vowel duration is purely the result of phonetic implementation, but synchronic facts in the prosodic morphology indicate that Italian tends towards the elimination of the (less optimal) uneven trochee (a heavy syllable followed by a light one) in favour of a (more optimal) single heavy syllable; compare, for instance, the truncation of *kam.(mi:.no)* > *kam.(min)* 'path, way' or the reduplication of *(pja:.no)* > *(pjan).(pja:.no)* 'slowly' (for more details see Bullock 1998).

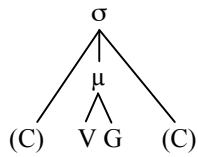
A nucleus analysis of *all* rising diphthongs seems superior. Not only does such an analysis correspond to the phonetic facts, it also assigns a largely autonomous phonological status to rising diphthongs, which may occur after all kinds of consonants, both word-initially and word-internally.

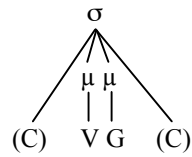
5.3.3. Offglides

Although this dissertation is mainly focused on the mobile diphthongs and their status in comparison to other rising diphthongs in Italian, the falling diphthongs are also of interest to us for historical reasons. In chapter 2 it was explained how in early Italian short *e* and *o* were realized as falling diphthongs in stressed position, which only later converted into the rising mobile diphthongs [jɛ] and [wɔ], respectively.

Regarding falling diphthongs, there are three syllable representations which might be proposed:

(5.12) (a) 

(b) 

(c) 

In (5.12a) the glide is in coda position, whereas in (5.12b) and (5.12c) the glide is part of the nucleus, which can be either monomoraic or bimoraic. Following Marotta (1988), I argue that there are solid arguments to assume that falling diphthongs are best represented by the structure in (5.12a). The first argument is of a distributional nature: falling diphthongs are never followed by geminates or tautosyllabic consonants.[77] It is therefore plausible that the glide occupies the coda position and closes the syllable. Since Italian treats closed syllables as bimoraic (see Bullock 1998 and references therein), I assume that the glide in the coda is mapped to a mora.

This argument predicts that stressed word-final falling diphthongs do not trigger gemination of a following word-initial consonant, whereas stressed word-final vowels do. This phonological process is known in the literature as *raddoppiamento sintattico* or 'syntactic redoubling'.[78] *Raddoppiamento sintattico* was shown to be a rule of the phrasal phonology by Nespor and Vogel (1986) and has a syllable closing effect, as in the following examples:

(5.13)	è buono	'he is good'	['ɛb.'bwɔ.no].
	può venire	'he can come'	['pwɔv.ve.'ni.re]

[77] Falling diphthongs do precede consonant clusters of which the first consonant is /s/, as in [aw]*spicare* 'to hope'; however, the syllabification of /s/ in consonant clusters is subject to phonological debate (see Bertinetto 1998/1999 and 1999*a* for Italian; e.g. Selkirk 1982, Treiman, R., J. Gross, and A. Cwikiel-Glavin 1992, and Barlow 2001 for English, among others).

[78] A vast literature on *raddoppiamento sintattico* has appeared; for more recent contributions see for instance Chierchia (1986), Davis (1990*a*,*b*), Sluyters (1990), Repetti (1991), Wiltshire and Maranzana (1999), McCrary (2004).

However, initial consonants do not geminate when preceded by a syllable ending in a stressed falling diphthong, which makes sense if we assume that the syllable is already closed by the glide:

(5.14) sei buono 'you are good' ['sɛj.'bwɔ.no], not *['sɛjb.'bwɔ.no]
puoi venire 'you can come' ['pwɔj.ve.'ni.re], not *['pwɔjv.ve.'ni.re]

The second argument is based on phonetic evidence. Offglides have a longer duration than onglides (Salza 1986, 1988, 1991*a*,*b* and Marotta, Rocca and Salza 1987). Importantly, the duration of offglides following stressed vowels is not significantly different from that of offglides following unstressed vowels. This acoustic fact strongly suggests that an offglide behaves as an autonomous segment and does not constitute a single element with the preceding vowel, as opposed to onglides, for which a nucleus analysis was proposed in the previous section.

5.4. An OT analysis of Italian glide formation

5.4.1. A syllable-based approach

Many languages tend to avoid vowel sequences by allowing one of the vowels to undergo glide formation, a process which maps an input vowel onto an output glide. In previous OT accounts, this widespread phenomenon was interpreted in terms of syllabification: see e.g. Rosenthall (1994) for exemplification from a large number of languages and Hall (2004) for German. In these approaches, gliding is conceived of as one of the possible strategies to achieve tautosyllabification of two adjacent vowels. The two main constraints involved in a syllable-based OT account of gliding are a markedness constraint ONSET, which requires syllables to have onsets, and an IDENT constraint which penalizes the realization of a vowel as a glide (cf. McCarthy 2002:97-99). Gliding satisfies the constraint ONSET, but in a constraint ranking where ONSET dominates IDENT, glide formation will be evaluated as more harmonic than hiatus. Tableau (5.15) illustrates the interaction of these two constraints for the word *avviamento* 'start' (syllables are separated by a dot):

(5.15)

Input: /avviamento/	ONSET	IDENT
a. av.vi.a.'men.to	*!	
b. ☞ av.vja.'men.to		*

In (5.15), candidate (a) is most faithful to the input but since the vocalic sequence is realized in hiatus, it has an onset-less fourth syllable and therefore it fatally violates high-ranked ONSET. The glided vowel in candidate (b) constitutes a rising diphthong together with the following vowel and in spite of its violation of the faithfulness constraint, this candidate is the winner since it satisfies ONSET.

Glide formation is only one strategy to resolve hiatus. Other strategies are epenthesis of an intervening consonant, vowel elision and coalescence (segment fusion) (cf. Casali 1996). Consonant epenthesis, for instance, satisfies ONSET, because the consonant is syllabified as an onset which precedes the second vowel in the vowel sequence. It also satisfies IDENT, since the prevocalic input vowel is not mapped to an output glide. However, epenthesis violates the faithfulness constraint DEPENDENCE (or DEP) which requires every output segment to have a correspondent in the input structure ('no insertion', cf. Kager 1999:205). If DEP outranks IDENT, the candidate with the glided vowel will win, as exemplified in tableau (5.16):

(5.16)

Input: /avviamento/	ONSET	DEP	IDENT
a. av.vi.a.ˈmen.to	*!		
b. ☞ av.vja.ˈmen.to			*
c. av.vi.Ca.ˈmen.to		*!	

Other faithfulness constraints that are relevant to hiatus resolution are anti-coalescence constraints such as UNIFORMITY, militating against segments in the output that have multiple segments in the input ('no coalescence'; McCarthy and Prince 1995) and a general anti-deletion constraint MAX, requiring that input segments have output correspondents. Within the framework of OT, the hiatus resolving strategy that a given language adopts, depends on the position of these faithfulness constraints in the constraint ranking of that language (see Casali 1996).

The fact that usually only high or less sonorant vowels become glides in glide formation contexts, can be explained in terms of peak hierarchy constraints (Prince & Smolensky 2002:155):

(5.17) Universal peak hierarchy:
*P/t » (...) *P/l » *P/i, u » *P/e, o » *P/ɛ, ɔ » *P/a
where *P/λ indicates a restriction against having segment λ in the syllable peak

Low vowels display more resistance to gliding than high vowels because they constitute more harmonic syllable peaks, as expressed by the ranking in (5.17). This universal ranking of the peak hierarchy constraints is illustrated in tableau (5.18):

(5.18)

Input: /avviamento/	*P/i, u	*P/a
a. ☞ av.vja.ˈmen.to		*
b. av.via.ˈmen.to	*!	

This ranking does not exclude less sonorant vowels, such as the mid vowels /e/ and /o/, from gliding, as in the words listed in (5.8b). Tableau (5.19) illustrates this for the word *soavità*[79]:

(5.19)

Input: /soavità/	*P/i, u	*P/e, o	*P/a
a. ☞ so̯a.viˈta			*
b. soa̯.viˈta		*!	

5.4.2. The syllable-based approach criticized

The syllabification-based OT approach of glide formation is criticized by Hamann (2003), who discusses glide formation in German.[80] The constraint ranking in (5.15) gives the correct result for a word such as *Stud*[jʊ]*m* 'study', the winning output for an input /ʃtuːdiʊm/, but following Hamann, it fails to account for output forms with stressed pre- or postvocalic vowels. In a word like *naiv* [naˈiːf] 'naive', the stressed post-vocalic [iː] is expected to undergo glide formation with the given constraint ranking.[81] This incorrect prediction is illustrated in tableau (5.20):

(5.20)

Input: /na.iːf/	ONSET	IDENT
a. ☞ naˈiːf	*!	
b. ☜ ˈnajf		*

In (5.20), candidate (b) (indicated by the incorrect winner symbol ☜) incurs a violation of IDENT, but more importantly it satisfies the higher ranked constraint ONSET and therefore it incorrectly wins. The same constraint ranking also incorrectly predicts that the stressed prevocalic vowel in a word like *Zion* [ˈtsiːɔn] 'zion' is realized as a glide:[82]

---

[79] Some speakers may feel that candidate (b) in tableau (5.19) is equally acceptable to candidate (a). Presumably it is difficult to perceive the distinction between a possible form *s*[oa̯]*vità* and a more carefully pronounced form *s*[o.a]*vità* with secondary stress on the first syllable (cf. fn. 71 supra).

[80] The syllable-based analysis explained in this chapter slightly departs from the one discussed by Hamann, in which glides are regarded as the nonmoraic counterparts of corresponding vowels and gliding therefore violates the faithfulness constraint MAX-μ. However, in § 5.3.2, I demonstrated that Italian glides in stressed syllables are associated to a mora, so for instance the unattested form *[ˈvja] (with a bimoraic diphthong), corresponding to /via/, would not violate MAX-μ. For this reason I decided to use an alternative faithfulness constraint which referes to featural instead of moraic content. Nothing crucial hinges upon this decision.

[81] It should be noted that perhaps long vowels do not undergo glide formation; however, this explanation is irrelevant for a word like *Zion* [ˈtsiːɔn], used as an example in tableau (5.21).

[82] In German, word-final stressed vowels are raised and lengthened, also in loanwords, see Hall and Hamann (2003).

(5.21)

Input: /tsi.ɔn/	ONSET	IDENT
a. ☞ 'tsi.ɔn	*!	
b. ☜ 'tsjoːn		*

Under this analysis, the constraints ONSET and IDENT can be claimed to be syllabification constraints only, which do not refer to stress. As a result, "[a] solution to this problem cannot be easily integrated in this approach" (Hamann 2003:143). It is my intention to develop an analysis that demonstrates how this problem can be overcome.

5.4.3. Positional Faithfulness

The proposal is based on the theory of Positional Faithfulness (Beckman 1998, 2004) which relies on functional considerations, namely that certain perceptually or psycholinguistically prominent positions are better suited to maintain particular featural or segmental contrasts than non-prominent positions. Examples of prominent contexts are root-initial syllables, stressed syllables and lexical (content) words or morphemes. For instance, Beckman (2004) gives examples from languages in which root-initial syllables fail to undergo regular phonological processes, such as consonant assimilation or dissimilation. The theory of Positional Faithfulness claims that the set of faithfulness constraints may be sensitive to particular prominent contexts, assuming the following format:

(5.22) FAITH-F/PP
Faithfulness pertaining to a feature (F) is required in a morphologically or prosodically defined prominent position (PP).

In OT, contrasts are preserved by faithfulness constraints, whereas markedness constraints militate against ill-formed structures. Phonological processes, such as assimilation, occur when some markedness constraint dominates a faithfulness constraint. The blocking of a process and the preservation of underlying contrasts in prominent positions derives from the ranking in (5.23).

(5.23) FAITH-F/PP » MARKEDNESS » FAITH-F

In the ranking in (5.23), the positional faithfulness constraint dominates some markedness constraint so that the relevant feature in the prominent position is immune to the phonological process which results from the ranking Markedness » FAITH-F.

To illustrate the theory of Positional Faithfulness, an example is taken from Beckman (2004). In Tamil, the absence of mid vowels in non-initial syllables results from a ranking where a positional faithfulness constraint IDENT-[high]/[σ competes

with the general faithfulness constraint IDENT-[high] and the intervening markedness constraint is *MID:

(5.24) IDENT-[high]/[σ » *MID » IDENT-[high]

Input height contrasts are preserved in root-initial syllables by the ranking of IDENT-[high]/[σ » *MID, whereas mid vowels are banned from all other, i.e. non-initial syllables by the ranking of *MID » IDENT-[high].

Positional Faithfulness has been applied to a wide range of phenomena, e.g. final devoicing and voicing assimilation (Grijzenhout and Krämer 1999), epenthesis (Alderete 2000), reduplication and truncation (Nelson 2003) and tone sandhi (Eberhard 2003). The theory also allows us to account for the stress-sensitivity of glide formation, by relativizing the IDENT constraint to certain salient contexts, such as the stressed syllable. Before moving on to my analysis, I will briefly outline a possible approach to Italian syllables in the next section.

5.4.4. Italian syllable structure in moraic theory

The phenomenon of glide formation is better understood in a wider context of Italian syllable structure, which also allows us to account for certain other phenomena, such as stress assignment and syllabification of segments. In this section the different types of Italian syllable structure are defined according to their moraic content.

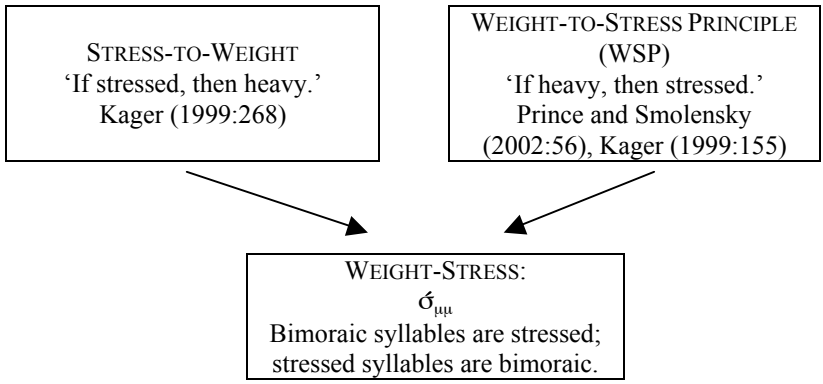
Italian syllables feature two types of moraic composition: they are either monomoraic or bimoraic. Usually syllables are monomoraic (or light), but stressed syllables are bimoraic (or heavy). Bimoraicity arises through a long vowel or diphthong consisting of two morae or a short vowel followed by a coda consonant, which realize one mora each. Although the mora is an abstract phonological unit of weight, it is generally assumed that this abstract notion of phonological weight roughly coincides with phonetic duration: bimoraic vowels are generally realized as long vowels and monomoraic vowels as short vowels (cf. Repetti 1991, Bullock 1998, Wiltshire and Maranzana 1998 and D'Imperio and Rosenthall 1999).

The moraic interpretation of durational differences (long vs short vowels) in Italian is based on the results of a large number of acoustic experiments. The oldest data pertaining to Italian duration phenomena are found in work that dates from 1900, *Étude sur la phonétique italienne* by Josselyn. His conclusion, that there is a significant durational difference between stressed vowels in open syllables and in closed syllables, was confirmed more than thirty years later by Parmenter and Carman (1932). In both studies, only bisyllabic words were examined. The same is true for later experiments carried out by Fava and Magno Caldognetto (1976) and Vogel (1982). Stimuli which contain more than two syllables were included in duration experiments conducted by Marotta (1985), Farnetani and Kori (1990) and D'Imperio and Rosenthall (1999). Interestingly, these three studies report that there are remarkable durational differences between stressed vowels depending on syllable position: stressed vowels in prefinal position are significantly longer than stressed vowels in pre-prefinal position – although according to Marotta this finding only holds consistently for words with stress on the first syllable. The results of the experiment

presented in chapter 3 of this dissertation confirm the existence of durational differences between stressed and unstressed vowels and provide evidence that these differences also hold for rising diphthongs. Furthermore, it was shown that the durations of stressed vowels and diphthongs depend on the duration of the whole word in which they occur.

The distribution of long and short vowels and long and short diphthongs in Italian can be understood as an interaction of a number of constraints that are concerned with moraic structure. The first constraint expresses a relationship between stress and bimoraicity. In OT literature this relationship is commonly captured by two different constraints: STRESS-TO-WEIGHT (Kager 1999:268), which requires stressed syllables to be heavy, and its opposite counterpart, the WEIGHT-TO-STRESS PRINCIPLE (WSP) (Prince and Smolensky 2002:56, Kager 1999:155), which requires that heavy syllables are stressed. In some analyses, however, the distinction between these two constraints becomes unclear. In Bullock (1998:60), for instance, the Italian output form ['ba.ra] 'tomb' incurs a violation of WSP, because the stressed syllable is not heavy. Since WSP does not say anything about *light* syllables, it seems preferable to interpret ['ba.ra] as a violation of STRESS-TO-WEIGHT instead. Confusions of this type may raise the question whether these two separate constraints might not be better understood as the consequences of one single constraint which covers both directions in the stress/weight relationship. A proposal for a constraint of this type is presented in (5.25):

(5.25)



The fact that Italian has a preference for short vowels in closed syllables is explained by the ban on *trimoraic* syllables expressed through the same constraint $\acute{\sigma}_{\mu\mu}$, on the assumption that syllable codas are moraic. Coda weight is determined by the interaction of the constraints WEIGHT-BY-POSITION (W×P) (codas must be moraic, cf. Kager 1999) and $*C_{\mu}$ (no moraic consonants). Whenever W×P dominates $*C_{\mu}$, coda consonants are moraic:

(5.26) W×P » $*C_{\mu}$
$CV_{\mu}C_{\mu}.CV > CV_{\mu\mu}C.CV$

Vowels and rising diphthongs in stressed open syllables lengthen under the duress of $\acute{\sigma}_{\mu\mu}$. This lengthening happens at the expense of a violation of the faithfulness constraint DEP-μ. DEP-μ requires that output morae have input correspondents (Kager 1999:156) and must therefore be ranked below $\acute{\sigma}_{\mu\mu}$:

(5.27) $\acute{\sigma}_{\mu\mu}$ » DEP-μ
$CV_{\mu\mu}.CV > CV_{\mu}.CV$

The two rankings in (5.26) and (5.27) are combined into the tableaux (5.28) and (5.29), thus illustrating how they are responsible for the distribution of long and short vowels in Italian (output moraicity is indicated by bold faced IPA symbols):

(5.28)

Input: /kasa/	$\acute{\sigma}_{\mu\mu}$	W×P	$*C_{\mu}$	DEP-μ
a. ☞ 'k**aɪ**.s**a**				*
b. 'k**a**.s**a**[83]	*!			

(5.29)

Input: /karta/	$\acute{\sigma}_{\mu\mu}$	W×P	$*C_{\mu}$	DEP-μ
a. 'k**aɪ**r.t**a**	*!		*	*
b. ☞ 'k**a**r.t**a**			*	
c. 'k**a**r.t**a**	*!	*		

Tableau (5.30) illustrates the lengthening of rising diphthongs[84]:

(5.30)

Input: /pjano/	$\acute{\sigma}_{\mu\mu}$	W×P	$*C_{\mu}$	DEP-μ
a. ☞ 'p **ja**. n**o** (μμ, | |)				*
b. 'p **ja**. n**o** (μ, / \)	*!			

[83] Constraint interaction for stress will not be discussed here. However, since it is generally agreed that Italian is a trochaic language, outputs such as [k**a**.'s**aɪ**] are always suboptimal; for an OT analysis of Italian stress, see Bullock (1998) and D'Imperio and Rosenthall (1999).

[84] A third output candidate could be added to this tableau, [pj**aɪ**.no], in which the glide is syllabified in the onset and the vowel lengthens to satisfy $'\sigma_{\mu\mu}$. I assume that onset affiliation of onglides in Italian is ruled out by a high-ranked markedness constraint that bans non-consonantal material from the syllable onset (cf. Harris 1983, Rosenthall 1994:140 and Casali 1996:21).

By reversing the input length (with respect to the output), the following tableau demonstrates that input vowel length is completely irrelevant to the outcome as long as $\acute{\sigma}_{\mu\mu}$ is undominated. For instance, if the input were /CVːC.CVː/, the winning output would still be ['CVC.CV] because this ranking forces vowels to be long if and only if they occur in *stressed open* syllables:

(5.31)

Input: /kaːrtaː/	$\acute{\sigma}_{\mu\mu}$	W×P	$*C_{\mu}$	DEP-μ
a. 'kaːr.taː	*!*		*	
b. ☞ 'kar.ta			*	
c. 'kar.taː	*!*	*		

In sum, undominated constraints on quantitative syllable well-formedness force vowels and diphthongs to be either monomoraic or bimoraic, at the expense of violations of low-ranked faithfulness to input quantity. In the next section, it will be shown how these constraints relate to the phenomenon whereby sequences of vowels lose an input mora and surface as diphthongs.

5.4.5. The extended syllable-based approach

Within the present analysis, a crucial role is played by the IDENT constraint that militates against glide formation (see § 5.4.1). Since gliding does occur in Italian, it is obvious that the faithfulness constraint is dominated by constraints on well-formedness.

In section 5.4.1, I argued that glide formation is one of the strategies to avoid a sequence of two vowels. Conversely, glide formation is sensitive to stress assignment, so that not every bivocalic sequence is transformed into a glide-vowel or vowel-glide sequence, as was demonstrated by the examples in (5.3) and (5.8). Consider the following data:

(5.32)

(a) /via/	['viː.a]	'road'
(b) /viale/	[vi.'aː.le]	'avenue'
(c) /traviamento/	[tra.vja.'men.to]	'deviation

OT approaches of glide formation that do not refer to stress correctly predict the output in (5.32c), but they cannot account for the forms in (5.32a-b), as is shown in the following tableaux:

(5.33)

Input: /traviamento/	ONSET	IDENT
a. tra.vi.a.'men.to	*!	
b. ☞ tra.vja.'men.to		*

(5.34)

Input: /via/	ONSET	IDENT
a. ☞ 'viː.a	*!	
b. ☜ 'vja		*

(5.35)

Input: /viale/	ONSET	IDENT
a. ☞ vi.'aː.le	*!	
b. ☜ 'vja.le		*

In these tableaux, undominated ONSET is fatally violated by any candidate that contains a sequence of two vowels in hiatus. In (5.34) and (5.35), this ranking incorrectly predicts that the candidates with glided vowels are the winners (the wrong prediction is represented by the symbol ☜). Somehow the grammar must block glide formation in stressed contexts. The solution to this problem comes from the theory of Positional Faithfulness, outlined above: it is worse for a candidate to violate IDENT in salient positions such as stressed syllables than it is elsewhere. Therefore, IDENT needs to be relativized to the context of stressed syllables, which is expressed through the following positional faithfulness constraint:

(5.36) IDENT/σ́
No vowel-to-glide mapping in heads of prosodic words (i.e. syllables which receive main stress).

This position-sensitive constraint belongs to the same family as the general, position-insensitive constraint IDENT, and universally dominates it (Kager 1999:409 and Beckman 2004:314). Hence the ranking in (5.37) obtains:

(5.37) IDENT/σ́ » IDENT

Glide formation is blocked in stressed syllables when ONSET is outranked by IDENT/σ́. At the same time, stressed syllables must fulfil the requirements imposed by $\sigma_{\mu\mu}$, which, as we have seen in the previous chapter, dominates DEP-μ. Thus, the following ranking correctly predicts glide formation in unstressed syllables and its non-occurrence in stressed ones:

(5.38) IDENT/σ́, σ́$_{\mu\mu}$ » ONSET » DEP-μ, IDENT

This ranking is illustrated in the tableaux (5.39) – (5.41):

(5.39)

Input: /via/	IDENT/σ́	σ́$_{\mu\mu}$	ONSET	DEP-μ	IDENT
a. 'vi.a		*!	*		
b. ☞ 'viː.a			*	*	
c. 'vja	*!	*			*
d. 'vjaː	*!			*	*

(5.40)

Input: /viale/	IDENT/σ́	σ́$_{\mu\mu}$	ONSET	DEP-μ	IDENT
a. vi.'a.le		*!	*		
b. ☞ vi.'aː.le			*	*	
c. 'vja.le	*!	*			*
d. 'vjaː.le	*!			*	*

(5.41)

Input: /traviamento/	IDENT/σ́	σ́$_{\mu\mu}$	ONSET	DEP-μ	IDENT
a. tra.vi.a.'men.to			*!		
b. ☞ tra.vja.'men.to					*

From these tableaux it can be concluded that underlying vowel sequences in Italian are mapped to two different output structures: the result is either hiatus, in which one of the vowels is stressed and lengthens to satisfy σ́$_{\mu\mu}$ (5.39b and 5.40b), or an unstressed (monomoraic) diphthong, in which the least sonorant vowel becomes a glide (5.41b), as predicted by the universal peak hierarchy (see 5.17).

In § 5.2 it was anticipated that glide formation is subject to variation. Some speakers may prefer hiatus to the shorter diphthongal variant, which is particularly true in slow or careful speech.[85] This variation can be explained by assuming that in the grammar of these speakers (or, alternatively, in the careful speech grammar, which is expected to be more "faithful") IDENT dominates ONSET, whereas in normal or fast speech the opposite ranking holds. When IDENT outranks ONSET, the candidate with the diphthong will be the winner; see tableaux (5.42) and (5.43).

[85] Hiatus prevails in a number of learned words, such as *d*[u.a]*lìsmo* 'dualism' and *mùt*[u.o] 'mortgage' (cf. Sabatini and Coletti 1997:VI). I assume that vowels in these words are protected from gliding by an IDENT constraint that is relativized to learned words.

(5.42)

Input: /traviamento/	IDENT	ONSET
a. ☞ tra.vi.a.'men.to		*
b. tra.vja.'men.to	*!	

(5.43)

Input: /klientɛla/	IDENT	ONSET
a. ☞ kli.en.'tɛː.la		*
b. kljen.'tɛː.la	*!	

To wind up this section, I conclude that stressed syllables are immune to glide formation due to undominated IDENT/ σ́. Glides may only occur in stressed syllables when they correspond to input glides, as in the words in (5.1) and (5.2). Tableau (5.44) shows that underlying glides do not pose a problem for the newly proposed constraint ranking: they will always surface as glides to avoid violations of ONSET and IDENT.

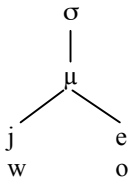
(5.44)

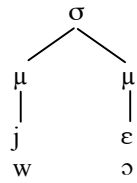
Input: /kwɔre/	IDENT/σ́	σ́$_{μμ}$	ONSET	DEP-μ	IDENT
a. ku.'ɔː.re			*!	*	*
b. ☞ μμ | | 'kwɔ.re				*	

5.5. The mobile diphthongs

There are good reasons to assume that the mobile diphthongs [jɛ] and [wɔ] do not need to be analyzed separately from the other Italian rising diphthongs. At the phonetic level, they show the same stress-induced lengthening patterns (see chapter 3) and at the phonological level their distributional characteristics are identical (see § 5.3).

The mobile diphthongs belong to the group of diphthongs of which examples were listed in (5.1a) and (5.2), i.e. their glides are present in the input: [jɛ] and [wɔ] correspond to /jɛ/ and /wɔ/, respectively. In stressed syllables, these diphthongs are bimoraic (5.45b), whereas their unstressed counterparts [je] and [wo] are monomoraic (5.45a):

(5.45) (a) 

(b) 

This view departs considerably from the account provided by Sluyters (1992). As explained in § 5.3.1, he claims that only the mobile diphthongs constitute a bimoraic nucleus and are thus prosodically identical to long vowels, whereas the glides of the other rising diphthongs are assumed to be affiliated to the onset. It remains unclear what prosodic status is claimed for the unstressed counterparts of the mobile diphthongs, as in his example of the derivation of /bɔn/ + /issim/ > *b*[wo]*nìssimo* (Sluyters 1992:303). Assuming that [wo] in *b*[wo]*nìssimo* constitutes a bimoraic nucleus runs counter to Sluyters' theory, which predicts that bimoraic nuclei occur only in stressed syllables. On the other hand, if the glide is syllabified into the onset, he would have to explain why [w], which in *b*[wɔ]*no* belongs to the nucleus, moves to the onset in the derived superlative *b*[wo]*nìssimo*. The only plausible solution to this problem would be to assume that the unstressed counterparts of the mobile diphthongs have a prosodic structure as in (5.45a), a category which is not available in Sluyters' analysis.

More problematic in Sluyters' proposal is the claim that the mobile diphthongs correspond to the underlying monophthongs /ɛ/ and /ɔ/. Diphthongization of the mid-low vowels and lengthening of all other vowels are both considered as processes which convert a foot containing two syllables of even duration into a foot in which the two syllables are of uneven duration. Since the result is an uneven trochee, instead of the universally preferred even trochee, Sluyters (1992:305) argues that "from a metrical point of view, lengthening rules (...) are "optional", since a quantity-sensitive binary foot is well-formed also when its dominant syllable is light." This view is problematic for several reasons.

First, vowel lengthening may be optional for some speakers, or the degree of lengthening may be variable, but it is unclear how Sluyters' theory can explain that in the words containing a (mobile) diphthong, it is obligatorily realized; i.e. if diphthongization is a lengthening rule, there is no reason why lengthening should be compulsory for /ɛ/ and /ɔ/ but not for all other vowels.

Second, Sluyters' theory cannot account for the absence of diphthongs in words such as *c*[ɔː]*pro* 'I cover', *abb*[ɔː]*no* 'I subscribe', *n*[ɔː]*to* 'I notice' and *rip*[ɛː]*to* 'I repeat', which show that long mid-low vowels do occur in Italian.[86] Simultaneously, the theory cannot be reconciled with the presence of diphthongs in closed syllables in a number of truncated forms such as *b*[wɔ]*n libro* 'good book', in which the diphthong occurs in a closed syllable. These examples are a strong indication that in

[86] It has often been argued that the absence of vowel–diphthong alternation in verbs like *abbonare* and *notare* could be due to the risk of confusing them with the phonologically very similar verbs *abbuonare* and *nuotare* (see, for instance, Dardano and Trifone 1989). However, the semantic fields of these and similar word pairs are so divergent that any confusion must be excluded (see Tekavčić 1972*b*).

Sluyters' account a synchronic analysis is mixed up with diachronic facts: diphthongization is no longer a productive process in Modern Italian.

A third problem is that the theory is inconsistent with the evidence provided by Sánchez Miret (1998), who demonstrates that the modern mobile diphthongs [jɛ] and [wɔ] are genealogically but not phonologically derived from /ɛ/ and /ɔ/. In late spoken Latin, a mid-low vowel diphthongized in stressed syllables, but the result was not immediately a rising diphthong, but a falling diphthong, presumably [ɛe̯] and [ɔe̯] (for more details, see § 2.4.2).

I agree with Sluyters that there is a relation between syllable weight and diphthongization of /ɛ/ and /ɔ/. In § 5.4.4 it was argued that there are two types of syllables in Italian. In order to satisfy the constraint $\acute{\sigma}_{\mu\mu}$, monomoraic syllables become bimoraic (or heavy) when stressed. There are two types of bimoraicity: either a long vowel or diphthong consisting of two morae or a short vowel followed by a coda segment, which realize one mora each. From a phonological point of view, diphthongization of /ɛ/ and /ɔ/ yields syllables of the second category, i.e. closed syllables, in which the glides are moraic due to high ranked W×P. The fact that /ɛ/ and /ɔ/ did not lengthen in Late Latin, as opposed to the other vowels, can be explained in terms of markedness. Long lax vowels are disfavoured (see Donegan 1985, Holt 1997), which is expressed through the markedness constraints *ɛː and *ɔː (*LONG-[–ATR] in Holt 1997). These constraints must outrank the syllable structure constraint which militates against bimoraic diphthongs, NODIPHTHONG (see 6.19). The interaction of constraints responsible for diphthongization of the mid-low vowels is illustrated in tableau (5.46).

(5.46)

Input: /bɔno/	$\acute{\sigma}_{\mu\mu}$	W×P	*ɔː	NODIPH	*C_{μ}	DEP-μ
a. ˈbɔ.no	*!					
b. ˈbɔː.no			*!			*
c. ☞ ˈbɔe̯.no				*		

In the tableau in (5.46), undominated $\acute{\sigma}_{\mu\mu}$ immediately disqualifies the first candidate, in which the stressed syllable is light. It is satisfied by the remaining candidates, but the candidate with the diphthong is more optimal, since NODIPH is dominated by *ɔː. The same constraint ranking predicts that non-lax vowels will lengthen in stressed syllables:

(5.47)

Input: /roma/	$\acute{\sigma}_{\mu\mu}$	W×P	*ɔː	NODIPH	*C_{μ}	DEP-μ
a. 'ro.ma	*!					
b. ☞ 'roː.ma						*
c. 'roo̯.ma				*!		

The tableaux in (5.46) and (5.47) reflect the stage of the language in which both vowel lengthening and diphthongization were closely related processes: both have the stressed open syllable as their domain of application and create well-formed stressed syllables. Eventually, the diphthongs [ɛo̯] and [ɔo̯] were stored as such in the lexicon, through the mechanism of Lexicon Optimization, to which we will return in the next chapter. Consequently, the input of a word such as *b*[ɔo̯]*no* is no longer reconstructed as /bɔno/, but as /bɔo̯no/. Through the years the diphthongs converted from falling into rising, [jɛ] and [wɔ], in which form they became part of the Italian lexicon.

In a subsequent language stage, stressed mid-low vowels did no longer differ from other vowels in stressed open syllables, as illustrated by a number of latinisms (*voci dotte*), used to enrich the Italian lexicon when the popular spoken language also became the written language. These words penetrated the lexicon without having undergone the normal phonetic evolution that characterizes the words of uninterrupted Romance tradition. Examples of latinisms are *m*[ɛː]*dico* 'doctor', *rip*[ɛː]*to* 'I repeat', *p*[ɔː]*ro* 'pore', *t*[ɔː]*no* 'tone', *st*[ɔː]*maco* 'stomach', all realized with long mid-low vowels in stressed open syllables.

The fact remains that, synchronically, the mobile diphthongs [jɛ] and [wɔ] alternate with the corresponding monophthongs [e] and [o] in unstressed positions. On the other hand, it is also true that this alternation is subject to a great degree of analogical levelling in numerous cases, the diphthongs having expanded to unstressed syllables, as confirmed by the experiments described in chapter 4. All these issues will be elaborated in the next chapter.

5.6. Conclusion

There is phonetic and phonological evidence that Italian onglides are most harmoniously syllabified as part of the nucleus, whereas a coda analysis is proposed for offglides.

Italian features a vowel–glide alternation: a sequence of two adjacent vowels surfaces in hiatus whenever one of the two vowels is stressed; otherwise the least sonorant vowel is parsed as a glide. In the constraint-based approach presented in this chapter, stress-sensitive vowel-glide alternation is determined by simultaneously best satisfying positional faithfulness and syllable structure constraints.

The distribution of vowels and glides cannot always be related to a stress-sensitive vowel–glide alternation. In a large number of lexical items, glides never alternate with vowels but always surface as glides. These glides must be present

underlyingly. The glides of the mobile diphthongs belong to this category: [jɛ] and [wɔ] correspond to /jɛ/ and /wɔ/, respectively, just like [ja] in *b*[ja]*nco* 'white' corresponds to an input /ja/. Hence, in synchronic Italian grammar, the mobile diphthongs do not need to be analyzed separately from the other Italian rising diphthongs.

6 Allomorphy and analogical change

6.1. Introduction

The 'mobile diphthong' rule produced a pattern of allomorphy, which through the centuries, has been subject to elimination through analogical change. Phenomena such as allomorphy and analogical change pose challenges to any phonological theory. This chapter discusses two recently proposed models within the framework of Optimality Theory: Rubach and Booij (2001) on allomorphy and McCarthy (2005) on paradigm uniformity effects. The goal of this chapter is to discover to what extent these models can accommodate the monophthong–diphthong alternation (§ 6.2) and its elimination (§ 6.3) so that we can conclude with an insightful analysis of the Italian data.

6.2. Allomorphy

6.2.1. Preliminaries

In their article on Polish iotation, Rubach and Booij (2001:26) define allomorphy as "a situation in which two or more different morphs share the same grammatical or semantic function and hence are allomorphs of one morpheme." They argue that the distribution of allomorphs is governed by phonological generalizations, morphological generalizations, or both. To illustrate these three possibilities, I will briefly repeat the examples taken from Dutch by the authors:

- phonological allomorphy:
  different surface allomorphs are derived from one single underlying representation, e.g. the allomorphs of *hoed* 'hat', [hut] and [hud], are derived from /hud/; the distribution of the two allomorphs is governed by a phonological generalization, final devoicing, yielding the singular [hut] and the plural [hudə].

- morphological allomorphy:
  different surface allomorphs are derived from different underlying representations, e.g. the suffixes *–iteit* '-ity' and *–heid* '-hood' are phonologically dissimilar and therefore not reducible to a single underlying representation; their distribution is governed by a morphological generalization, i.e. the lexical subcategorization of morphemes with respect to their native vs non-native status: *–heid* is attached to both native and non-native stems, whereas *–iteit* is attached exclusively to non-native stems.

- mixed phonological and morphological allomorphy:
  different surface allomorphs are derived from different underlying representations but their distribution is phonologically principled. Dutch has a preference for plural nouns ending in a trochee, which determines the selection of the plural suffix *–en* vs *–s*, e.g. *kanón* 'gun', *kanónn* + *en* vs *kánon* 'canon', *kánon* + *s*.[87]

In this section it will be claimed that, from a synchronic perspective, the phenomenon of the *dittonghi mobili* is best analysed as an instance of the third type of allomorphy, i.e. involves mixed phonological and morphological allomorphy.

6.2.2. One or more morphemes?

As we know by now, the 'mobile diphthong rule' refers to the alternation pattern of the stressed diphthongs [jɛ] and [wɔ] vs the unstressed corresponding monophthongs [e] and [o]. This alternation plays a role in the inflection of a number of verbs (see 6.1) as well as some derivational processes (including diminutivization) (see 6.2).

(6.1)

siedo	['sjɛdo]	'I sit'	sederò	[sede'ro]	'I shall sit'
vieni	['vjɛni]	'you come'	veniamo	[ve'njamo]	'we come'
muovo	['mwɔvo]	'I move'	moviamo	[mo'vjamo]	'we move'
suono	['swɔno]	'I play'	soniamo	[so'njamo]	'we play'

(6.2)

dieci	['djɛtʃi]	'ten'	decina	[de'tʃi:na]	'ten or so'
muovo	['mwɔvo]	'I move'	movimento	[movi'mento]	'movement'
uomo	['wɔmo]	'man'	omino	[o'mi:no]	'little man'

In the phonological literature that has appeared on this topic, this alternation pattern has been analysed as a case of allomorphy in which the allomorphs are distributed according to phonological generalizations. Sluyters (1992) relates the alternation to stressed open syllable diphthongization. Conversely, Saltarelli (1970) invokes a monophthongization rule. In both analyses, the allomorphs are derived from one single underlying representation. For instance, *muov–* and *mov–* are derived from either /mov-/ (Sluyters) or /muov-/ (Saltarelli). Both theories were extensively discussed in chapter 2, but for explanatory reasons I will phrase them in optimality-theoretic terms and show that these two analyses, although based on opposite assumptions,

[87] Cf. the distinction made by Rebrus and Törkenczy (2005) between phonological and lexical allomorphy: phonological allomorphy is driven by phonological regularities while lexical allomorphy is defined as follows: "The allomorphs are phonologically 'unrelated', i.e. the relationship between the allomorphs is *not* a regular/general phonological relationship in the language; the allomorphs have no generalizable common underlying form; the alternation may or may not be conditioned by the phonological environment" (*ibidem*:270).

are functionally related in that they aspire toward the same output target, i.e. metrical optimality.

Sluyters (1992:266) assumes that diphthongization and vowel lengthening in Italian are complementary phonological processes, which are "expected in a language which has a quantity-sensitive stress system." The intention of Sluyters' rule-based theory of stress and length in Italian is to relate length phenomena to stress assignment. However, in his serial approach, the rules that assign stress are not intrinsically connected to the lengthening and diphthongization rules. In the first step, feet are constructed, while in a subsequent step possibly ill-formed feet are corrected by lengthening or diphthongization. Optimality Theory, on the contrary, is designed to evaluate all aspects of stress and length phenomena simultaneously at one single level: the output. In such an approach, Sluyters' analysis can be interpreted as a conflict between constraints forcing output vowels to remain faithful to their input correspondents and constraints on stress and syllable structure. I will illustrate this argument by way of two constraints:

(6.3) FAITH
Output segments are faithful to input segments.

For expositional simplicity, I assume that this constraint covers a number of constraints such as IDENT-[high] and DEP-μ (see chapter 5).

(6.4) $\acute{\sigma}_{\mu\mu}$
Bimoraic syllables are stressed; stressed syllables are bimoraic.[88]

Following Sluyters, it is more important for stressed syllables in Italian to be heavy than to remain faithful to input morae. This fact is expressed by the following ranking:

(6.5) $\acute{\sigma}_{\mu\mu}$ » FAITH

This ranking results in an alternation between short unstressed vowels and corresponding long stressed vowels, for example in verbal paradigms. Tableau (6.6) illustrates this alternation for the second person singular and plural of the present indicative of the verb *vedere* 'to see':

[88] For an extensive OT analysis of Italian stress, see Bullock (1998) and D'Imperio and Rosenthall (1999).

(6.6) Short vowel/long vowel alternation (after Sluyters 1992)

(a)

Input: /ved-i/	ˊ$_{\mu\mu}$	FAITH
a. 've.di	*!	
b. ☞ 'veː.di		*

(b)

Input: /ved-ete/	ˊ$_{\mu\mu}$	FAITH
a. ve.'de.te	*!	
b. veː.'de.te	*!*	*
c. ☞ ve.'deː.te		*

According to Sluyters, the monophthong–diphthong alternation is closely related to the short vowel–long vowel alternation. The disadvantage of his theory is that he has to formulate different rules, one for vowel lengthening and one for diphthongization, which apply in different conditions, and thus fails to capture an important generalization, namely that both rules aspire toward the same goal: well-formed stressed syllables. An optimality-theoretic approach would be superior, since it captures this generalization straightforwardly: the constraints which cause mid-low vowels to diphthongize (see 6.7) interact directly with the metrical and faithfulness constraints.

(6.7) *ɛː and *ɔː
No long mid-low vowels.

If, under the duress of ˊ$_{\mu\mu}$, stressed syllables containing mid-low vowels must become heavy, a possible way out is diphthongization, also at the expense of violating the lower-ranked faithfulness constraints (covered under the umbrella constraint FAITH). This is shown in the following tableaux for the first person singular and plural of the present indicative of the verb *sedere* ‘to sit’:

(6.8) Monophthong–diphthong alternation (after Sluyters 1992)[89]

(a)

Input: /sɛd-i/	σ́$_{μμ}$	*ɛː	FAITH
a. 'sɛ.di	*!		
b. 'sɛː.di		*!	*
c. ☞ 'sjɛ.di			*

(b)

Input: /sɛd-ete/[90]	σ́$_{μμ}$	*ɛː	FAITH
a. se.'de.te	*!		*
b. 'sjɛ.de.te[91]			*
c. sje.'deː.te	*!		*
d. ☞ se.'deː.te			*

The parallelism between vowel lengthening and diphthongization, as intended by Sluyters, is now clear. The output forms in (6.6) and (6.8) are evaluated by a single constraint hierarchy; both vowel lengthening and diphthongization appear to be functionally related in that both processes are triggered by a high-ranked constraint on syllable well-formedness (σ́$_{μμ}$) and the markedness constraints *ɛː and *ɔː, at the expense of lower-ranked faithfulness constraints (FAITH).

Interestingly, the input in the tableaux in (6.8) could freely be changed to include a diphthong, with no adverse effects, since the constraint ranking ensures the correct output. This is shown in (6.9).

[89] A possible candidate ['seː.di] is not included in tableau (6.8a). This candidate is interesting in that it avoids a violation of *ɛː. The faithfulness constraint IDENT-[high] (which is assumed under the cover constraint FAITH) is low-ranked, but when relativized for stressed syllables, i.e. IDENT-[high]/σ́, I assume it is undominated in Italian and therefore rules out a candidate ['seː.di].

[90] In unstressed syllables, the height distinction of the mid vowels is neutralized to mid-high.

[91] This candidate is also ruled out by high-ranked metrical constraints responsible for Italian stress (see fn. 88 supra).

(6.9) Monophthongization

(a)

Input: /sjɛd-i/	ˊσμμ	*ɛː	FAITH
a. 'sɛ.di	*!		*
b. 'sɛː.di		*!	*
c. ☞ 'sjɛ.di			

(b)

Input: /sjɛd-ete/	ˊσμμ	*ɛː	FAITH
a. se.'de.te	*!		*
b. sje.'deː.te	*!		*
c. ☞ se.'deː.te			*

In fact, the tableaux in (6.9) can be considered as an improved OT version of Saltarelli's (1970) rather peculiar monophthongization rule, which deletes prevocalic glides before unstressed, long, open vowels (for more details, see § 2.5.2.1). In Saltarelli's generative grammar of Italian, the monophthongization rule remains unmotivated and is certainly not related to rules pertaining to vowel length, since in this analysis vowel length is established in the input, not in the output. The OT approach of monophthongization as exemplified in (6.9) is therefore more attractive, because it shows that two opposite processes (diphthongization and monophthongization) can be functionally related: in the given examples above, both aspire toward a single output target, i.e. metrically well-formed syllables.

Both Saltarelli and Sluyters analyse the monophthong–diphthong alternation as a synchronically productive phenomenon in Italian grammar. However, this synchronic approach is problematic, since it predicts the occurrence of diphthongization or monophthongization in cases where this is not correct. For instance, in a number of Italian verbs there is no monophthong–diphthong alternation at all: either the mid vowel or the diphthong is maintained throughout the paradigm. Examples of such verbs are given in (6.10).

(6.10)

spiegare	'to explain'	coprire	'to cover'
chiedere	'to ask'	levare	'to lift'
nuotare	'to swim'	notare	'to note'
vuotare	'to empty'	votare	'to vote'
abbuonare	'to forgive'	abbonare	'to subscribe'

Thus, the indicative present of the verbs *spiegare* and *coprire* is as follows:

(6.11)				
	SG	1	spiego	copro
		2	spieghi	copri
		3	spiega	copre
	PL	1	spieghiamo	copriamo
		2	spiegate	coprite
		3	spiegono	coprono

If, for example, the second person singular of the present indicative of the verb *coprire* 'to cover' is submitted to the constraint ranking above, we get the following results (☞ is intended winner; ☜ is wrong winner):

(6.12)

Input: /kɔpr-i/	$\acute{\sigma}_{\mu\mu}$	*ɔː	FAITH
a. 'kɔ.pri	*!		
b. ☞ 'kɔː.pri		*!	*
c. ☜ 'kwɔ.pri			*

Compare this result to the evaluation of the second person plural of the present indicative of the verb *spiegare* 'to explain':

(6.13)

Input: /spjɛg-ate/	$\acute{\sigma}_{\mu\mu}$	*ɛː	FAITH
a. spe.'ga.te	*!		*
b. ☞ spje.'gaː.te	*!		*
c. ☜ spe.'gaː.te			*

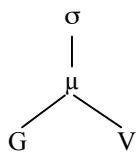
The constraint ranking incorrectly predicts that the stressed mid-low vowel diphthongizes (6.12) or that the unstressed diphthong monophthongizes (6.13): the forms **cuopri* and **spegate* (marked by the symbol ☜) are not attested in modern Italian. Interestingly, in early Italian texts we do find forms such as *cuopro, cuopri, cuopre*, which suggests that stressed open syllable diphthongization may once have been a productive process in the language but no longer is. An analysis of the Italian monophthong– diphthong alternation in terms of phonological allomorphy, deriving the allomorphs from a single underlying representation, cannot differentiate between alternating and non-alternating vowels and diphthongs and would have to allow for many lexical exceptions.[92]

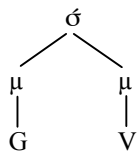
An alternative to positing a single underlying representation is to follow Rubach and Booij's (2001) analysis of Polish iotation and list the allomorphs in the lexicon.

[92] Cf. Vogel (1993:226), who also claims that "a (morpho)phonological rule can be used to diphthongize the appropriate vowels", deriving the correct outputs from one single stem, although she admits that "it is not predictable which verbs with *-e-* and *-o-* in their roots exhibit diphthongization."

Rubach and Booij argue that this strategy does not imply that there is no task for phonology: the allomorphs may be arbitrary, but their distribution is principled by the ranking of universal constraints. The listing requires that we posit multiple stems for each morpheme, so, for instance, the verb *sedere* would have two underlying allomorphs: /sɛd/ and /sjɛd/. Following the authors, the selection of either /sɛd/ or /sjɛd/ is predicted by the interaction of faithfulness and markedness constraints, as will be demonstrated in the remainder of this section.

In chapter 5, I provided evidence that Italian rising diphthongs belong to the nucleus. In unstressed syllables they are monomoraic and in stressed (open) syllables they are bimoraic, see (6.14):

(6.14) (a) 

(b) 

Now suppose we assume two underlying allomorphs for the root of the verb *sedere*: /sɛd/ and /sjɛd/. Subsequently, we would have to establish the constraint ranking responsible for the following alternation pattern:

(6.15) *sedere*, present indicative

SG	1	s[jɛ]do
	2	s[jɛ]di
	3	s[jɛ]de
PL	1	s[e]diamo
	2	s[e]dete
	3	s[jɛ]dono

In § 5.4.4, I showed how high-ranked $\acute{\sigma}_{\mu\mu}$ forces stressed syllables to be heavy at the expense of the lower-ranked faithfulness constraint DEP-μ. The (simplified) tableaux for *casa* 'house' and *piano* 'flat' are repeated below:

(6.16)

Input: /kasa/	$\acute{\sigma}_{\mu\mu}$	DEP-μ
a. ☞ ˈkaː.sa		*
b. ˈka.sa	*!	

(6.17)

Input: /pjano/	$\acute{\sigma}_{\mu\mu}$	DEP-μ
a. ☞ 'pj$_{\mu}$a$_{\mu}$.no		*
b. 'pja$_{\mu}$.no	*!	

If we construct a tableau in the Rubach and Booij style, i.e. with two underlying allomorphs, we must conclude that the ranking $\acute{\sigma}_{\mu\mu}$ » DEP-μ cannot determine which of the output candidates is optimal:

(6.18)[93]

(a)

/sɛd/ /sjɛd/ } + i	$\acute{\sigma}_{\mu\mu}$	DEP-μ
1. ☞ 'sɛɪ.di		*
2. ☞ 'sj$_{\mu}$ɛ$_{\mu}$.di		*

(b)

/sɛd/ /sjɛd/ } + ete	$\acute{\sigma}_{\mu\mu}$	DEP-μ
1. ☞ se.'dɛɪ.te		
2. ☞ sje$_{\mu}$.'dɛɪ.te		

Candidates with light stressed syllables are not included in the tableaux in (6.18), since they are ruled out immediately by $\acute{\sigma}_{\mu\mu}$ (see 6.16 and 6.17). Since both vowels and rising diphthongs can surface as either short or long, the constraint ranking in (6.18) does not suffice to select the correct output. In (6.18a) both candidates violate the faithfulness constraint, because both contain a mora which has no correspondent in the input. In (6.18b) no violation is incurred by either of the candidates. Therefore, the alternation pattern cannot be dealt with without additional constraints.

The key to the solution lies in the shape of the syllabic nuclei. The candidates in (6.18) exhibit the complete inventory of possible syllabic nuclei: (1) short vowels, (2) long vowels, (3) monomoraic diphthongs, and (4) bimoraic diphthongs. All languages have short vowels, but the occurrence of type 2, 3 and 4 is dictated by markedness constraints on syllable structure. The following three syllable structure constraints are crucial in the current analysis:

(6.19) (a) *Vɪ
No long vowels (cf. Rosenthall 1994, D'Imperio and Rosenthall 1999).

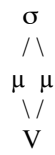
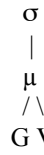
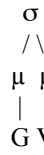
[93] In these tableaux constraint violations are only indicated if the relevant (i.e. first) syllable of each output candidate does not meet the requirements posited by a particular constraint.

(b) *BRANCH-μ
No branching morae (cf. Rosenthall 1994).

(c) NODIPHTHONG
Tautosyllabic morae cannot link to two separate vocoids (cf. Rosenthall 1994).

Each of these constraints militates against the presence of a specific syllabic nucleus, as shown schematically in table (6.20).

(6.20)

constraint:	**violated by:**
*V:	long vowels
	
*BRANCH-μ	monomoraic diphthongs
	
NODIPHTHONG	bimoraic diphthongs
	

Since, apart from short vowels, all three syllabic nuclei listed in (6.20) occur in Italian, these constraints must occupy relatively low positions in the constraint hierarchy. However, this does not imply that the constraints are not ranked with respect to each other. When *V: dominates NODIPHTHONG and *BRANCH-μ, a diphthongal nucleus will always be evaluated as more optimal than a candidate with a long vowel. Since short vowels are always unmarked, they are always most optimal:

(6.21) *V: » NODIPHTHONG, *BRANCH-μ[94]
(V >) $G_{\mu}V_{\mu}$, $GV_{\mu} > V_{\mu\mu}$

The ranking in (6.21) is independently motivated by data from other languages, in which vowels tend to diphthongize, such as numerous variants of English and Dutch (see also fn. 15, chapter 2).[95] The tableaux in (6.22) demonstrate how the constraint ranking proposed above selects the optimal candidates in our case of allomorphy:

(6.22)

(a)

/sɛd/ /sjɛd/ } + i	*V:	NODIPH	*BRANCH-μ
1. 'sɛɪ.di	*!		
2. ☞ 'sj$_{\mu}$ɛ$_{\mu}$.di		*	

(b)

/sɛd/ /sjɛd/ } + ete	*V:	NODIPH	*BRANCH-μ
1. ☞ se.'deɪ.te	*		
2. sje$_{\mu}$.'deɪ.te	*		*!

Candidate (1) in (6.22a) loses as it fatally violates high-ranked *V:. In (6.22b) the candidate with the short vowel wins, because in unstressed syllables a short vowel is always the most optimal syllable nucleus. The point of interest is that stressed long vowels and unstressed monomoraic diphthongs are perfectly acceptable syllabic nuclei in Italian. In cases where these types of nuclei surface, the underlying representations do not parallel those of cases with different underlying allomorphs (as in 6.22). For instance, the verb *coprire* 'to cover' only has /kɔpr/ as its underlying form and a high-ranked faithfulness constraint DEP$_{seg}$ ('no epenthesis') prevents the stressed nucleus from surfacing as a bimoraic diphthong by glide insertion, as shown in (6.23):

[94] If the constraint *V: is interpreted as shorthand for a battery of constraints that ban individual vowels of different quality, more subtle rankings are conceivable, e.g. * ɛ: » NODIPH » eɪ. In the following tableaux I will slightly oversimplify matters in order to illustrate the general idea of the approach.

[95] The diphthongization of the tense central vowels in Standard Dutch ([e^{j}, ø^{j}, o^{w}]), is usually argued to be phonetic and of no consequence for the phonology (Van der Velde 1996). Hermans and van Oostendorp (2000) deal with the interaction between diphtongization and tone structure in Sittard Dutch and argue that in this dialect NODIPH is dominated by a constraint requiring that the dependent mora needs to have a different quality than the head mora.

(6.23)

/kɔpr/ + i	DEP$_{seg}$	*Vː	NODIPH
a. ☞ 'kɔɪ.pri		*	
b. 'kw$_{\mu}$ɔ$_{\mu}$.pri	*!		*

Conversely, the bimoraic diphthong in candidate (2) in (6.22a) is not an instance of glide insertion, because the glide is present in the /sjɛd/ allomorph and therefore DEP$_{seg}$ is not violated, as can be seen in the following tableau:

(6.24)

/sɛd/ /sjɛd/ } + i	DEP$_{seg}$	*Vː	NODIPH
a. 'sɛɪ.di		*!	
b. ☞ 'sj$_{\mu}$ɛ$_{\mu}$.di			*

Similarly, monomoraic diphthongs surface because of high-ranked MAX$_{seg}$ ('no deletion'). The tableau in (6.26) evaluates the second person plural of the present indicative of *spiegare* 'to explain':

(6.25)

/spjɛg/ + ate	MAX$_{seg}$	*Vː	*BRANCH-μ
a. spe.'gaɪ.te	*!	*	
b. ☞ spje$_{\mu}$.'gaɪ.te		*	*

Candidate (6.25a) fatally violates MAX$_{seg}$, because the input glide is deleted. The verb *spiegare* has only one input /spjɛg/, as opposed to *sedere*. In (6.26) the tableau for the second person plural of *sedere* is repeated, this time including the relevant faithfulness constraint. Since the input contains an allomorph without a glide, the winning candidate does not violate MAX$_{seg}$.

(6.26)

/sɛd/ /sjɛd/ } + ete	MAX$_{seg}$	*Vː	*BRANCH-μ
a. ☞ se.'deɪ.te		*	
b. sje$_{\mu}$.'deɪ.te		*	*!

The 'multi-input' analysis developed here has some major advantages with respect to the 'mono-input' OT analysis that was based on the theories of Sluyters (1992) and Saltarelli (1970), who claimed that the monophthong–diphthong alternation was triggered by a diphthongization or monophthongization rule, respectively. Mono-input approaches to the monophthong–diphthong alternation suffer from overappli-

cation effects – diphthongs or monophthongs occur where they should not. They rely on arbitrary and language-specific rules; from a historical point of view it seems implausible that, for instance, the diphthongal outputs of the Italian mid-low vowels are the rising diphthongs [jɛ, wɔ] (see chapter 2). In multi-input theories of allomorphy, the underlying allomorphs are arbitrary, but their distribution is governed by a language-specific ranking of universal constraints. The conclusion is that the monophthong–diphthong alternation is not a phenomenon triggered by active phonological processes but an instance of mixed phonological and morphological allomorphy: the allomorphs are posited in the input and the constraint ranking predicts where these allomorphs will appear.

Another advantage is that the newly proposed analysis also works for other alternation patterns in Modern Italian. For instance, velar palatalization, i.e. the palatalization of a velar sound in the context of a following high front vowel, has typically been considered as a readjustment phenomenon triggered by phonological factors (cf. Scalise 1994). It characterizes the flexion and derivation of a number of words, as in the following examples:

(6.27)	amì[k]o	'friend'	amì[tʃ]i	'friends'
	bèl[g]a	'Belgian'	bèl[dʒ]i	'Belgians'
	cattòli[k]o	'catholic	cattoli[tʃ]issimo	'very catholic'
	stòri[k]o	'historian'	stòri[tʃ]i	'historians'

However, velar palatalization is not a generalized phenomenon in Italian, so it is not possible to interpret the [k]/[tʃ] and [g]/[dʒ] alternations as instances of exclusively phonological allomorphy (see Celata and Bertinetto 2005). Such an explanation would have to deal with too many lexical exceptions, as exemplified below:

(6.28)	grè[k]o	'Greek'	grè[tʃ]i	'Greeks'
	còmi[k]o	'comedian'	còmi[tʃ]i	'comedians'
	bèl[g]a	'Belgian'	bèl[dʒ]i	'Belgians'
		as opposed to:		
	tùr[k]o	'Turkish'	tùr[k]i	'Turks'
	càrico	'freight'	càri[k]i	'freights'
	collè[g]a	'colleague'	collè[g]i	'colleagues'

Since it seems impossible to derive palatalization effects from a single underlying representation, an effective alternative is to list the allomorphs in the input. For instance, the underlying allomorphs of *greco* are /grɛk/ and /grɛtʃ/, whereas *turco* has only one input morpheme /turk/. Assuming a palatalization markedness constraint PAL (cf. Łubowicz 2002), it is clear that PAL is dominated by IDENT(Place), a faithfulness constraint that calls for correspondents in input and output to have identical place features. Such a ranking blocks palatalization, as illustrated in the tableau for *turchi*, the plural of *turco*:

(6.29)

/turk/ + i	ID(Place)	PAL
a. ☞ 'tur.ki		*
b. 'tur.tʃi	*!	

The ranking in (6.29) will yield a different output when the input consists of multiple allomorphs, as in the following tableau for *greci*, the plural of *greco*. Here, the palatalized output will win, since it does not violate the faithfulness constraint.[96]

(6.30)

{grɛk, gretʃ} + i	ID(Place)	PAL
a. 'grɛ.ki		*!
b. ☞ 'grɛ.tʃi		

The current approach can be elegantly related to one of the key consequences of Optimality Theory, called 'the emergence of the unmarked' (McCarthy and Prince 1994). Consider the singular form *greco*: the constraint ranking in (6.30) does not prohibit the allomorph /grɛtʃ/ from surfacing before a back vowel and evaluates the candidates ['grɛ.ko] and ['grɛ.tʃo] as equally optimal. Rubach and Booij (2001) propose to solve this dilemma with the help of markedness constraints. In this case, it can be argued – in the spirit of Prince and Smolensky (1993/2002) – that /tʃ/ is a more marked and crosslinguistically less frequent segment than /k/, resulting in the ranking **tʃ* » **k*. The role that markedness constraints play in selecting the unmarked allomorph is demonstrated in the following tableau:

(6.31)

{grɛk, gretʃ} + o	ID(Place)	PAL	**tʃ*	**k*
a. ☞ 'grɛ.ko				*
b. 'grɛ.tʃo			*!	

A final advantage of the multi-input approach is that it makes an extremely interesting typological prediction. It was argued that irregular, non-productive alternations are lexicalized. As a consequence, the lexicon is more complex than in an approach that derives the allomorphs from one single input. This entails a substantially increased memorization burden on the speaker. When memory fails and analogical speech errors are produced, it is expected that errors of this kind – i.e. regularizations of non-productive alternations – are more easily accepted than forms that result

[96] For a more detailed description of palatalization (or velar softening), the reader is referred to Halle (2005).

from regularizations of productive alternations (cf. Wetzels 1981). This concept of analogical change is pursued in the next section.

6.3. Analogical change

The monophthong–diphthong alternation, "just like all other alternations, represents a redundancy for the language" (Tekavčić, 1972*b*:345).[97] In fact, written sources and the experiments in chapter 4 provide evidence that this alternation is subject to a great degree of analogical levelling. In numerous cases the diphthongs are reported to have extended to unstressed syllables, as illustrated in (6.32).

(6.32)

s[je]derò	'I shall sit'
p[je]dìno	'small foot'
m[wo]viàmo	'we move'
b[wo]nìno	'rather good'

The elimination of morphophonemic alternations, also referred to as analogical levelling, under the pressure of paradigm uniformity, is a fairly common phenomenon in the world's languages. Some salient observations about analogical change are made by Wetzels (1981). The central idea of this dissertation, couched in the SPE framework, is that opaque alternations are lexicalized by the speaker and, since they constitute an awkward allomorphy for the speaker, are subject to elimination (see also Kiparsky 1982).

One of the main pieces of evidence used in support of this theory is the levelling of alternations in Latin that had arisen from rhotacism. Rhotacism is a well-known phonological process whereby dental/alveolar fricatives /s/-/z/ develop into a rhotic consonant, e.g. in Latin *honoːs* ~ *honoːsis* > (*honoːzis* >) *honoːris* 'honor GEN'. In the majority of the non-neutral, polysyllabic nouns, the newly created alternation was levelled – the nominative ending *-oːs* was replaced by (*–oːr* >) *–or*, whereas the alternation was maintained in monosyllables, e.g. *floːs* ~ *floːris* 'flower', and in neuters, e.g. *genus* ~ *generis* 'origin'. Wetzels (1981:128 ff.) puts forward evidence that levelling of paradigms of the *honoːs* ~ *honoːris* type took place only after the process of rhotacism had become opaque. For instance, loanwords with intervocalic *–s–* were introduced in the language after the completion of rhotacism (5th century BC) and before the regularization of paradigms of the *–oːs* ~ *–oːris* type (3rd century BC). Wetzels reconstructs the history of *honos* as follows:

[97] "(questa alternanza) – come tutte le alternanze – rappresenta una ridondanza per la lingua (...)."

(6.33) History of *honos*, after Wetzels (1981:115)

	output		*input*	
stage 1	hono:s~hono:sis	flo:s~flo:sis	hono:s	flo:s
stage 2	hono:s~hono:zis	flo:s~flo:zis	hono:s	flo:s
stage 3	hono:s~hono:zis/ris	flo:s~flo:zis/ris	hono:s	flo:s
stage 4	hono:s~hono:ris	flo:s~flo:ris	hono:s/hono:r	flo:s/flo:r
stage 5	honor~hono:ris	flo:s~flo:ris	hono:r	flo:s/flo:r

Rhotacism became active in stage 3, changing intervocalic [s] into [z] and subsequently into [r], after a period of variation. Note that, for the stage in which rhotacism became an opaque process, i.e. stage 4, Wetzels assumes that the alternation [s] ~ [r] is lexicalized, resulting in multiple inputs. This analysis, reminiscent of that of Rubach and Booij (2001) (see § 6.2), departs significantly from classic generative approaches, which posit single underlying representations even in cases in which the surface allomorphs are significantly different from each other (cf. Rubach and Booij). In stage 5 the inputs of nouns of the *honos* type are reanalysed as *–o:r*. In Optimality Theory, this strategy is called Lexicon Optimization (Prince and Smolensky 2002:209).

There is good evidence that the 'mobile diphthong rule' also had become opaque. Since the 10^{th}/11^{th} century, surface exceptions had been brought about by other changes in the language, such as the palatalization of post-consonantal /l/, the elimination of the onglides [j] and [w] after consonant clusters ending in /r/ or the introduction of loanwords, mostly latinisms (*voci dotte*):

(6.34) Sources of opacity of the 'mobile diphthong rule'

- palatalization of /l/ in the consonant clusters /pl/, /bl/, /kl/, /gl/ and /fl/ (10^{th}/11^{th} century, cf. Castellani 1976)
  sp[jɛ]go ~ sp[je]ghiàmo 'I explain, we explain' (cf. Latin *explico* 'I unfold')
  p[jɛ]no ~ p[je]nézza 'full, fullness' (cf. Latin *ple:nus* 'full')

- deletion of [j] and [w] after consonant clusters ending in /r/ (14^{th}/15^{th} century, cf. Castellani 1967)
  pr[jɛ]go > pr[ɛ:]go ~ pr[e]ghiàmo 'I beg, we beg'
  tr[wɔ]va > tr[ɔ:]va ~ tr[o]viàmo 'he finds, we find'
  pr[wɔ]va > pr[ɔ:]va ~ pr[o]viàmo 'he tries, we try'

- deletion of [w] after the palatal consonants /j/, /ʎ/, /ɲ/, /ʃ/, /tʃ/ and /dʒ/ (19^{th} century, cf. Migliorini 1963)
  [dʒwɔ]ca > [dʒɔ:]ca ~ [dʒo]chiàmo 'to play'
  tova[ʎʎwɔ]lo > tova[ʎʎɔ]lo ~ tova[ʎʎo]lìno 'napkin, small napkin'

- loanwords
  rip[ɛ:]to ~ rip[e]tiàmo 'I repeat, we repeat'

In (6.35) I summarize the history of the monophthong–diphthong alternation:

(6.35) History of the monophthong–diphthong alternation

	output (stressed~unstressed)	*input*
stage 1	mɔːv-~mov-	mɔv-
stage 2	mɔo̯v-~mov-	mɔv-
stage 3	muo̯v-~mov-	mɔv-
stage 4	mwɔv-~mov-	mɔv-
stage 5	mwɔv-~mov-	mɔv-/ mwɔv-
stage 6	mwɔv-~mov-/mwov-	mɔv-/ mwɔv-
(stage 7)	mwɔv-~mwov-	mwɔv-

Stage 1 reflects the pre-diphthongization stage in late spoken Latin; stressed open syllable diphthongization is assumed to have taken place in subsequent stages (stages 2-4) (see chapter 2). In stage 5, the diphthongization process became opaque and multiple inputs are posited. Stage 6 is a variation stage in which more and more speakers started to eliminate the alternation, extending the diphthong to the unstressed syllables; this levelling is almost complete, although back vowels/diphthongs are slightly more resistant to the change. Complete levelling of the monophthong–diphthong alternation is reached in (hypothetical) stage 7. Conversely, the alternation between stressed mid-low vowels and unstressed mid-high vowels persists, because in Italian the mid vowels in unstressed syllables are neutralized. We may nevertheless assume that this predictable allophonic alternation between [jɛ, wɔ] and [je, wo] is a more harmonic levelling than the alternation between [jɛ, wɔ] and [e, o].

It is clear that, as van de Weijer (1999:148) observes, "analogical change touches on many different aspects of grammar: phonology, morphology and the (re–)representation of lexical items." Recently, paradigm effects have received considerable attention in linguistics, considering for instance the publication of Downing, Hall and Raffelsiefen (2005). These theories face the daunting challenge of covering the various aspects of paradigm effects and analogical change. In the following sections, I will present the 'mobile diphthong rule' as a test case for a recently proposed model of analyzing uniformity in inflectional paradigms within the framework of Optimality Theory: McCarthy's (2005) Optimal Paradigms (OP) model. An obvious question is then: can OP be integrated into the multi-input approach of allomorphy presented in the previous section and account for the changes from stage 5 to 6 (and 7) in (6.35)? We will see that OP can describe this diachronic change, but that it fails to capture some generalizations which go beyond a mere description of the facts and actually explain the change, for inflectional and derivational paradigms alike. Before we can go into detail, I must provide an introduction to the OP model.

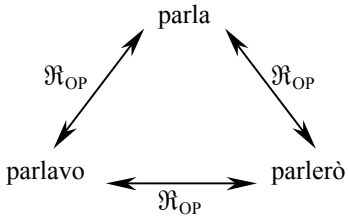
6.3.1. Optimal Paradigms (McCarthy 2005)

Optimal Paradigms (McCarthy 2005) is a means of implementing the concept of 'paradigm uniformity' within a parallelist, constraint-based model of phonology such as Optimality Theory. OT analysts have proposed that correspondence constraints can be appealed to in order to evaluate similarity between the outputs of morphologically related forms (Kenstowicz 1996, Benua 1997*a,b*). In Optimal Paradigms, the correspondence constraints that assess intraparadigmatic correspondence are limited to examining the stem portion of each member of the paradigm. The model differs from standard OT in the following respects:

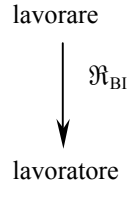
(6.36) (a) Candidates consist of entire flectional paradigms.
(b) Markedness and input-output (IO) faithfulness constraints evaluate all members of the candidate paradigm. The violation marks incurred by each paradigm member are added to those incurred by all the others.
(c) The stem (output form of the shared lexeme) in each paradigm member is in a correspondence relation $\mathfrak{R}_{OP}$ with the stem in every other paradigm member.
(d) There is a set of output-output faithfulness constraints on the $\mathfrak{R}_{OP}$ correspondence relation.
(McCarthy 2005:173-174)

In OP, then, correspondence relations hold symmetrically between every form in the paradigm: all paradigm members are potentially able to influence the phonology of the others. In this respect, OP contrasts with the 'base-identity' model introduced by Benua (1997*a,b*), in which one member of the paradigm – the base – has priority over the others. OP is claimed to work exclusively for inflectional paradigms, whereas base-priority analyses should account for opacity induced by derivational morphology (but see Downing 2005 for an OP account of derivational paradigm effects). The difference between symmetrical and base-priority models is schematized in (6.37).

(6.37) Symmetrical model



Base-priority



The interesting part of the OP model is that it yields strong and rather restrictive predictions about paradigm uniformity effects. In particular, it predicts that if a phonological process affects one member of the paradigm, it may potentially (over)apply to the other members of the paradigm. As a result, the unmarked allomorph triggers paradigm levelling. The only way for underapplication to win (a

situation in which all paradigm members fail to undergo some change, even though one or more members meet the context in which this change normally takes place) is if some other constraint blocks overapplication. These predictions are dubbed *over-application-only* and *attraction to the unmarked*.

To illustrate these predictions, consider the following hypothetical language with no suffix in the singular, the suffix *–i* in the plural and coronal palatalization before [i]. In this language, the markedness constraint PAL will outrank the IO-faithfulness constraint IO-IDENT(place). When coronal palatalization applies without any OP effect, the OP faithfulness constraint OP-IDENT(place) is ranked low. When OP-IDENT(place) is ranked high, coronal palatalization (over)applies throughout the paradigm, i.e. also when the phonological environment that triggers palatalization is not met. Both possibilities are presented in the following tableaux, in which /mat/ is a hypothetical input lexeme and the outputs are entire paradigms:

(6.38) No OP effect

/mat/ + {∅, i}	PAL	IO-ID(Place)	OP-ID(Place)
a. <mat, mati>	*!		
b. ☞ <mat, matʃi>		*	**
c. <matʃ, matʃi>		**!	

(6.39) OP effect

/mat/ + {∅, i}	OP-ID(Place)	PAL	IO-ID(Place)
a. <mat, mati>		*!	
b. <mat, matʃi>	*!*		*
c. ☞ <matʃ, matʃi>			**

Note that in tableau (6.39) the predicted paradigm uniformity effects (*overapplication-only* and *attraction to the unmarked*) are only enforced when the OP faithfulness constraint outranks the corresponding IO faithfulness constraint, that, in turn, is dominated by a markedness constraint. If the markedness constraint were ranked below the IO faithfulness constraint, palatalization would underapply and candidate (a) would be the winner:[98]

[98] The logic that McCarthy (2005:175) uses to identify the unmarked attractor is as follows: given two candidate paradigms <A1, B1> and <A2, B2> that equally satisfy high-ranked OP: identify the highest-ranking markedness constraint that favours A1 over A2 – M(A1>A2) – and the one that favours B2 over B1 – M(B2>B1). If M(A1>A2) » M(B2>B1), then A1 is the superior attractor and the paradigm <A1, B1> wins; if M(B2>B1) » M(A1>A2), then B2 is the superior attractor and the paradigm <A2, B2> wins.

(6.40) OP effect: underapplication

/mat/ + {∅, i}	OP-ID(Place)	IO-ID(Place)	PAL
a. ☞ <mat, mati>			*
b. <mat, matʃi>	*!*	*	
c. <matʃ, matʃi>		*!*	

In his paper, McCarthy (2005) presents the templatic structure of the Classical Arabic verb as evidence in support of his model. Crucially, his arguments are synchronic in nature; the model is not applied to account for diachronic paradigm effects, for instance the change from a stage in which IO faith dominates OP faith (as in 6.38) to a stage in which OP faith dominates IO faith (as in 6.39). An interesting attempt to analyse a case of language change under the OP approach is Albright (2004), who claims that the "loss of final devoicing" in early Yiddish constitutes a counterexample to some of the key predictions of OP; the change involves underapplication of final devoicing and extension of marked forms, hence a change *bunt*, *bunde* ⇒ *bund*, *bunde* and not *bunt*, *bunde* ⇒ **bunt*, **bunte.* We will now investigate to what extent the OP architecture can be built into the multi-input approach of allomorphy (based on Rubach and Booij 2001) and predict levelling effects for lexicalized allomorphs.

6.3.2. Optimal Paradigms and multiple inputs

Suppose that the environment for coronal palatalization in our hypothetical language were opaquely obscured by later changes. In a later stage of such a language, we could expect the following – hypothetical – noun paradigms:

(6.41)
a. mat, matʃi palatalization applies regularly
b. pot, poti palatalization underapplies
c. kitʃ, kitʃi palatalization overapplies

In line with my proposal for the monophthong–diphthong alternation in Italian, I assume that, within the framework of Optimality Theory, the alternation in (6.41a) is best analysed by positing multiple inputs, since palatalization is no longer transparent in this language. In optimality-theoretic terms, the loss of a general process can be represented by constraint reranking, in this particular case the demotion of PAL (markedness) below IO-ID(Place) (faithfulness).[99] The paradigm in (6.41a) is not levelled, so OP-ID(Place) remains low-ranked. The new ranking is exemplified in the following tableau, in which additional segment markedness constraints play a role to select the unmarked paradigm as the winner (cf. § 6.2.2):

[99] According to Tesar and Smolensky's (1993) constraint demotion algorithm, constraint reranking always involve demotion, never promotion, but see Adam (2002) for discussion.

(6.42)

mat, matʃ + {∅, i}	IO-ID(Place)	PAL	*tʃ	*t	OP-ID(Place)
a. <mat, mati>		*!		**	
b. ☞ <mat, matʃi>			*	*	**
c. <matʃ, matʃi>			**!		

In tableau (6.42), all three candidate paradigms pass successfully on IO-faithfulness, given the double input forms. Therefore, the tableau illustrates nicely how markedness comes into play for a decisive role in allomorph selection. Candidate paradigm (a) is immediately ruled out by high-ranked PAL, whereas the segment markedness constraint **tʃ* favours candidate (b) over (c). Non-alternating paradigms, such as those in (6.41b) and (c), have a single underlying allomorph, so that IO-faithfulness is the critical constraint, as illustrated for hypothetical /pot/ in (6.43).

(6.43)

/pot/ + {∅, i}	IO-ID(Place)	PAL	*tʃ	*t	OP-ID(Place)
a. ☞ <pot, poti>		*		**	
b. <pot, potʃi>	*!		*	*	**
c. <potʃ, potʃi>	*!*		**		

Now suppose that the next stage in the hypothetical language under analysis is characterized by the levelling of the *<mat, matʃi>* type of paradigm. The only way of achieving this within the OP framework is through demotion of the markedness constraints below the OP constraint. The result of this reranking is that palatalization overapplies in the singular, as in (6.44c).

(6.44)

mat, matʃ + {∅, i}	IO-ID(Place)	OP-ID(Place)	PAL	*tʃ	*t
a. <mat, mati>			*!		**
b. <mat, matʃi>		*!*		*	*
c. ☞ <matʃ, matʃi>				**	

Thus, OP formalizes our intuition that the elimination of alternations within paradigms takes place under the duress of paradigm uniformity. The winning, non-alternating paradigm not only satisfies high-ranked OP-faithfulness but also high-ranked markedness constraints, beating competing non-alternating paradigms that do not, such as (6.44a).

However, this analysis is problematic in some respects. For instance, it runs counter to the factorial typology predicted by OP. As shown in § 6.3.1, the predicted

paradigm uniformity effects (such as *overapplication-only* and *attraction to the unmarked*) are only visible when an OP-Faithfulness constraint OP outranks an IO-Faithfulness constraint IO, that is dominated by a markedness constraint M. Any other configuration yields different output patterns: when IO dominates M, unpredicted paradigm effects take place, such as underapplication; when IO dominates OP, no paradigm effect takes place. The factorial typology of the constraints that play a role within OP are summed up below:

(6.45) Factorial typology of the OP model

a. OP » M » IO	predicted OP effects (cf. tableau 6.39)
b. IO » M	the process enforced by M is blocked and underapplies (cf. tableaux 6.40 and 6.43)
c. IO » OP	faithfulness to the input prevails over faithfulness to other paradigm members (cf. tableaux 6.38 and 6.42)

It is now clear what the problem is with the ranking in tableau (6.44): it matches that of (6.45b), which predicts patterns of underapplication. Yet the winning candidate in (6.44) is a levelled paradigm that shows overapplication of palatalization. In fact, paradigm levelling through underapplication is excluded under a multi-input OP approach. This raises an important question: why did the <*mat, matʃi*> type of paradigm become intolerable and give way by definition to the <*matʃ, matʃi*> type? An interesting generalization seems to be missing here. The constraint reranking seems merely stipulated and in itself it does not explain the change – it only describes it. Furthermore, it is debatable whether this missing generalization does not also hold for derivational paradigms for which multiple inputs are posited. Recall that McCarthy assumes that derivational effects are best analysed within the 'base-identity' model (see also McCarthy 2005:n.6). In order to explore the missing generalization, I shall call upon a theory that casts doubt on one of the main premises of McCarthy's model, which says that the very notion of a 'base' within inflectional paradigms is gone and each member of the paradigm is capable of influencing the phonology of the others equally.

6.3.3. Paradigms and their bases

Contrary to McCarthy, Albright and Hayes (2002) claim that language learners compare all the available paradigms and select the base form that allows to construct the remaining members of the paradigm as reliably and efficiently as possible. They present a computational model of base discovery, which has been applied to a number of languages (e.g. Albright 2002, 2004, 2005*a*,*b*). Given paradigms of related words, the model learns the morphological and phonological rules needed to derive the entire paradigm from one single base form. In this section I use hypothetical language data to illustrate the premises of the model and construct a subgrammar of consonant alternation in nouns. Consider the following hypothetical language:

(6.46) Hypothetical language (stage 1)

SG	PL
pan	pani
tap	tapi
kam	kami
pa**k**	pa**k**i
ra**k**	ra**g**i
ma**t**	ma**t**ʃi
pa**t**	pa**t**ʃi

In this language, phonology acts to neutralize the contrast between voiced /g/ and voiceless /k/: the contrast is present in plural nouns before the plural ending *-i*, but neutralized in word-final position in singular nouns, where we find only [k]. These data suggest that the language has a process of final velar devoicing. The language learner can discover this process (1) by comparing the singular (*rak*) with the plural (*ragi*) and (2) by comparing *rak ~ ragi* with *pak ~ paki*. This second comparison is necessary to discover the direction of the process, which, in fact, is a process of final devoicing and not of prevocalic voicing, otherwise we would expect the plural of *pak* to be *pagi*. Since the neutralization affects the singular forms, the mapping from the singular to the plural is unpredictable. Therefore it is unlikely that the learner would memorize just the singular, since he would need two rules to project the plural ([k] → [ki] and [k] → [gi]) which would only have 50 percent accuracy in the form sets presented in (6.46). If, on the other hand, the learner were to derive the singular from the plural, he would still need two rules ([ki] → [k] and [gi] → [k]), but each of the rules would have 100 percent accuracy in the lexicon. Suppose the learner were confronted with a hypothetical new plural form *bagi*, he would, with 100 percent certainty, derive the correct form for the singular: *bak*.

The data further suggest that the language has a process of coronal palatalization, [t] becoming [tʃ] before the plural ending *–i*. To capture this process, the language learner will set up a morphological rule [tʃi]→ [t], i.e. taking the plural form as the base, as he does for the cases of devoicing.

Albright and Hayes' base discovery model or algorithm assesses the reliability of these types of morphological rules and tries to find generalizations that have as few exceptions as possible. For more detailed analyses of real language data, the reader is referred to work by Albright, cited above. Not only does their model show that paradigms (including inflectional paradigms) are constructed around bases, it also claims to make correct predictions about the direction of analogical change. To illustrate this, let us assume that the hypothetical language considered so far reaches a new stage in which we encounter the following noun paradigms:

(6.47) Hypothetical language (stage 2)

SG	PL
ma**t**	ma**t**ʃi
ki**t**ʃ	ki**t**ʃi
po**t**	po**t**i

Apparently, the process of coronal palatalization has been obscured by other generalizations and has become opaque. Now we find [t] in contexts where we would have expected [tʃ]. Besides, the morphological rule [tʃi] → [t], set up in a previous stage, has no longer 100 percent accuracy. As a result of the changes, contrasts are no longer more faithfully preserved in the plural. In such cases, Albright (2005*b*) proposes that the learner is forced to choose a single form that is generally most predictive: since the plural is most informative about other contrasts in the language (e.g. the contrast between [k] and [g]), it serves as the base for the words in (6.47) as well. If the non-alternating <*kitʃ, kitʃi*> type of paradigm becomes lexically more dominant in the language than the alternating <*mat, matʃi*> type of paradigm, the rule [tʃi]→ [t] would have extremely low confidence. Therefore, Albright suggests that the alternating forms are memorized as irregular exceptions, an idea which coincides with the multi-input approach presented in the previous sections.

The fact that opaque alternations tend to be eliminated (cf. Wetzels 1981, Kiparsky 1982), is also satisfactorily predicted by the current model. Albright (2005*b*:17) assumes that "errors (by children or adults) are overwhelming overregularizations (that is, replacement of irregular forms by grammatically expected forms)." On analogy with regular paradigms, the learner would expect the singular of *matʃi* to be *matʃ*. So, the model predicts that the <*mat, matʃi*> paradigm may change to <*matʃ, matʃi*>. Since the plural is adopted as the base form, converse changes are not predicted, i.e. the plural of *mat* becoming **mati*, or the plural of *pot* becoming **potʃi* (on analogy with <*mat, matʃi*>). Thus, this model of paradigm acquisition predicts which forms will be affected and in which direction the change goes. It provides us with a more explanatory generalization concerning analogical change, namely that analogical change is more than a phonological effect of paradigm uniformity; actually it can be interpreted as a morphological effect that results from the way that paradigms are learned. In the next section, we will see how the model makes the correct predictions for the monophthong–diphthong alternations in Italian and how this insight can be accommodated within an optimality-theoretic analysis.

6.3.4. Analogical levelling of the monophthong–diphthong alternation

In order to discover the generalizations behind the elimination of alternations caused by the 'mobile diphthong rule', I will construct a (simplified) subgrammar of vowel quality alternation in Italian verb paradigms. The implications of this subgrammar will – *mutatis mutandis* – also hold for other types of paradigms, including derivational ones.

Most verb paradigms in Italian do not show vowel quality alternations:

(6 48) Paradigms without alternations

PRES IND/3SG	INFINITIVE	Gloss
gr[iː]da	gr[i]dàre	'to shout'
v[iː]ra	v[i]ràre	'to bend'
c[uː]ra	c[u]ràre	'to cure'
r[uː]ba	r[u]bàre	'to steal'
[aː]ma	[a]màre	'to love'
r[aː]sa	r[a]sàre	'to shave off'

However, in a large number of paradigms, surface contrasts are neutralized. Consider the following sets of forms, some of which do not show vowel alternations (6.49a), while others do (6.49b):

(6.49) Phonological neutralization

a. Non-alternating stems

PRES IND/3SG	INFINITIVE	Gloss
v[eː]de	v[e]dére	'to see'
m[eː]na	m[e]nàre	'to lead'
d[oː]na	d[o]nàre	'to donate'
v[oː]la	v[o]làre	'to fly'

b. Alternating stems

PRES IND/3SG	INFINITIVE	Gloss
ann[ɔː]ta	ann[o]tàre	'to note down'
d[ɔ]rme	d[o]rmìre	'to sleep'
c[ɔː]pre	c[o]prìre	'to cover'
p[ɛ]nsa	p[e]nsàre	'to think'
pr[ɛː]da	pr[e]dàre	'to plunder'
r[ɛː]ca	r[e]càre	'to bring'

According to the paradigm acquisition model discussed in the previous section, the learner can discover that Italian has a vowel raising process which neutralizes the contrast between mid-low and mid-high vowels in unstressed syllables. The acquisition proceeds in two steps: (1) base discovery and (2) rule construction:

- Base discovery: by comparing the third person singular (*p*[ɛ]*nsa*) with the infinitive (*p*[e]*nsàre*) and by comparing *p*[ɛ]*nsa* ~ *p*[e]*nsàre* with *v*[eː]*de* ~ *v*[e]*dére*, the learner discovers that the language has a process of vowel raising and not lowering, since otherwise he would find 3SG **v*[ɛː]*de*; quality contrasts are preserved in the singular forms and therefore these forms constitute reliable bases to construct the remaining paradigm members.

- Rule construction: the learner sets up two rules: [ˈɛ, ˈɔ] → [e, o] and [ˈe, ˈo] → [e, o], each having 100 percent accuracy; from a hypothetical new form *pr*[ɔː]*pa* PRES IND/3SG, he would, with 100 percent certainty, derive the correct infinitive: *propare*.

This process of vowel raising is robust in modern Italian, whereas another process – stressed open syllable diphthongization – seems to have lost its robustness due to the emergence of other processes (see 6.34). Thus, the learner may be confronted with the following forms:

(6.50) Opacity

PRES IND/3SG	INFINITIVE	Gloss
s[wɔ]na	s[o]nàre	'to ring'
n[wɔ]ta	n[wo]tàre	'to swim'
pr[ɔː]va	pr[o]vàre	'to try'

In a system in which the majority of the verbs have non-alternating nuclei and in which alternations due to vowel raising are robust, the <*s*[wɔ]*na*, *s*[o]*nàre*> type of paradigm is confusing and the only way to produce such forms is, as argued before, to memorize them as irregular exceptions. Albright's theory predicts that this double input may be regularized by error, on analogy with other paradigms. It also predicts the direction of the change. Since the third person singular of the indicative is more informative about contrasts in the nucleus of the verb stem than the infinitive, we expect the diphthong to be extended from the present indicative singular to the infinitive, i.e. <*s*[wɔ]*na*, *s*[wo]*nàre*>, on analogy with regular paradigms. And, as we know, this is the correct prediction.[100]

In a sense, then, Albright's theory of analogical change is determined by input regularization. In Optimality Theory this mechanism is referred to as Lexicon Optimization and it is precisely this strategy that I will focus on now. In (6.51) I repeat the forms listed in (6.50), this time with their respective input forms.

(6.51)

PRES IND/3SG	INFINITIVE	Input
s[wɔ]na	s[o]nàre	/sɔn/, /swɔn/
n[wɔ]ta	n[wo]tàre	/nwɔt/
pr[ɔː]va	pr[o]vàre	/prɔv/

It is unlikely that learners who – initially by error – eliminate the monophthong–diphthong alternation, still posit double input allomorphs. It is more plausible that the input forms of the levelled paradigms are reanalysed: if the output forms of a verb as *s(u)onare* are erroneously produced as <*s*[wɔ]*na*, *s*[wo]*nàre*>, the learner will choose /swɔn/ as the underlying form, because that form will do. The strategy of selecting optimal inputs is called Lexicon Optimization in Prince and Smolensky (2002:209):

[100] There is a very small number of exceptions, which are discussed in § 6.3.5.

> Suppose that several different inputs I_1, I_2, ..., I_n when parsed by a grammar G lead to corresponding outputs O_1, O_2, ..., O_n, all of which are realized as the same phonetic form Φ – these inputs are all *phonetically equivalent* with respect to G. Now one of these outputs must be the most harmonic, by virtue of incurring the least significant violation marks: suppose this optimal one is labelled O_k. Then the learner should choose, as the underlying form for Φ, the input I_k.

Instead of modelling diachronic paradigm uniformity effects by means of reranking OP constraints (M » IO » OP → OP » M » IO), I propose to analyse them as a consequence of Lexicon Optimization, i.e. positing a single input instead of multiple inputs. This approach is motivated by the insight that analogical change, instead of being a merely phonological effect, is rather a morphological effect that results from the way that paradigms are learned (see the previous section). In fact, the newly posited input is not merely stipulated, but it has the phonological shape of the form that, within the language under analysis, functions as a base within the paradigm, e.g. the non-affixed form in derivational paradigms or the 3rd person singular of the present indicative in Italian verb paradigms. The following tableaux illustrate the transition from an early grammar (featuring the opaque alternation) to a later grammar in which the alternation is eliminated:

(6.52) Stage I: opaque alternation and multiple inputs

(a)

/sɔn/ /swɔn/ } + a, are	DEP/ MAX_{seg}	*Vː	NODIPH	*BRANCH-μ
1. 'sɔɪ.na, so.'naɪ.re		*!*		
2. 'sw$_{\mu}$ɔ$_{\mu}$.na, swo$_{\mu}$.'naɪ.re		*	*	*!
3. ☞ 'sw$_{\mu}$ɔ$_{\mu}$.na, so.'naɪ.re		*	*	

Stage II: no alternation and single input

(b)

/swɔn/ + a, are	DEP/ MAX_{seg}	*Vː	NODIPH	*BRANCH-μ
1. 'sɔɪ.na, so.'naɪ.re	*!*	**		
2. ☞ 'sw$_{\mu}$ɔ$_{\mu}$.na, swo$_{\mu}$.'naɪ.re		*	*	*
3. 'sw$_{\mu}$ɔ$_{\mu}$.na, so.'naɪ.re	*!	*	*	

The current proposal entails a unified account of inflection and derivation. Opaque alternations in derivational paradigms are levelled through the same mechanism of Lexicon Optimization, as is exemplified by the following tableaux for *fuoco* ~ *f(u)ocherello* 'fire, small fire':

(6.53) Stage I: opaque alternation and multiple inputs

(a)

/fɔk/ /fwɔk/ } + o, erɛllo	DEP/ MAX_{seg}	*V:	NODIPH	*BRANCH-μ
1. 'fɔɪ.ko, fo.ke.'rɛl.lo		*!		
2. 'fw$_{\mu}$ɔ$_{\mu}$.ko, fwo$_{\mu}$.ke.'rɛl.lo			*	*!
3. ☞ 'fw$_{\mu}$ɔ$_{\mu}$.ko, fo.ke.'rɛl.lo			*	

Stage II: no alternation and single input

(b)

/fwɔk/ + o, are	DEP/ MAX_{seg}	*V:	NODIPH	*BRANCH-μ
1. 'fɔɪ.ko, fo.ke.'rɛl.lo	*!*	*		
2. 'fw$_{\mu}$ɔ$_{\mu}$.ko, fwo$_{\mu}$.ke.'rɛl.lo			*	*
3. ☞ 'fw$_{\mu}$ɔ$_{\mu}$.ko, fo.ke.'rɛl.lo	*!		*	

From written and spoken sources we know that both [e, o] and [je, wo] variants persisted for a very long time – in fact, variation is still found at present (see chapter 4). It is also known that grammars and dictionaries included the *regola del dittongo mobile*, from the 16th century onwards; even today the rule is defended by a number of linguistic purists (see chapter 2 and van der Veer 2001). This fact may certainly have slowed down the levelling process, especially in a community which only in the last century was unified linguistically.[101] The asymmetric generalization of back and front diphthongs in unstressed syllables is perceptually conditioned, as explained in chapter 4: given the fact that the acoustic cues of diphthongization are stronger in front vowels than in back vowels, it is not unlikely that the allomorphs containing front diphthongs were extended in an earlier stage of the language than those containing back diphthongs. Hence, social and phonetic factors may be assumed to have an effect on the way that learners regularize paradigms and their input forms. Note that if we were to analyse this variation under an OP approach, we would have to assume gradient interaction (see Boersma and Hayes' 2001 gradual learning algorithm[102]) between OP constraints on the one hand and IO faithfulness and markedness constraints on the other, which, given the considerable difference in position of OP before levelling (low-ranked) and after levelling (top-ranked) would probably not have been an easy task.

[101] To get an idea of the linguistic diversity in Italy halfway the twentieth century, I quote some numbers from De Mauro (1976): in 1951, 18.5% of the Italians used only the standard language, 13% only a dialect, 87% were capable of using standard Italian and 63.5% used a dialect in most situations.

[102] Other OT approaches to variation are Anttila (1997) and Anttila and Cho (1998).

Nevertheless, a small number of lexical items was never affected by paradigm levelling. These cases are discussed in the next section.

6.3.5. Some lexical exceptions

In a relatively small number of paradigms, levelling of the monophthong—diphthong alternation did not take place or occurred in the opposite direction, i.e. the monophthong instead of the diphthong was extended to the other members of the paradigm.

First, alternation persists in the following verbs with an irregular present indicative:

(6.54) dolere 'to hurt':
d[ɔ]lgo, d[wɔ]li, d[wɔ]le, d[o]liàmo, d[o]léte, d[ɔ]lgono
morire 'to die':
m[wɔ]io, m[wɔ]ri, m[wɔ]re, m[o]riàmo, m[o]réte, m[wɔ]iono
solere 'to be in the habit of':
s[ɔ]glio, s[wɔ]li, s[wɔ]le, s[o]liàmo, s[o]léte, s[ɔ]gliono
tenere 'to hold':
t[ɛ]ngo, t[jɛ]ni, t[jɛ]ne, t[e]niàmo, t[e]néte, t[ɛ]ngono
venire 'to come':
v[ɛ]ngo, v[jɛ]ni, v[jɛ]ne, v[e]niàmo, v[e]nìte, v[ɛ]ngono
volere 'to want':
v[ɔ]glio, v[wɔ]i, v[wɔ]le, v[o]gliàmo, v[o]léte, v[ɔ]gliono

For each of these verbs, learners have to posit three underlying allomorphs, for instance /mwɔj/, /mwɔr/ and /mɔr/ for the verb *morire* and /vɛng/, /vjɛn/ and /vɛn/ for the verb *venire*. A crucial difference between these irregular verbs and verbs such as *sedere* or *suonare* is that the distribution of these three allomorphs is not governed by phonological principles: for example, no plausible constraint ranking would prohibit [mwɔr] or [vjɛn] before *–o* or [vɛng] before *–i*.[103] Instead, the distribution of these allomorphs is morphologically principled, i.e. they are lexically subcategorized with respect to number and person. My hypothesis is that these lexically specified allomorphs are more strongly anchored in the lexicon and therefore less prone to be reanalysed in favour of one of the three forms.

Alternation also persists in a number of derivational paradigms. In most of these cases, the derivatives date back to a very early stage of the language or were probably directly inherited from Late Latin. Following Bertinetto (1999*b*), I assume that later changes, such as levelling of the monophthong–diphthong alternation, did not affect the words already acclimatized in the language. The relationship between, for example, *piede* 'foot' and *pedone* 'pedestrian' or *cuore* 'heart' and *coraggio* 'courage' is etymological rather than synchronic. In both *pedone* and *coraggio*, the inter-

[103] A nice illustration of the morphological complexity of a verb such as *morire* is provided by Jacqmain (1987), a grammatical study in which the author observes that the 1st person plural of the present indicative and subjunctive is realized as *moiamo, moriamo, muoiamo* or *muoriamo*, whereas the form *moriate* is reserved exclusively for the 2nd person plural of the present subjunctive.

nal morpheme boundaries have been lost and speakers have no reason to store these forms as divisible (cf. Bertinetto 1999*b*:278). Besides, elimination of the monophthong–diphthong alternation is reported to be perceived more often in inflectional than in derivational paradigms (see chapter 4), which is most likely due to the fact that not all derivational suffixes are equally productive, whereas inflection is generally highly productive in a language.[104]

Diminutivization, which is a separate morphological process in Italian according to Scalise (1994), is also synchronically productive, but here the incidence of diphthongs throughout the paradigms is higher for front vowels than for back vowels (see chapter 4). Although a straightforward account for this difference is difficult to give, I presume that the weaker acoustic cues of back diphthongs, which were discussed in the previous section and in chapter 4, could have played a role here and that there is a tendency to store some diminutivizations as indivisible items in the lexicon. This seems particularly true for the diminutives of *uomo* 'man' (*omino*, *ometto*) and *uovo* (*ovetto*) 'egg', which are never realized with diphthongs.[105]

In three verb paradigms, levelling has occurred in the opposite direction, i.e. the monophthong is found throughout the paradigm:

(6.55) negare 'to deny': n[ɛ]go ~ n[e]ghiàmo
levare 'to raise': l[ɛ]vo ~ l[e]viàmo
coprire 'to cover': c[ɔ]pro ~ c[o]priàmo

The diphthongized forms of these verbs, e.g. *n*[jɛ]*go* and *c*[wɔ]*pro*, are archaic (cf. Sabatini and Coletti 1997) and we must assume that their paradigms were already levelled by the time the monophthong–diphthong alternation was levelled through extension of the diphthongs.

6.4. Summary

The monophthong–diphthong alternation in Italian is an instance of mixed phonological and morphological allomorphy, since stressed open syllable diphthongization is no longer a transparent phonological process in the language. The surface allomorphs are derived from different underlying representations but their distribution is phonologically principled. Within the framework of Optimality Theory, Rubach and Booij (2001) developed an analysis of mixed allomorphy, in which multiple inputs are posited and an important role is played by markedness constraints in selecting the unmarked allomorph. This approach turns out to yield an elegant solution for the problem posed by the Italian facts.

Opaque alternations are frequently subject to paradigm levelling. The Optimal Paradigms (OP) model, recently proposed by McCarthy (2005) to accommodate synchronic paradigm effects, proves to be problematic when applied to diachronic changes. Instead, I have proposed an analysis of analogical change which reserves a

[104] For an in-depth study of morphological productivity, the reader is referred to Bauer (2001).
[105] Interestingly, though, a small number of instances of *uomino*, *uometto* and *uovetto* can be found on different Italian websites.

central role for Lexicon Optimization. This analysis integrates the insight that analogical change, instead of being a merely phonological effect, is rather a morphological effect that results from the way that paradigms are acquired by learners (Albright 2005*a*,*b*). Another advantage is that analogical changes in both inflectional and derivational paradigms can be dealt with under a single approach, whereas OP is claimed to capture only inflectional paradigm effects successfully.

7 Conclusion

7.1. Introduction

"Suffice it to say that the 'mobile diphthong' rule is a typically Italian law."[106] This witty remark, quoted from Luciano Satta's normative language guide *Come si dice: uso e abuso della lingua italiana*, sheds light on the complexity of one of the salient analogical changes that occurred in the Italian language, i.e. the elimination of the alternation between stressed diphthongs and unstressed monophthongs within a limited group of inflectional and derivational paradigms. The first aim of the present study was to scrutinize durational aspects of Italian diphthongs and monophthongs in general. The second aim was to examine to what extent the variation caused by analogical levelling of the alternation between 'mobile diphthongs' and their corresponding monophthongs, attested in written sources, also occurs in the spoken language. To investigate these issues, I carried out a series of production experiments with native speakers of Italian. My final aim was to provide a coherent phonological treatment of the insights provided by the experiments within the framework of Optimality Theory.

7.2. Summary and main findings

The acoustic duration analysis reported in chapter 3 was motivated by Sluyters' (1992) claim that the 'mobile diphthongs' surface in the same context as phonologically long vowels, i.e. the stressed open syllable. Furthermore, Sluyters claims that the glides of the 'mobile diphthongs' are syllabified into the syllable nucleus, whereas the glides of other rising diphthongs are considered to be part of the onset. Based on these claims, I hypothesized that:

(1) the duration of long vowels would be equivalent to the duration of the 'mobile diphthongs' [jɛ] and [wɔ];
(2) the duration of the 'mobile diphthongs' [jɛ] and [wɔ] would be shorter than the duration of other stressed rising diphthongs;
(3) stressed 'non-mobile diphthongs' would be longer than long vowels.

Since previous duration experiments concluded that prefinally stressed vowels are significantly longer than pre-prefinally stressed vowels (Farnetani and Kori 1990 and D'Imperio and Rosenthall 1999)[107], I formulated an additional hypothesis:

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[106] "È sufficiente per dire che quella del dittongo mobile è proprio una legge all'italiana." (Satta 1968:118).
[107] In both studies, the two stress conditions are compared in words which differ in number of syllables.

(4) stressed pre-prefinal monophthongs and diphthongs are shorter than stressed prefinal monophthongs and diphthongs.

The results of the experiment revealed that the durations of all measured target segments (monophthongs, glides and vocalic portions of rising diphthongs and complete rising diphthongs) vary as a function of stress and word length. Although the absolute durations of long vowels and rising diphthongs diverge considerably, their values seem to converge remarkably once converted to relative durations (percentage of word duration), irrespectively whether the diphthongs are 'mobile' or 'non-mobile'. Consequently, the hypothesis that the duration of long vowels is equivalent to the duration of the 'mobile diphthongs' was confirmed by the results, but no experimental support was found for the expectation that 'non-mobile' rising diphthongs should be distinguished from the 'mobile diphthongs' and long vowels (hypotheses 2 and 3). The new empirical data also suggested that the predicted durational differences (pre-prefinal vs prefinal syllables; hypothesis 4) depend on word length rather than on syllable position. In quadrisyllabic words, the durations of stressed monophthongs and diphthongs are on average 1/4 of the total word durations, whereas in trisyllabic words these values amount to 1/3 of the total word durations. On the basis of these data, I presented a formula (see § 3.4.2), which allows a rough computation of the absolute duration of stressed monophthongs and diphthongs by dividing the duration of the word in milliseconds by the number of syllables in the word. The formula also regulates the glide-to-vowel ratio within rising diphthongs, which is virtually constant: 1:3 for [jV]-diphthongs and 1:4 for [wV]-diphthongs. This formula proved to be superior to an account of nucleus duration based on just the linear position of the stressed syllable within the (prosodic) word, since it accounts for 47.7% of the variance in the actual nucleus duration, whereas the simple linear model accounts for only 34.3% of the variance.

From a phonological perspective, the effect of stress on the durations of vowels, glides and complete diphthongs was analyzed as a strategy to satisfy the newly proposed syllable structure constraint $\acute{\sigma}_{\mu\mu}$, which conflates the weight-to-stress principle – 'if heavy, then stressed' – and the stress-to-weight principle – 'if stressed, then heavy' – into a single constraint (§ 5.4.4). Given the identical behaviour of monophthongs and rising diphthongs under the influence of stress, I proposed that they are both bimoraic in stressed open syllables and monomoraic elsewhere. Italian onglides, for all of which a nucleus analysis was claimed to be most harmonious with phonotactic arguments and the findings of the acoustic duration analysis, were shown to correspond either to input glides (as is the case for the glides in 'mobile diphthongs') or a prevocalic input vowel, which surfaces as a glide through a process of glide formation. This process is stress-sensitive in that it only occurs in unstressed syllables. A sequence of two adjacent vowels surfaces in hiatus whenever one of the two vowels is stressed, e.g. ['viː.a], [vi.'aː.le] vs [vja.'let.to]. Stress-sensitive vowel–glide alternation is determined by simultaneously best satisfying the syllable structure constraints $\acute{\sigma}_{\mu\mu}$ and ONSET and positional faithfulness constraints – i.e. faithfulness constraints relativized to certain salient contexts, such as stressed syllables (§ 5.4.5).

The results of the variation analysis, presented in chapter 4, revealed the absence of the monophthong–diphthong alternation in 70% of the target word pairs (79% for front /e/ and 55% for back /o/) and in 90% of the non-word pairs (100% for /e/ and 87% for /o/). These data indicate that the final stage of a linguistic change has now been reached. I repeat the hypothesized reconstruction of this change, given in § 4.5. In late spoken Latin (or the language stage that immediately precedes Tuscan Italian), all the mid vowels were monophthongs. Towards the middle of the 7th century, a split came about such that the low-mid monophthongs were diphthongized only in stressed syllables. This change probably ended in a relatively stable situation in which the 'mobile diphthong' rule was applied practically without exception. From the 16th century onwards, the second stage in the change took effect. The diphthongization was analogically extended to the non-stressed vowels. The generalization first affected words with front vowels but later also words with back vowels that were related to the base word (with the stressed diphthong) through productive and predictable morphological processes (e.g. diminutivization, inflection of regular verbs, suffixation of *–mente*/*–issimo*). Unstressed vowels in semantically transparent derivatives changed in a later stage, whereas unstressed vowels in words that were opaquely related to the diphthongized base forms resisted the change as these words were lexicalized with the monophthong. By now, the second stage of the diphthongization process seems virtually complete for front vowels and almost complete for back vowels.

In chapter 6, an attempt was undertaken to 'explain' the analogical extension of the diphthongs to the unstressed syllables: what caused it and why did it occur in this direction and not vice versa, i.e. extension of the monophthongs to the stressed syllables? I followed up a suggestion of Wetzels (1981:3) that non-productive alternations are lexicalized and are therefore likely to be eliminated by analogical forces, given the increased memorization burden on the speaker. This suggestion left us with two issues to be explored from an optimality-theoretic perspective: (1) opaque allomorphy and (2) analogical change.

The first issue was approached in § 6.2 under the model developed by Rubach and Booij (2001). In their model, OT predicts that the monophthong–diphthong alternation, which in traditional generative accounts has been analyzed as the result of a diphthongization or monophthongization rule, must be reanalyzed as an instance of mixed phonological and morphological allomorphy, i.e. the allomorphs have different, less abstract but arbitrary input forms whereas their distribution is regulated by the ranking of universal constraints. An important role is played by markedness constraints in selecting the unmarked allomorph.

To address the second issue, I sought to reconcile Rubach and Booij's multiple input approach with McCarthy's (2005) Optimal Paradigms (OP) model, which formalizes our intuition that the elimination of alternations within paradigms is due to a pressure for paradigm uniformity (see § 6.3.1). However, an OP approach fails to account for the diachronic facts: *why* did levelling take place and *why* in this direction? As an alternative, I proposed an analysis of analogical change which reserves a central role for Lexicon Optimization (§ 6.3.4). Learners – erroneously – reanalyze multiple input allomorphs of irregular paradigms as a single input, on analogy with regular paradigms. This new input has the phonological shape of the

form that functions as a base within the inflectional or derivational paradigm, which explains the direction of an analogical change An important asset of my proposal is that it integrates the insight that analogical change, instead of being a merely phonological effect, is more insightfully regarded as a morphological effect that results from the way that paradigms are acquired by learners (Albright 2005*a*,*b*).

7.3. Additional issues and suggestions for further research

The results of the variation analysis corroborated my expectation that paradigms with [wɔ]/[o] alternations are slightly more resistant to the change than paradigms with alternating [jɛ]/[e]. It is noteworthy that this asymmetry is also reflected by the lesser degree of expansion and the instability of back diphthongs in the Romance languages. My hypothesis was that the effect of diphthongization is more clearly perceived in front vowels than in back vowels. In order to test this hypothesis, an additional experiment was conducted, investigating the relationship between production and perception of diphthongs based on formant frequencies (§ 4.6). I found a clear and significant (though moderately strong) correlation between the acoustics and the perception of diphthongization. F1 and F2 frequency values as well as vowel duration constitute subtle acoustic cues of diphthongization, to which listeners attend differently. More importantly, in front vowels these cues are stronger than in back vowels, which confirms our hypothesis. Therefore, the asymmetry in the sound change can plausibly be explained as being perceptually conditioned. It will take more time before learners implement changes which involve less clearly perceived sounds. Another possibility is that there is a greater anatomical and/or physiological potential for diphthongization in front vowels. This alternative hypothesis, which does not necessarily contradict the former one, could be tested by a variety of techniques, such as measuring mandible opening using a strain gauge, or tracking the surface of the tongue using EMMA (Electro-Magnetic Mid-sagittal Articulography).

Another issue requiring further experimental research is that of the perceptional variation between the listeners of different native languages who were involved in the variation analysis. The data provided by this analysis indicated that the three Italian native listeners are more prone to perceive diphthongs than the two Dutch native listeners. The variation is significant: in roughly two-thirds of the cases where the Dutch listeners report a monophthong, the Italians perceive a diphthong. It would be interesting to investigate whether this difference is a matter of response bias (possibly induced by orthographic practice) or whether the diphthongization cues (F1 and F2 frequency and vowel duration) are too subtle to be attended to by non-native listeners. The outcome of such an investigation may shed light on the question why both variants – alternating paradigms vs levelled paradigms – persisted for so long, particularly for words containing back diphthongs. Given the fact that the linguistic unification of Italy only took place in the last century, we might hypothesize that non-native speakers of Standard Italian, i.e. speakers of dialects and regional variants, also attended differently to the diphthongization cues when listening to Standard Italian and did not immediately implement the analogical change.

My final remarks concern the empirical and theoretical aspects of the present study. This dissertation contributes to current methodologies within the area of experimental phonetics and phonological theory. First, I presented a formula to estimate the durations of Italian vowels and diphthongs in stressed open syllables (§ 3.4.2). Further experiments are needed to investigate whether this formula is also applicable to the duration of stressed closed syllables. In her dissertation, McCrary (2004) finds that the durations of vowels in stressed closed syllables are determined by the quantity and durations of the following consonants, but the question to what extent vowels in stressed closed syllables also vary as a function of total word duration, seems relevant.

Secondly, an objective and quantifiable method was developed to test my hypothesis about the elimination of the monophthong–diphthong alternation in spoken Italian. Speech data were elicited through a phoneme restoration task using the speech shadowing technique (§ 4.2). Shadowing tasks, in which the original stimuli are manipulated, have been used in the domain of auditory word recognition (see, for instance, van Heuven 1988 and Bailly 2003). In this study, the method proved to be a valuable tool in language-variation research if combined with a phoneme restoration task. The advantage of the shadowing condition is its guaranty that restoration is performed under considerable temporal pressure while shadowers are often not aware that the target to be restored is missing at all. In this respect, the elicited speech production resembles that of spontaneous speech. Therefore, the technique is recommended for any research project which requires the recording of spontaneous speech production.

Finally, this dissertation makes at least the following contributions to phonological theory within the framework of Optimality Theory. The formulation of a new constraint $\acute{\sigma}_{\mu\mu}$ (§ 5.4.4) invites a re-examination of the relationship between stress assignment and syllable weight. Future phonological analyses of syllabic-prosodic structure must reveal whether my proposal is on the right track. Ultimately, interpreting Lexicon Optimization as a mechanism of reanalyzing multiple input allomorphs as a single input provides a contribution to an insightful theory of analogical change under the pressure of paradigm uniformity. It corresponds to our intuition that analogical changes are motivated by the speaker's tendency to overregularize the lexicon and eliminate irregular alternations. A legitimate question that remains to be answered, is why, within a single language, one opaque alternation is clearly subject to levelling whereas another seems immune to a regular pattern of levelling. For instance, Celata and Bertinetto (2005) point out the relatively frequent occurrence of speech errors in Italian alternations involving velar palatalization (see § 6.2.2): at first sight, the oscillations seem to go in both directions: palatalized words are de-palatalized and follow the regular mechanism of plural formation or exactly the reverse happens (*recipro*[k]*o* ~ **recipro*[k]*i* 'mutual SG and PL' vs *rammari*[k]*o* ~ **rammari*[tʃ]*i* 'regret SG and PL'). The answer may be found by comparing the reliability factors of the morphophonological rules that learners of a specific language set up in order to construct different types of paradigms, following Albright and Hayes' (2002) computational model of base discovery. Another interesting option to explore is the role that sociolinguistic factors play in determining the extent to which paradigm levelling is accepted in a speech community.

Appendix A Original sources of the translated quotations

A.1. Buommattei (1729:67-68)

De' Dittonghi fermi, e mobili. Cap. III
Un'altra division de' dittongi si fa da noi per maggior intelligenza di questa materia, e diciamo altri FERMI, altri MOBILI.

Fermi dittongi chiamo io quelli che sempre son dittongi: come PIEGO, QUESTO, AURORA, VEEMENZA; che sempre mantengono'l dittongo, benché mutin le sillabe, e tanto si scrive PIEGARE, PIEGAVANO, e PIEGO' col dittongo, quanto s'era fatto nella sua minor voce PIEGO.

Mobili dittongi appello que'che si mutano, e si lievano col mutar delle sillabe, come PRIEGO, TRUOVA, CIECO, TUONA, che (*a*) mentre quelle parole si crescono; si toglie via il dittongo, e si dice PREGARE, TROVARE, CECONE, TONARE, senza dittongo.

Il dittongo fermo non ha considerazione alcuna ad accento; perchè se (*b*) PIEGO ha l'accento sopra la prima, PIEGARE, l'ha sopra la seconda, PIEGHEREI sopra la terza, e pur sempre v'è il dittongo.

Ma il mobile è sempre sotto l'accento. E quando si muta l'accento il dittongo si toglie via. Ecco BUONO, e BONISSIMO, ecco PRIEGO, PREGARE, anzi quel che più lo manifesta PREGO'; ecco TRUOVA, SIAMO, SUONO, VUOGLI, e MUORE, ed ecco TROVERAI, SAREMO, SONERO', VORRESTI, e MORREBBE, che mutando l'accento, levano anco via il dittongo.

[footnotes]
(*a*) Dicesi *Fuoco* col dittongo Toscano, e poi *Infocate*. E *Tuona*; e poi *Tonare*; perciocchè non si può far forza, nè accento acuto in due luoghi, e quando l'acutezza passa oltre si scarnisce, per così dire, il dittongo, per far la forza, e l'appoggiatura della voce più là. Perciò *Fiede* è da *Fedire*, *Riede* da *Reddire*; onde *Fedita*, *Reddita*.
(*b*) Piego è dittongo fermo, perchè è dal Lat. *plico*; ma *precor* fa *prego*, e poi *priego* per eleganza, e riempitura di grazia; però può togliersi via: laddove nell'altra voce *piego* l'*i* è per così dire, radicale essendo succeduta nella *L*.

A.2. Fouché (1927:42-43)

[c]ette divergence entre *tiers*, *nièce*, d'une part, et *force*, *noce* de l'autre, n'a rien que de très explicable. La diphtongaison a très bien pu avoir lieu pour *ĕ*, et non pour *ŏ*. Un *o*, qui exige deux mouvements articulatoires nets, est plus résistant qu'un *e*, tant que les deux mouvements sont parfaitement coordonnées et équilibrées. En espagnol, l'*ŏ* s'est diphtongué dans *fuerza* et le v. cast. *nuepças*. En français, où

l'articulation labiale est particulièrement soignée, il s'est maintenu tel quel: les deux mouvements, labial et lingual, ont été assez nets et la coordination a été parfaite (...).

A.3. Bembo, *Prose*, § 28 in Bembo (1967:135-136)[108]

(...) in *Doglio Tengo* e simili, non *Dogli Tenghi*, ma *Duoli Tieni* si dice. Nella qual voce, oltre acciò che il fine non ha con lei somiglianza, aviene ancor questo, che vi s'aggiugne di nuovo una vocale, per empierlane di piú quel tanto: *Doglio Duoli*, *Voglio Vuoli*, *Soglio Suoli*, *Tengo Tieni*, *Seggo Siedi*, *Posso Puoi*, e altri (...). Passa questo uso nella terza voce del numero del meno medesimamente continuo, ma più oltre non si stende (...).

Di che altra regola dare non vi si può, se non questa: che altre vocali che la *I* e la *U* non hanno in ciò luogo; e quest'altra: che nelle voci, nelle quali la *A* giace nella penultima sillaba, non entran di nuovo queste vocali né veruna altra; ché *Vaglio* e simili non crescono da questa parte. [Bembo, *Prose*, § 28 in Bembo 1967:136]

A.4. Salviati, *Regole*, 24,18-26 in Salviati (1991:173)

Irregolati ancora, benché non tanto, sono nella seconda coniugazioni certi verbi i quali con la lettera maestrale prendono (ma davanti e nella stessa sillaba, stringendola con esso lei), prendono, dico, in essa maestral voce, ovvero *i*, ovvero *u*, che nella general voce non si trovavano; e in cambio di *sole* e di *tene*, che *solere* e *tenere* dovrebbono aver formata, e *suole* e *tiene* ricevono in quella sedia per altro ragguardamento che qui sarebbe lungo a toccare. Ma *sole* e *tene* si dee far conto che sia la maestral voce, secondo che de' precedenti s'è diffinito.

A.5. Varchi, *Gramatica toscana*, 185r in Maraschio (2002:120)

Favellano ancora barbaramente tutti coloro i quali aggiugnendo lettere o trasponendole *buonissimo* dicono e non *bonissimo* (…).

A.6. Varchi, *L'Hercolano*, *Ques.* VII, 169 in Varchi (1995:726)

Buono, quando è positivo, si scrive per *u* liquida innanzi l'*o*, ma quando è superlativo non si può non si dee nè profferire nè scrivere *buonissimo*, come fanno molti forestieri, ma bisogna per forza scrivere e pronunziare *bonissimo* senza la *u* liquida.

[108] Bembo (1967) is based on the *edizione torrentiniana* of 1549.

Appendix B Additional tables

Table B.1: Italian lexical items containing the diphthongs [jɛ] and [wɔ] etymologically related to Late Latin /ɛ, ɔ/. (Chapters 2 and 4)

[jɛ]		[wɔ]	
Nouns			
cielo	'heaven'	*aiuola*	'flower bed'
fieno	'hay'	*buoi*	'oxes'
fiero	'wild beast'	*cuoco*	'cook'
miele	'honey'	*cuoio*	'leather'
piede	'foot'	*cuore*	'heart'
pietra	'stone'	*duolo*	'pain'
siepe	'hedge'	*duomo*	'cathedral'
siero	'serum'	*fuoco*	'fire'
		lenzuolo	'sheet'
		luogo	'place'
		nuora	'daughter-in-law'
		ruota	'wheel'
		scuola	'school'
		stuoia	'floor mat'
		stuolo	'procession'
		suocero	'father-in-law'
		suola	'sole'
		suono	'sound'
		suora	'sister'
		uomo	'man'
		uovo	'egg'
Adjectives			
cieco	'blind'	*buono*	'good'
dieci	'ten'	*nuovo*	'new'
fiero	'proud'	*vuoto*	'empty'
lieto	'happy'		
lieve	'light'		
tiepido	'lukewarm'		
vieto	'antiquated'		
Adverbs			
ieri	'yesterday'	*fuori*	'outside'
insieme	'together'		

Verbs			
chiedere	'to ask'	*abbuonare*	'to forgive'
mietere	'to reap'	*cuocere*	'to cook'
riedere	'to turn'	*dolere (duol-)*	'to hurt'
sedere (sied-)	'to sit'	*morire (muor-)*	'to die'
tenere (tien-)	'to hold'	*muovere*	'to move'
vietare	'to prohibit'	*nuotare*	'to swim'
venire (vien-)	'to come'	*potere (può)*	'to be able to'
		ruotare	'to roll'
		scuoiare	'to skin'
		scuotere	'to shake'
		solere (suol-)'	'to be in the habit of'
		suonare	'to ring'
		tuonare	'to blast'
		volere (vuol-)	'to want'
		vuotare	'to empty'
Suffixes			
		-uolo (> -olo)	diminutive suffix

Table B.2: Set of target words – experiment on vowel duration. (Chapter 3)

low vowel [a]				
[pre-prefinal]/[+stress]	[-clitic]		[+clitic]	
[-glide]	*ripagano*	'pay back PRES IND/3PL'	*ripagalo*	'pay it back IMP'
[jV]	*richiamano*	'call back PRES IND/3PL'	*richiamalo*	'call him back IMP'
[wV]	*riquadrano*	'make square PRES IND/3PL'	*riquadralo*	'make it square IMP'
[prefinal]/[+stress]	[-clitic]		[+clitic]	
[-glide]	*ripago*	'pay back PRES IND/1SG'	*	
[jV]	*richiamo*	'call back PRES IND/1SG'	*	
[wV]	*riquadro*	'make square PRES IND/1SG'	*	
[pre-prefinal]/[-stress]	[-clitic]			
[-glide]	*ripagava*	'pay back IMPERF IND/3SG'		
[jV]	*richiamava*	'call back IMPERF IND/3SG'		
[wV]	*riquadrava*	'make square IMPERF IND/3SG'		
low vowel [ɛ/e]				
[pre-prefinal]/[+stress]	[-clitic]		[+clitic]	
[-glide]	*ripetere*	'repeat INF'	*ripetilo*	'repeat it IMP'
[jV]	*risiedino*	'sit again PRES SUBJ/3PL'	*risiediti*	'sit again IMP'
[wV]	*querulo*	'querulous'	*	
[prefinal]/[+stress]	[-clitic]		[+clitic]	
no glide	*ripeto*	'repeat PRES IND/1SG'	*	
[jV]	*risiedo*	'sit again PRES IND/1SG'	*	
[wV]	*		*	
[pre-prefinal]/[-stress]	[-clitic]			
[-glide]	*ripeteva*	'repeat IMPERF IND/3SG'		
[jV]	*risiedeva*	'sit again IMPERF IND/3SG'		
[wV]	*querela*	'lawsuit'		

low vowel [ɔ/o]				
[pre-prefinal]/[+stress]	[-clitic]		[+clitic]	
[-glide]	*ripopolo*	'populate again PRES IND/1SG'	*riposati*	'rest IMP'
[jV]	*richiodano*	'nail down again PRES IND/3PL'	*richiodalo*	'nail it down again IMP'
[wV]	*ricuocere*	'cook again INF'	*ricuocilo*	'cook it again IMP'
[prefinal]/[+stress]	[-clitic]		[+clitic]	
[-glide]	*riposo*	'I rest PRES IND/1SG'	*	
[jV]	*richioda*	'nail down again PRES IND/3SG'	*	
[wV]	*ricuocio*	'cook again PRES IND/1SG'	*	
[pre-prefinal]/[-stress]	[-clitic]			
-glide]	*riposava*	'rest IMPERF IND/3SG'		
[jV]	*richiodava*	'nail down again IMPERF IND/3SG'		
[wV]	*ricuoceva*	'cook again IMPERF IND/3SG'		

Table B.3: Set of target words – elicitation experiment I. (Chapter 4)[109]

Base = Noun			
Diphthong	Morphological operation	Target words	
[jɛ]	Suffixation	*impietrire*	'to petrify'
		pediera	'foot board'
	Diminutivization	*piedino*	'little foot'
[wɔ]	Suffixation	*infuocare*	'to make red-hot'
		stuoino	'door mat'
	Diminutivization	*fuocherello*	'little fire'

Base = Adjective			
Diphthong	Morphological operation	Target words	
[jɛ]	Suffixation	*diecina*	'ten or so'
	Diminutivization	*tiepidino*	'rather tepid'
	Inflection	*lievissimo*	'very light'
[wɔ]	Suffixation	*nuovismo*	'the uncritical extolling of what is new NOUN'
	Diminutivization	*buonino*	'rather good'
	Inflection	*buonissimo*	'very good'

Base = Verb			
Diphthong	Morphological operation	Target words	
[jɛ]	Suffixation	*mietitore*	'harvester'
	Inflection	*siederà*	'to sit FUT IND/3SG'
[wɔ]	Suffixation	*suonatore*	'player, musician'
	Inflection	*cuocevo*	'to cook IMPERF IND/1SG'

[109] In this table, the most frequent variant of the target words is listed, according to information provided by the dictionaries of Sabatini and Coletti (1997) and De Mauro (2000).

Table B.4: Set of sentences – experiment I. (Chapter 4)

Target words are boldfaced; noise sections are underlined.

1. si lava la camicia anche se la camicia non è lavabile
2. si legge il libro anche se il libro non è leggibile
3. non si vede la città perché non è visibile.
4. Arturo spreme limoni con uno spremilimoni
5. Si rompe il ghiaccio con un rompighiaccio
6. una grande bottiglia e una piccola bottiglietta
7. un grande albero e un piccolo alberello
8. un grande fuoco e un piccolo **fuocherello**
9. un grande quadro e un piccolo quadretto
10. una grande tavola e una piccola tavoletta
11. un piccolo piede e un piccolo **piedino**.
12. una grande montagna e una piccola montagnola
13. vive in campagna; è un vero campagnolo
14. una grande bandiera e una piccola banderuola
15. è molto brutto, è un po' bruttino
16. è molto tiepido, è un po' **tiepidino**
17. è molto buono, è piuttosto **buonino**
18. la casa è alta, anzi, è altissima
19. la pasta è buona, anzi, è **buonissima**
20. il libro è caro, anzi, è carissimo
21. la donna è ricca, anzi, è ricchissima
22. la perdita è lieve, anzi, è **lievissima**
23. la testa del letto si chiama la testiera
24. il piede del letto si chiama la **pediera**
25. una grande casa in città, una piccola casetta in campagna
26. una grande stuoia nel salotto, un piccolo **stuoino** davanti alla porta
27. oggi preparo la pasta e anche ieri preparavo la pasta
28. oggi cuocio pasta e anche ieri **cuocevo** pasta
29. oggi fa caldo e anche ieri faceva caldo
30. oggi si sente a suo agio e anche domani si sentirà a suo agio
31. oggi si siede nella sua poltrona e anche domani si **siederà** nella sua poltrona
32. chi segue i principi del verismo si chiama un verista
33. l'esaltazione acritica del nuovo si chiama anche il **nuovismo**
34. Paolo lavora bene, è un buon lavoratore
35. Paolo suona bene, è un buon **suonatore**
36. Paolo vende bene, è un buon venditore.
37. Paolo miete bene, è un buon **mietitore**
38. compra venti aranciate, ne compra una ventina
39. compra dieci pomodori, ne compra una **decina**
40. ci vuole una serratura per serrare la porta
41. ci vuole un fuoco per **infuocare** il metallo

42. ha un anello d'argento, mi sembra argentato.
43. ha un cuore di pietra, mi sembra proprio **impietrito**.

Table B.5: Set of target words experiment II. (Chapter 4)

Morphological operation: diminutivization	
Diphthong	Target words
[jɛ]	*piepa*
[wɔ]	*puopo*

Morphological operation: inflection	
Diphthong	Target words
[jɛ]	*piepo*
[wɔ]	*puopo*

Morphological operation: derivation	
Diphthong	Target words
[jɛ]	*tietere*
[wɔ]	*tuotere*

Table B.6: Perceptual decisions (monophthong [m], diphthong [d]) for ten speakers, broken down by item and by listener. (Chapter 4)

Words

	Speaker 1					Speaker 2				
Item	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)
[e]/[je]										
p...dino	d	d	d	d	d	d	d	d	d	d
t...pidino	d	d	d	d	d	d	d	d	d	d
l...vissima	d	d	d	d	d	d	d	d	d	d
p...diera	m	d	m	m	m	d	d	m	d	m
s...derà	d	d	d	d	d	m	m	d	m	m
m...titore	m	m	m	m	m	d	d	d	d	d
d...cina	m	m	m	m	m	d	m	d	d	d
imp...trito	d	d	d	d	d	m	m	d	m	m
[o]/[wo]										
f...cherello	m	m	d	d	d	m	m	m	m	m
b...nino	m	m	d	m	m	m	m	m	m	m
b...nissima	m	m	d	d	d	m	m	d	d	d
st...ino	m	m	d	m	d	m	m	d	d	d
c...cevo	d	d	d	d	d	d	m	d	d	m
n...vismo	m	m	d	m	d	*	*	*	*	*
s...natore	m	m	d	m	d	m	m	m	m	m
inf...care	m	m	d	d	d	d	m	d	d	d

	Speaker 3					Speaker 4				
Item	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)
[e]/[je]										
p...dino	d	d	d	d	d	d	d	d	d	d
t...pidino	d	m	d	d	d	d	d	d	m	d
l...vissima	d	d	d	d	d	d	d	d	d	d
p...diera	m	d	m	m	m	m	d	m	m	m
s...derà	m	m	d	d	d	d	d	d	d	d
m...titore	d	m	d	m	d	d	d	d	d	d
d...cina	m	m	m	d	m	m	m	m	m	m
imp...trito	d	d	d	d	d	d	d	d	d	d
[o]/[wo]										
f...cherello	m	m	m	m	d	m	m	d	d	d
b...nino	d	d	d	d	d	d	d	d	m	d
b...nissima	m	m	d	d	d	m	m	d	m	d
st...ino	m	m	m	m	m	m	m	m	m	m
c...cevo	m	m	d	d	d	d	d	d	d	d
n...vismo	d	m	d	d	d	*	*	*	*	*
s...natore	m	m	d	d	d	d	d	d	m	m
inf...care	m	m	d	d	d	d	d	d	d	d

	Speaker 5					Speaker 6				
Item	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)
[e]/[je]										
p...dino	d	d	d	d	d	d	m	d	d	d
t...pidino	d	d	d	d	d	d	d	d	d	d
l...vissima	d	d	d	d	d	d	d	d	d	d
p...diera	d	d	d	d	d	d	d	d	d	d
s...derà	d	d	d	d	d	m	m	d	d	d
m...titore	m	m	d	d	d	d	d	d	d	d
d...cina	m	m	m	m	m	m	m	m	m	m
imp...trito	d	d	d	d	d	d	d	d	d	d
[o]/[wo]										
f...cherello	m	m	d	d	d	m	m	m	d	d
b...nino	m	m	d	m	d	m	m	m	d	d
b...nissima	m	m	d	d	d	d	d	d	d	d
st...ino	m	m	d	m	d	m	m	m	m	m
c...cevo	m	m	d	d	d	m	m	m	m	d
n...vismo	m	m	d	d	d	d	d	d	d	d
s...natore	m	m	d	m	d	m	m	d	m	m
inf...care	d	d	d	d	d	m	m	d	d	d

	Speaker 7					Speaker 8				
Item	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)
[e]/[je]										
p...dino	d	d	d	d	d	d	d	d	d	d
t...pidino	d	d	d	d	d	d	d	d	d	d
l...vissima	d	d	d	d	d	d	d	d	d	d
p...diera	d	d	d	d	d	d	d	d	d	d
s...derà	m	m	d	d	d	d	d	d	d	d
m...titore	m	m	d	d	d	d	d	d	d	d
d...cina	d	d	d	d	d	m	m	m	m	m
imp...trito	d	d	d	d	d	d	d	m	d	d
[o]/[wo]										
f...cherello	m	m	d	d	d	m	m	m	d	d
b...nino	d	d	d	d	d	m	m	d	d	m
b...nissima	m	m	m	m	d	m	m	d	d	m
st...ino	m	m	m	m	m	m	m	d	d	d
c...cevo	d	d	d	d	d	d	d	d	d	d
n...vismo	m	m	d	d	d	m	m	d	d	d
s...natore	m	m	d	d	d	m	m	d	m	m
inf...care	d	m	d	d	d	m	m	d	d	d

	Speaker 9					Speaker 10				
Item	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF (IT)
[e]/[je]										
p...dino	d	d	d	d	d	d	d	d	d	d
t...pidino	d	d	d	d	d	d	d	d	d	d
l...vissima	d	d	d	d	m	d	d	d	d	d
p...diera	d	d	d	d	d	d	d	d	d	d
s...derà	d	m	d	d	m	m	m	d	d	d
m...titore	d	d	d	d	d	m	m	d	d	d
d...cina	d	d	d	d	d	m	m	m	m	d
imp...trito	d	d	d	d	d	d	d	d	d	m
[o]/[wo]										
f...cherello	m	m	m	d	m	m	m	d	d	d
b...nino	d	d	d	d	m	m	m	d	d	d
b...nissima	m	m	d	d	d	d	d	d	d	m
st...ino	m	m	d	m	d	m	m	d	d	d
c...cevo	m	m	m	m	m	d	d	d	d	d
n...vismo	*	*	*	*	*	d	d	d	d	d
s...natore	m	m	d	d	d	m	m	d	d	d
inf...care	m	m	d	d	d	d	d	d	d	d

Non-words

	Speaker 1						Speaker 2				
Item	BV (NL)		VH	VM	CB	IF (IT)	BV	VH (NL)	VM (IT)	CB	IF
[e]/[je]											
p...pina	d	d	d	d	d		d	d	d	d	d
p...pare	d	d	d	d	d		d	d	d	d	d
t...timento	d	d	d	d	d		d	d	d	d	d
[o]/[wo]											
p...pino	d	m	d	d	d		d	d	d	d	d
p...pare	d	d	d	d	d		d	d	d	d	d
t...timento	d	d	d	d	d		d	d	d	d	d

	Speaker 3						Speaker 4				
Item	BV (NL)		VH	VM	CB	IF (IT)	BV	VH (NL)	VM (IT)	CB	IF
[e]/[je]											
p...pina	d	d	d	d	d		d	d	d	d	d
p...pare	d	d	d	d	d		d	d	d	d	d
t...timento	d	d	d	d	d		d	d	d	d	d
[o]/[wo]											
p...pino	d	d	d	d	d		d	d	d	d	d
p...pare	d	d	d	d	d		d	d	d	d	d
t...timento	d	d	d	d	d		d	d	d	d	d

	Speaker 5						Speaker 7				
Item	BV (NL)		VH	VM	CB (IT)	IF (IT)	BV	VH (NL)	VM (IT)	CB	IF
[e]/[je]											
p...pina	d	d	d	d	d		d	d	d	d	d
p...pare	d	d	d	d	d		d	d	d	d	d
t...timento	d	d	d	d	d		d	d	d	d	d
[o]/[wo]											
p...pino	m	m	d	d	d		m	m	d	d	d
p...pare	d	m	d	d	d		m	m	m	d	d
t...timento	d	d	d	d	d		d	m	d	d	d

	Speaker 7					Speaker 8				
Item	BV (NL)	VH	VM	CB	IF (IT)	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF
[e]/[je]										
p...pina	d	d	d	d	d	d	d	d	d	d
p...pare	d	d	d	d	d	d	d	d	d	d
t...timento	d	d	d	d	d	d	d	d	d	d
[o]/[wo]										
p...pino	m	m	d	d	d	d	d	d	d	d
p...pare	d	d	d	d	d	m	m	d	d	d
t...timento	m	m	d	d	d	d	d	d	d	d

	Speaker 9					Speaker 10				
Item	BV (NL)	VH	VM	CB	IF (IT)	BV (NL)	VH (NL)	VM (IT)	CB (IT)	IF
[e]/[je]										
p...pina	d	d	d	d	d	d	d	d	d	d
p...pare	d	d	d	d	d	d	d	d	d	d
t...timento	d	d	d	d	d	d	d	d	d	d
[o]/[wo]										
p...pino	d	d	d	d	d	m	m	d	d	d
p...pare	d	d	d	d	d	m	d	d	d	d
t...timento	d	d	d	d	d	d	d	d	d	d

Table B.7a-f: Crosstabulates of monophthong (mono) vs diphthong (diph) decisions for all Dutch-Italian pairs of listeners. (Chapter 4)

Table B.7a: CB (I) × VH (NL).

		VH (NL)		
		mono	diph	**Total**
CB (I)	mono	24	5	29
	diph	68	120	188
Total		92	125	217

Table B.7b: VM (I) × VH (NL).

		VH (NL)		
		mono	diph	**Total**
VM (I)	mono	32	6	38
	diph	60	119	179
Total		92	125	217

Table B.7c: IF (I) × VH (NL).

		VH (NL)		
		mono	diph	**Total**
IF (I)	mono	25	9	34
	diph	67	116	183
Total		92	125	217

Table B.7d: CB (I)× BV (NL).

		BV (NL)		
		mono	diph	**Total**
CB (I)	mono	27	2	29
	diph	57	131	188
Total		84	133	217

Table B.7e: VM (I)× BV (NL).

		BV (NL)		
		mono	diph	**Total**
VM (I)	mono	34	4	38
	diph	50	129	179
Total		84	133	217

Table B.7f: IF (I)× BV (NL).

		BV (NL)		
		mono	diph	**Total**
IF (I)	mono	26	8	34
	diph	58	125	183
Total		84	133	217

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Samenvatting (summary in Dutch)

"Het is een regel die nooit rust heeft gevonden in de Italiaanse taal en die, zo blijkt, uiteindelijk die rust heeft gevonden in de dood."[110] Met deze woorden typeert Franco Fochi in zijn normatieve taalgids voor geschreven en gesproken Italiaans het lot van de zogeheten *regola del dittongo mobile*, de regel van de 'mobiele diftong'. Sinds de zeventiende eeuw gebruiken Italiaanse grammatici en lexicografen de term *dittongo mobile* wanneer ze verwijzen naar de stijgende diftongen [jɛ] en [wɔ], die historisch verwant zijn met de laat-Latijnse beklemtoonde middenklinkers [ɛ] en [ɔ] en die alterneren met overeenkomstige monoftongen zodra de klemtoon naar een andere lettergreep verspringt ten gevolge van een morfologische operatie. Voorbeelden zijn: *se**dià**mo* 'wij zitten' vs *si**è**di* 'jij zit' and *mo**vi**mén**to*' beweging' vs *mu**ò**vo* 'ik beweeg'.

Uit geschreven bronnen blijkt dat reeds in de zestiende eeuw deze diftongen hypercorrect werden uitgebreid naar de onbeklemtoonde lettergrepen, bijv. *si**e**derò* 'ik zal zitten' en *mu**o**viàmo* 'wij bewegen', naar analogie van de vormen met een beklemtoonde diftong. Deze analoge verandering heeft tot heel wat variatie geleid, waarbij de monoftong–diftong-alternantie in het ene geval behouden bleef en in het andere geval werd geëlimineerd. Dit is zelfs in de twintigste eeuw nog merkbaar in literaire teksten: een auteur als Grazia Deledda schrijft zowel *moveva* als *muoveva* of *scoteva* naast *scuoteva* (IMPERF IND/3SG van respectievelijk *muovere* 'bewegen' en *scuotere* 'schudden') en zo zijn er nog talrijke voorbeelden te vinden in andere literaire teksten (zie van der Veer 2001). Het mag dan ook enigszins verbazingwekkend zijn dat de befaamde regel nog altijd wordt voorgeschreven in recente woordenboeken en verdedigd door een aantal taalpuristen, onder wie Gabrielli (1956, 1976).

In de fonologische literatuur is niet veel aandacht besteed aan de Italiaanse 'mobiele diftongen'. Saltarelli (1970) beschrijft de monoftong–diftong-alternantie als het effect van een monoftongeringsregel: onderliggende diftongen komen in een bepaalde context aan de oppervlakte als monoftongen. Sluyters (1992) gaat een stapje verder in een poging het fenomeen ook te verklaren: in de taal bestaat een actief diftongeringsproces dat, net als klinkerverlenging, optreedt in beklemtoonde open lettergrepen, met als doel een welgevormde voetstructuur te creëren. Met deze analyse wordt eigenlijk gesuggereerd dat de 'mobiele diftongen' fonologische equivalenten zijn van lange klinkers in beklemtoonde open lettergrepen.

Het doel van dit proefschrift was drieledig: (1) aan de hand van een productie-experiment de duuraspecten van Italiaanse diftongen en monoftongen in het algemeen in kaart brengen; (2) een doeltreffend productie-experiment ontwerpen en uitvoeren om vast te stellen in welke mate de monoftong–diftong-alternantie voorkomt in het hedendaags *gesproken* Italiaans en (3) een fonologische analyse ontwikkelen

[110] "È una regola che non è mai riuscita a trovar pace nella lingua italiana, e che finalmente, la trova, come pare, nella morte." Fochi (1969:86).

van de resultaten van de experimenten binnen het raamwerk van de optimaliteitstheorie (OT).

In hoofdstuk 3 wordt verslag gedaan van het akoestische duurexperiment. Uitgangspunt voor dit experiment was de bewering van Sluyters (1992) dat 'mobiele diftongen' in dezelfde fonologische context voorkomen als lange klinkers. Bovendien beweert Sluyters dat de glide van een 'mobiele diftong' onderdeel is van de nucleus van een lettergreep, terwijl die van de andere stijgende diftongen in de onset wordt gesyllabificeerd. De volgende hypotheses werden geformuleerd:

(1) Lange klinkers zijn even lang als 'mobiele diftongen';
(2) 'Mobiele diftongen' zijn korter dan andere stijgende diftongen;
(3) Beklemtoonde 'niet-mobiele diftongen' zijn langer dan lange klinkers.

Aangezien in voorgaande duurexperimenten is aangetoond dat beklemtoonde klinkers in voorlaatste lettergrepen significant langer zijn dan die in voor-voorlaatste lettergrepen (Farnetani en Kori 1990 en D'Imperio en Rosenthall 1999)[111], heb ik een vierde hypothesis geformuleerd:

(4) Beklemtoonde voor-voorlaatste monoftongen en diftongen zijn korter dan beklemtoonde voorlaatste monoftongen en diftongen.

Uit het experiment bleek dat de duur van alle opgemeten doelsegmenten (monoftongen, glides en klinkergedeeltes van stijgende diftongen en gehele stijgende diftongen) varieert in functie van klemtoon en woordlengte. Hoewel de absolute duurwaardes van lange klinkers en stijgende diftongen aanzienlijk verschillen, blijken de waardes opmerkelijk overeen te komen wanneer ze worden omgerekend in relatieve duur (een percentage van de hele woordduur). Er is dan ook geen verschil meer tussen 'mobiele' en andere diftongen. De hypothese dat lange klinkers even lang zijn als de 'mobiele diftongen' werd dus bevestigd. De verwachting dat de 'mobiele diftongen' qua duur moeten worden onderscheiden van de andere diftongen en van lange klinkers (hypotheses 2 en 3) kwam echter niet uit. Op basis van de nieuwe empirische gegevens kon ook worden vastgesteld dat de voorspelde duurverschillen in voorlaatste en voor-voorlaatste lettergrepen (hypothese 4) afhankelijk zijn van de totale woordduur eerder dan van lettergreeppositie. In vierlettergrepige woorden bedraagt de duur van beklemtoonde klinkers en diftongen ongeveer 1/4 van de totale woordduur, terwijl in drielettergrepige woorden deze waarden oplopen tot 1/3 van de totale woordduur. Uitgaande van deze data werd een formule gepresenteerd (§ 3.4.2) waarmee een grove berekening van de absolute duur van beklemtoonde klinkers en diftongen kan worden gemaakt: de totale woordduur in milliseconden wordt gedeeld door het aantal lettergrepen in het woord. De formule beregelt ook de verhouding tussen de glide en het klinkergedeelte in stijgende diftongen. Deze verhouding wordt namelijk nagenoeg constant gehouden: 1:3 voor [jV]-diftongen en 1:4 voor [wV]-diftongen. Met deze formule kon de variatie in nucleusduur van beklemtoonde lettergrepen in 47,7% van de onderzochte gevallen juist worden voor-

[111] In beide studies worden de twee klemtooncondities met elkaar vergeleken in woorden die verschillen in het aantal lettergrepen.

speld, terwijl voorspellingen op basis van de lineaire positie van deze lettergrepen in het (prosodische) woord slechts in 34,3% van de gevallen juist bleken te zijn.

Vanuit een fonologische invalshoek werd het effect van klemtoon op de duur van klinkers, glides en volledige diftongen geanalyseerd als een strategie om aan een nieuw voorgestelde conditie op lettergreepstructuur te voldoen: het *weight-to-stress*-principe – 'indien zwaar, dan beklemtoond' – en het *stress-to-weight*-principe – 'indien beklemtoond, dan zwaar' – werden ondergebracht onder één enkele conditie $\acute{\sigma}_{\mu\mu}$ (§ 5.4.4). Gelet op de identieke reactie van monoftongen en diftongen op de aanwezigheid van klemtoon, werd voorgesteld dat zij beide bimoraïsch zijn in beklemtoonde open lettergrepen en monomoraïsch in andere contexten. Er zijn fonotactische argumenten en argumenten op basis van de bevindingen van het duurexperiment om aan te nemen dat Italiaanse onglides thuishoren in de nucleus. Ofwel komen output glides overeen met glides in de input (hetgeen het geval is in 'mobiele diftongen') ofwel komen ze aan de oppervlakte ten gevolge van een glidevormingsproces. Dit proces is gevoelig voor de aanwezigheid van klemtoon; het treedt alleen op in onbeklemtoonde lettergrepen. Een sequentie van twee klinkers wordt als een hiaat gerealiseerd indien één van de twee klinkers klemtoon krijgt, bijv. ['viː.a], [vi.'aː.le] vs [vja.'let.to]. Klemtoongevoelige klinker–diftong alternantie wordt beregeld door de noodzaak om tegelijkertijd te voldoen aan condities op lettergreepstructuur, $\acute{\sigma}_{\mu\mu}$ en ONSET, én positionele getrouwheidscondities (*positional faithfulness constraints*), d.w.z. condities die gerelativeerd zijn voor prominente contexten, zoals beklemtoonde lettergrepen (§ 5.4.5).

De resultaten van de variatieanalyse worden gepresenteerd in hoofdstuk 4. Hieruit blijkt dat er in 70% van de bestudeerde woordparen geen monoftong–diftong-alternantie is (79% voor de voorklinkers en 55% voor de achterklinkers). Voor nonsenswoordparen is dat 90% (100% voor de voorklinkers en 87% van de achterklinkers). Deze gegevens duiden erop dat de laatste fase van een taalverandering nagenoeg bereikt is. Deze verandering kan als volgt worden gereconstrueerd. In gesproken laat-Latijn (of in het taalstadium dat onmiddellijk voorafgaat aan Toscaans Italiaans) waren alle middenklinkers monoftongen. Tegen het midden van de zevende eeuw kwam hierin een verandering toen de lage middenklinkers werden gediftongeerd in beklemtoonde lettergrepen. Vermoedelijk resulteerde deze verandering in een relatief stabiele situatie waarin de regel van de 'mobiele diftong' min of meer zonder uitzonderingen werd toegepast. Vanaf de zestiende eeuw kwam een tweede fase in deze taalverandering op gang. De diftongering werd analogisch uitgebreid naar de niet-beklemtoonde lettergrepen. Deze uitbreiding trof aanvankelijk de woorden met voorklinkers, maar later ook de woorden met achterklinkers die verwant zijn met basiswoorden (met de beklemtoonde diftongen) via productieve en voorspelbare morfologische processen (o.a. inflectie van regelmatige werkwoorden, suffixering van *–mente/–issimo*). Onbeklemtoonde klinkers in semantisch transparante afleidingen veranderden in een later stadium, terwijl onbeklemtoonde klinkers in woorden die niet op een transparante wijze met de gediftongeerde basisvorm verwant zijn, resistent waren voor de verandering omdat dit soort woorden gelexicaliseerd werd met de monoftong. Op dit moment lijkt de tweede fase van het diftongeringsproces nagenoeg voltooid voor de voorklinkers en bijna voltooid voor de achterklinkers.

Om de hypotheses omtrent het verdwijnen van de monoftong–diftong-alternantie in gesproken Italiaans te toetsen, werd een objectieve experimentele methode ontwikkeld. Spraakdata werden verkregen door middel van een *phoneme restoration*-taak waarbij gebruik gemaakt werd van de *speech shadowing*-techniek. Door de proefpersonen te laten 'shadowen', kon worden gegarandeerd dat de foneemrestauratie onder een zekere tijdsdruk gebeurde en dat de data vrijwel spontaan werden geproduceerd.

In hoofdstuk 6 werd getracht de analogische uitbreiding van de diftongen naar onbeklemtoonde lettergrepen te 'verklaren': wat was de oorzaak en waarom in deze richting en niet andersom, d.w.z. uitbreiding van de monoftongen naar de beklemtoonde lettergrepen? Hiervoor werd teruggegrepen op een theorie van Wetzels (1981): niet-productieve alternanties worden door sprekers gelexicaliseerd en het is aannemelijk dat dergelijke alternanties worden geëlimineerd door de kracht van analogie, omdat ze anders het geheugen van sprekers teveel zouden belasten. Met deze beweringen als uitgangspunt werden twee verschijnselen vanuit een OT-perspectief onderzocht: (1) niet-transparante alternanties en (2) analogische verandering.

Het eerste verschijnsel wordt in § 6.2 benaderd aan de hand van een model dat ontwikkeld werd door Rubach en Booij (2001). In dit model voorspelt OT dat de monoftong–diftong-alternantie, die in traditionele generatieve grammatica's geanalyseerd werd als het resultaat van een monoftongerings- of diftongeringsregel, geheranalyseerd moet worden als een verschijnsel van gemengde, fonologische én morfologische allomorfie. Dit betekent dat de allomorfen verschillende, minder abstracte maar arbitraire inputvormen hebben en dat de distributie ervan beregeld wordt door de rangschikking van universele condities. Een belangrijke rol wordt daarbij gespeeld door condities op welgevormdheid (*markedness constraints*) voor het selecteren van de ongemarkeerde allomorf.

Om het tweede verschijnsel te behandelen, werd een poging ondernomen om de theorie van Rubach en Booij te verzoenen met McCarthy's (2005) *Optimal Paradigms*-model (OP). OP is eigenlijk een formalisering van onze intuïtie dat er binnen een paradigma een zekere druk tot uniformisering ontstaat waardoor alternanties binnen dat paradigma worden voorkomen (*paradigm uniformity*, zie § 6.3.1). Een OP-aanpak bleek echter niet geschikt te zijn om de diachronische feiten te verklaren: *waarom* vond er uniformisering plaats en *waarom* in deze richting? Om die reden heb ik een alternatief voorstel gedaan waarin een centrale rol is weggelegd voor *Lexicon Optimization* (§ 6.3.4). Wanneer sprekers een taal leren, heranalyseren ze abusievelijk de meervoudige inputallomorfen van onregelmatige paradigma's als een enkelvoudige input, naar analogie van regelmatige paradigma's. Deze nieuwe input heeft de fonologische structuur van de vorm die als basis fungeert in het inflectionele of derivationele paradigma, waarmee de richting van de analogische verandering wordt verklaard. Een troef van mijn voorstel is dat er een belangrijk inzicht aan ten grondslag ligt, namelijk dat analogische verandering niet een louter fonologisch effect is, maar vooral ook beschouwd moet worden als een morfologisch effect dat het gevolg is van de manier waarop paradigma's worden geleerd door sprekers (Albright 2005*a*,*b*).

Riassunto (summary in Italian)

"È una regola che non è mai riuscita a trovar pace nella lingua italiana, e che finalmente, la trova, come pare, nella morte." Così Franco Fochi conclude le sue osservazioni relative al destino della regola del dittongo mobile, nella sua guida normativa allo scrivere e al parlare (1969:86). Fin dal Seicento i grammatici e lessicografi italiani si avvalgono del termine *dittongo mobile* quando si riferiscono ai dittonghi ascendenti [jɛ] e [wɔ], storicamente derivati dalle vocali medie accentate [ɛ] e [ɔ] del tardo latino. Questi dittonghi si alternano con monottonghi corrispondenti appena l'accento si sposta a un'altra sillaba per effetto di un'operazione morfologica. Alcuni esempi sono: *s**e**diàmo* vs *s**iè**di* e *m**o**viménto* vs *m**uò**vo*.

Da fonti scritte risulta che già nel Cinquecento i dittonghi mobili si estesero erroneamente alle sillabe non accentate, ad esempio *s**ie**derò* e *m**uo**viàmo*, per analogia con le forme con dittongo accentato. Questo mutamento per analogia ha generato molte variazioni, poiché l'alternanza monottongo–dittongo è stata mantenuta in certi casi ed eliminata in altri. Questo fenomeno si osserva ancora nei testi letterari del Novecento: un'autrice come Grazia Deledda scrive sia *moveva* che *muoveva* e *scoteva* accanto a *scuoteva*, ma anche in altri testi letterari si riscontrano numerosissimi esempi simili (v. van der Veer 2001). Ciò non toglie che ancora oggi la famosa regola sia prescritta in dizionari di stampa recente e difesa da un certo numero di puristi, fra cui Gabrielli (1956, 1976).

Pochi sono gli studi fonologici dedicati al problema dei dittonghi mobili. Saltarelli descrive l'alternanza monottongo–dittongo come l'effetto di una regola di monottongazione: in certi contesti dei dittonghi sottostanti emergono in superficie come monottonghi. Sluyters (1992) fa il primo passo verso una spiegazione del fenomeno: la sua analisi gli ha permesso di affermare che la lingua italiana presenta un attivo processo di dittongazione che, come l'allungamento vocalico, si manifesta in sillaba aperta accentata, allo scopo di creare un piede ritmico ben formato. In fondo, questa analisi suggerisce che i dittonghi mobili siano gli equivalenti fonologici delle vocali lunghe in sillabe aperte accentate.

Lo scopo di questa dissertazione è triplice: (1) rivelare gli aspetti di durata dei dittonghi e monottonghi italiani sulla base di un esperimento di produzione; (2) realizzare un esperimento di produzione efficace che permetta di verificare fino a che punto l'alternanza monottongo–dittongo si manifesti nell'italiano moderno *parlato* e (3) sviluppare un'analisi fonologica dei risultati degli esperimenti nel quadro della Teoria dell'Ottimalità (*Optimality Theory* o OT).

Il terzo capitolo riferisce i risultati dell'esperimento riguardante la durata di vocali e dittonghi. Punto di partenza per questo esperimento era l'opinione di Sluyters (1992) secondo cui i dittonghi mobili si riscontrerebbero nello stesso contesto delle vocali lunghe. Inoltre Sluyters ritiene che l'approssimante in un dittongo mobile formi parte del nucleo sillabico e che quello di altri dittonghi ascendenti si sillabifichi, al contrario, come elemento della testa sillabica.

(1) Le vocali lunghe sono lunghe quanto i dittonghi mobili;
(2) I dittonghi mobili sono più brevi degli altri dittonghi ascendenti;
(3) I dittonghi 'non-mobili' accentati sono più lunghi delle vocali lunghe.

Siccome altri studi sperimentali hanno dimostrato che la vocale accentata in parola parossitona è significativamente più lunga di quella in parola proparossitona (Farnetani e Kori 1990 e D'Imperio e Rosenthall 1999)[112], si è formulata una quarta ipotesi:

(4) I monottonghi e dittonghi in parole proparossitone sono più brevi di quelli in parole parossitone.

Dall'esperimento risulta che la durata di tutti i segmenti fonici misurati (monottonghi, approssimanti, porzioni vocaliche dei dittonghi ascendenti e dittonghi completi) varia in funzione di accento tonico e lunghezza della parola. Benché per le vocali lunghe e i dittonghi ascendenti i valori di durata assoluta divergano notevolmente, i valori risultano notevolmente convergenti una volta convertiti in durata relativa (percentuale della durata globale della parola), indicando l'uguaglianza fra dittonghi mobili e 'non-mobili' . Di conseguenza si è confermata l'ipotesi che la durata delle vocali lunghe e quella dei dittonghi mobili siano identiche. Non ha trovato invece conferma la tesi che i dittonghi debbano essere distinti dagli altri dittonghi e dalle vocali lunghe per quanto riguarda la loro durata (ipotesi 2 e 3). Sulla base di nuovi dati empirici si è inoltre potuto verificare che le presunte differenze di durata nei parossitoni e proparossitoni (ipotesi 4) sono in funzione della durata globale della parola piuttosto che della posizione della sillaba. In parole quadrisillabiche le vocali e i dittonghi accentati occupano circa 1/4 della durata della parola, mentre questi valori ammontano a 1/3 nel caso delle parole trisillabiche. Sulla base di questi esiti si è presentata una formula (§ 3.4.2) che permette un calcolo approssimativo della durata assoluta delle vocali e dei dittonghi accentati: la durata globale della parola si divide per il numero di sillabe contenute nella parola. La formula regola anche il rapporto tra approssimante e porzione vocalica in dittonghi ascendenti. Infatti questo rapporto è praticamente stabile 1:3 per i dittonghi del tipo [jV] e 1:4 per quelli del tipo [wV]. Questa formula ha consentito di predire la durata dei nuclei sillabici accentati correttamente nel 47,7% dei casi esaminati, mentre invece le predizioni sulla base della posizione lineare della sillaba si sono rivelate corrette solo nel 34,3% dei casi.

Da un'angolatura fonologica l'effetto dell'accento tonico sulla durata delle vocali, degli approssimanti e dei dittonghi completi si è analizzato come una strategia volta a soddisfare una condizione di buona formazione sillabica: questa condizione, $\acute{\sigma}_{\mu\mu}$ (v. § 5.4.4), si è proposta come una 'condizione ombrello' che coprisse due principi finora adottati separatamente: il principio del *weight-to-stress* – 'la sillaba pesante si accenta' – e quello dello *stress-to-weight* – la sillaba accentata è pesante. Visto che sia monottonghi che dittonghi reagiscono in modo uguale alla presenza

[112] In ambedue gli studi gli effetti della posizione dell'accento si confrontano in parole che si differenziano in numero di sillabe.

dell'accento, si è proposto che fossero ambedue bimoraici in sillabe aperte accentate e monomoraici in altri contesti. Ci sono argomenti fonotattici e argomenti basati sugli esiti del primo esperimento in favore della teoria che gli approssimanti prevocalici italiani formino parte del nucleo sillabico. Un approssimante nell'output corrisponde a un approssimante nell'input (come nei dittonghi mobili) oppure si manifesta in superficie come il risultato di un processo di 'approssimantizzazione' (*gliding*). Questo processo è sensibile alla presenza dell'accento tonico: si verifica soltanto in sillabe disaccentate. Una sequenza di due vocali si realizza come uno iato qualora una delle due vocali riceva l'accento, per esempio ['viː.a], [vi.'aː.le] vs [vja.'let.to]. L'alternanza monottongo–dittongo sensibile all'accento è regolata dal conflitto tra condizioni di buona formazione sillabica, $\acute{\sigma}_{\mu\mu}$ e ONSET, e condizioni di fedeltà posizionale (*positional faithfulness constraints*), vale a dire condizioni relativizzate a contesti prominenti, fra cui la sillaba accentata (§ 5.4.5).

Il quarto capitolo presenta i risultati dell'analisi di variazione, da cui emerge che nel 70% delle coppie di parole esaminate manca l'alternanza monottongo–dittongo (il 79% per le vocali anteriori e il 55% per quelle posteriori). Per le coppie di pseudoparole questa percentuale ammonta al 90% (100% per le vocali anteriori e il 87% per quelle posteriori). Questi dati dimostrano che l'ultima fase di un cambiamento linguistico si è pressoché compiuta. Il cambiamento si potrebbe ricostruire come segue. Nel tardo latino parlato (o nello stadio linguistico immediatamente precedente al toscano) tutte le vocali erano monottonghi. Verso la metà del VII secolo si effettuò un cambiamento dal momento in cui le vocali medio-basse si dittongarono in sillaba accentata. Probabilmente questa modifica risultò in una situazione relativamente stabile in cui la regola del dittongo mobile si applicava praticamente senza eccezioni. Nel Cinquecento prese il via la seconda fase del cambiamento. La dittongazione si estese analogicamente alle sillabe disaccentate. Inizialmente questa estensione colpì soltanto le vocali posteriori, ma dopo anche quelle posteriori, in parole imparentate con parole di base (con dittongo accentato) tramite processi morfologici produttivi e prevedibili (fra cui la flessione dei verbi regolari, la suffissazione di *–mente/–issimo*). Le vocali disaccentate in derivazioni semanticamente trasparenti cambiarono in uno stadio successivo, laddove quelle in derivazioni non trasparenti resistettero al cambiamento, poiché questo tipo di parole erano lessicalizzate con il monottongo. Attualmente la seconda fase del processo di dittongazione si rivela sostanzialmente compiuta per le vocali anteriori e quasi compiuta per le vocali posteriori.

Per testare le ipotesi circa l'eliminazione dell'alternanza monottongo–dittongo nella lingua parlata, si è sviluppato un metodo sperimentale obiettivo. Gli enunciati si sono elicitati mediante un compito di *phoneme restoration* (restauro di fonemi) in combinazione con la tecnica dello *speech shadowing*. I tempi minimi concessi per le risposte hanno fatto sì che il restauro presentasse i necessari requisiti di spontaneità.

Nel sesto capitolo ho tentato di spiegare l'estensione analogica dei dittonghi alle sillabe disaccentate: qual è la causa e perché in questa direzione e non viceversa, ossia estensione dei monottonghi alle sillabe accentate? Ci si è basati su una teoria di Wetzels (1981): le alternanze non produttive sono lessicalizzate dai parlanti ed è plausibile che tali alternanze siano eliminate dalle forze analogiche, essendo una zavorra per la memoria dei parlanti. Da queste osservazioni si sono prese le mosse

per analizzare due fenomeni nel quadro dell'OT: (1) le alternanze opache e (2) i cambiamenti analogici.

Il primo fenomeno viene trattato nel § 6.2 alla luce di un modello sviluppato da Rubach e Booij (2001), in cui l'OT predice che le alternanze monottongo–dittongo, che grammatiche generative tradizionali analizzano come il risultato di una regola di dittongazione oppure di monottongazione, vadano rianalizzate come un caso di allomorfia fonologicamente e morfologicamente mista. Ciò siginifica che gli allomorfi hanno diverse forme sottostanti nell'input che sono arbitrarie ma meno astratte e che la loro distribuzione è regolata dall'ordinazione delle condizioni universali. Un ruolo importante è riservato alle condizioni di buona formazione (*markedness constraints*) per la selezione dell'allomorfo non marcato.

Al fine di trattare il secondo fenomeno, si è tentato di riconciliare la teoria di Rubach e Booij con il modello degli *Optimal Paradigms* (OP) di McCarthy (2005). In essenza, OP è la formalizzazione della nostra intuizione che dentro un paradigma sorga una certa pressione verso l'uniformità, evitando alternanze dentro quel paradigma (*paradigm uniformity*, v. § 6.3.1). Tuttavia OP non è risultato appropriato per spiegare i fatti diacronici: *perché* vi è quella tendenza all'uniformità e *perché* nella direzione attestata? Per questi motivi si è presentata una proposta alternativa in cui un ruolo centrale è riservato all'ottimalizzazione del lessico (*Lexicon Optimization*, v. § 6.3.4). Quando i parlanti imparano una lingua, rianalizzano erroneamente i vari allomorfi sottostanti di paradigmi irregolari come un input semplice (un solo allomorfo) per analogia con i paradigmi regolari. Questo nuovo input presenta la struttura fonologica della forma che svolge la funzione di base nei paradigmi flessivi e derivazionali, e ciò spiega la direzione del cambiamento analogico. Un vantaggio della nuova proposta è che permette di confermare l'importanza di un principio di base: il cambiamento analogico non è un mero effetto fonologico ma va considerato innanzitutto come un effetto morfologico che è il risultato della maniera in cui i parlanti imparano paradigmi (Albright 2005*a*,*b*).

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Curriculum vitae

Bart van der Veer was born on 11 July 1968 in The Hague and graduated from *S.G. Spieringshoek* in Schiedam in 1986. From 1986 to 1990 he studied nursing in Delft, after which he decided to exchange his nurse's cap for his true passion: languages. He received a propaedeutic degree in Greek and Latin Languages and Cultures at Leiden University (1992, *cum laude*) and a Master's degree in Translation Studies (Dutch, French, Italian and Danish) at the *Hoger Instituut voor Vertalers en Tolken – Hogeschool Antwerpen* (*HIVT-HA*, 1992 *cum laude*). In 1999, this same institute hired him as a junior lecturer in Italian linguistics and translation. One year later he was accepted to prepare a doctoral thesis at the Leiden University Centre for Linguistics as an external PhD candidate. From 2000 to the present, he has combined this doctoral research with his teaching activities at *HIVT,* where he has been coordinating the Italian department since 2004. He is also a member of the editorial board of *Linguistica Antverpiensia New Series*, a journal devoted to the study of language, translation and culture. His interests include modern architecture, underground stations, singing and Italy: its culture and – needless to say – its food.

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