ARTUR KIJAK

LABIAL-DORSAL INTERACTIONS

A Phonologically Based Approach

WYDAWNICTWO
UNIWERSYTETU ŚLĄSKIEGO
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Preface and Acknowledgments

Over the past several decades, there has been a huge increase in the number of studies of the consonantal place features. This has brought about the accumulation of a large amount of new evidence and knowledge, and in consequence has contributed to a prevailing view that place features are one of the best studied areas in phonology. What is more, there is little disagreement about the major regions of labial, coronal, dorsal, radical, and laryngeal. However, a closer look at this idyllic picture reveals some cracks, and it turns out that there are still numerous problems calling for explanation. For instance, it has been repeatedly pointed out that even though the major division of consonants into classes is well established, some sounds do not appear to fit neatly into these categories, such as, labio-dentals, which involve both a labial and a coronal component, and some gutturals, which pattern with both dorsals and radicals, not to mention the continuing debate around the nature of the coronal sub-places. One such particular problem will be made the object of investigation in the present study. Specifically, this book seeks to offer an explanation for the phonological patterning of two articulatorily distant consonant classes: labials and dorsals. In this way, it contributes to the broader discussion of segmental phonology or, more exactly, to the issue of the consonantal place features. It must be clarified right at the outset that in this study the term dorsal is used to cover velars and uvulars only. Other dorsal consonants, such as radicals (guttural consonants) and laryngeals, are not included in the following discussion, and so they are only briefly mentioned when appropriate.

The deep complexity of the issue is caused by the curiously unique character of the labial-dorsal mutual interactions, in that they involve a radical change in the place of articulation. More frequent sound changes, by contrast, involve a change only in the manner of articulation, for example, [p] > [f], or possibly a change to an adjacent place of articulation, for instance, palatalization. Labial-velar changes also distinguish themselves from other changes because they can take place in both directions. Furthermore, the relationship between labials and dorsals is frequently manifested indirectly via various apparently unrelated processes, such as vocalization, gliding, epenthesis, and diphthongization. It follows that a discussion of the mutual interactions between labials and dorsals must encompass vocalic segments. The inevitability of this move is dictated by the high frequency of the processes in which labial vowels interact with dorsals.

The explanation of the intimate triangular relationship of labials, dorsals, and rounded vowels inescapably leads to a discussion of the internal structure of segments and, more generally, to the decision on the theoretical model which can best capture this relationship. There are several decisive factors making Element Theory an optimal choice for the task ahead of us. These factors include the ability to capture the vowel-consonant unity and the cognitive character of the primes, among many others. Element Theory is a model of segmental structure which rejects feature definitions based on articulation or raw acoustics. Instead, it holds that "the mental representation of speech sounds is constituted not of tongue heights, (…) nor of formant heights, nor for that matter of basilar stimulation points. Rather it is constituted of information-bearing patterns which humans perceive in speech signals" (Harris and Lindsey 2000: 186). Moreover, this model assumes that phonological behavior can say more about segmental structure than phonetic (articulatory and acoustic) details. It means that the phonological classes of segments are modelled on linguistic behavior, which does not always coincide with place of articulation labels, like palatal, labio-dental, and so on. As Backley (2011: 105) points out, it is "feature theories in which a particular articulatory feature is universally associated with a particular phonological place category. This may be sufficient for describing articulation, but it does not tell us much about phonology." This stance explains the meaning of the phonologically based perspective adopted in this study and contained in its title. In short, the intrasegmental structure is established on the basis of a segment's phonological behavior rather than on its acoustic properties. And since it is frequently the historical data we look at in the following discussion, the "phonological approach" suits perfectly the analysis of the sound systems of some earlier stages in language development. Finally, the present study adopts the view that phonological representation is organized by a series of alternating non-branching onsets and nuclei characteristic of the Strict CV version of Government Phonology (Lowenstamm 1996; Scheer 2004; Cyran 2010).

A preliminary hypothesis is that the key to understanding the phonological activity of velars and their common interactions with labials and round vowels lies in their internal structure. And it is the representation of velars which has always bothered phonologists. This has led to the appearance of two main phonological camps. The representatives of one group assume velars to be defective segments in that they are either negatively specified (classical Generative Phonology) or empty (Radical CV Phonology). On the other hand, the proponents of the opposite view, such as Roman Jakobson, Alastair Cambell, David Oden, Robert Vago, and John Anderson, maintain that velars do contain the phonological material in the form of a relevant prime. Interestingly, Element Theory (ET) practitioners are divided into two camps, too. According to the dominant group (e.g., John Harris, David Huber), velars are devoid of any place definers, while the opposition group holds that velars are specified for such primes (Judith Broadbent, Phillip Backley). The findings in this study place us in the group of the proponents of the latter view. Note further that the discussion of the internal structure of segments in general and the content of velars in particular right from the beginning disqualifies certain theoretical models. This is the case of, for example, Optimality Theory (OT), which is first of all a theory of phonological alternations and as such does not impose any restrictions on possible phonological representations. Since, in principle, it could be combined either with the abstract features used in the Sound Pattern of English (SPE) and feature geometry, or with concrete phonetic specifications, or, as the case may be, with both of them at the same time, it is not an optimal candidate for the analysis of the internal structure of segments.

The book is organized into three chapters, which can be approached either separately or as a self-contained whole. Readers who are interested in segmental phonology and the formal solutions proposed for the representation of phonological segments over recent decades are referred to Chapter One. This chapter is also addressed to those who might be seeking better formal tools to solve the labial-dorsal relationship puzzle and ways to compare it with the previous models. Chapter Two is to be thought of as a data repository containing cross-linguistic data. It may prove useful for those who are looking for labial-dorsal related phenomena. Additionally, since it is theoretically neutral, the data in Chapter Two can be used as a testing ground by younger researchers. Finally, Chapter Three offers a representation for velars and tests it against a selected group of cross-linguistic processes. A part of Chapter Three is based on my earlier published work (Kijak 2009, 2010, 2014 and 2015), which has been thoroughly revised and expanded for the purposes of this book. This chapter is addressed to all those interested in the formal analysis of the labial-dorsal interactions within the Element Theory model and those who look for the solution of particular phonological phenomena. Finally, it is hoped that this book can also be of help for students who are interested in the development of segmental phonology in general and Element Theory in particular. Needless to say, the central theme which threads all three chapters is the phonological patterning of labials and dorsals.

I wish to thank all my friends and colleagues who have contributed to the appearance of this book. I am especially grateful to Rafał Molecki for his invaluable advice, encouragement, critical reading of the manuscript, and detailed comments. I would like to thank the reviewer, Eugeniusz Cyran, for his helpful comments on and constructive criticism of the preliminary draft. I would also like to thank David Schauffler and Krystyna Warchał for helping me to eliminate linguistic imperfections. All remaining errors are my own.

Finally, I would like to thank my wife Katarzyna for her patience and support, and my daughter Martyna, who is still teaching me how to overcome great adversities in life.

Chapter One

Labials and dorsals in cross-theoretical perspective

1. Preliminaries

It is rather trivial to note that a serious scholarly enterprise aiming to explore a linguistic problem should begin with a perusal of all the available previous analyses and solutions. Still at the preparatory stage, a researcher has to decide whether they want to devote some space to discussing the previous solutions or right away set about presenting a new proposal with only a couple of footnotes referring the reader to the past studies. While the latter strategy is usually adopted in articles, the former one is commonly applied in large-scale works, like books and dissertations. Since the present study is a book-length analysis, we have decided to devote the first chapter to a short presentation and critical discussion of those proposals that turned out to be the most valuable and influential contributions to the issue. One of the advantages of this research strategy is that it will help us realize the significance of the dilemma that has preoccupied researchers' minds for decades now and which we are going to grapple with in the rest of the book. The discussion we are going to briefly outline in Chapter One concerns the phonological representation of two articulatorily distant consonant classes: labials and dorsals (with the emphasis on velars).

Apart from various doubts concerning the appropriate representation of both classes, there exists, side by side, another highly problematic fact: although articulatorily distant, labials and dorsals pattern phonologically on a massive, cross-linguistic scale. This observation has quite a long history in the literature; the phonological patterning of labials and dorsals is a well-known and hotly debated issue, present in phonological circles at least since Jakobson, Fant and Halle (1952). Despite this long tradition, however, the efforts to formally capture this relatedness have always caused some difficulties.

Therefore, the present chapter aims at a brief presentation and discussion of selected models which have contributed to the understanding of the internal structure of labials and dorsals and their phonological patterning. The discussion centers on research studies published within the past few decades and across various theoretical models. The chapter is organized as follows. Section 2 provides a short overview of the history of segmental phonology meant to highlight the fact that the study of the intrasegmental structure has always been one of the most important issues in phonological investigation. Subsection 2.1 narrows down the discussion to the representation of major places of articulation in various segmental studies. This part is designed to serve as a background for a more detailed discussion of labials and dorsals and their mutual interactions. It is pointed out there that a study of the selected place features must encompass not only the whole system, including vowels and consonants, but also other consonant classes. Section 3 briefly outlines the representation of labials and dorsals in classical distinctive feature theories, starting with Jakobson et al. (1952) (Subsection 3.1) and Chomsky and Halle (1968) (Subsection 3.2). After a short comparison of both models, Subsection 3.3 provides an overview of the critical discussion which swept through the articulatory based models in the 1970s. This part pinpoints the major design flaws of the Sound Pattern of English (SPE) articulatory-based feature theory. Section 4 elaborates on both the major repair solutions applied to the orthodox SPE feature theory (geometry models) and totally new proposals, like Dependency Phonology and acoustic studies. Subsection 4.1 discusses feature geometry models, characterized by segment-internal feature organization arranging distinctive features into a tree hierarchy. It is pointed out that such models contribute significantly to the explanation of vowel-consonant interactions. This subsection critically discusses two competing models: Sagey's (1986) Articulator Theory and Clements and Hume's (1995) Unified Feature Theory. Subsection 4.2 is devoted to the critical discussion of two models which stand in sharp opposition to the SPE-type frameworks, namely Dependency Phonology and its direct continuation, Radical CV Phonology. Both of them descend into abstractness in that they shift away from articulatory-based features to single-valued components. Subsection 4.3 outlines various acoustic studies and auditory experiments, including confusion laboratory studies. These auditory-acoustic investigations concentrate on the speech signal in an attempt to establish the primitives of segmental structure. In this subsection, the models are looked at through the prism of labials and velars which share some acoustic properties. While useful in phonetic description, such properties cannot explain labial-velar interactions simply because acoustic studies are still characterized by the lack of a one-to-one correspondence between the acoustic signal and the phonological segments that human beings perceive. Finally, Section 5 introduces the fundamentals of Element Theory (ET), a model which completely replaces the traditional binary features with a set of monovalent cognitive elements. Since this is the approach adopted for data analysis in further chapters, its basics are discussed in greater detail. Section 5 serves as an introduction to the theory, followed by a more specific discussion concerning the representations of labials and dorsals made by numerous contributions to development of the model. Thus, Subsection 5.1 outlines the early proposal put forward by Kaye et al. (1985, 1990). Their proposal is further developed by Harris and Lindsey (1995), who propose the neutral element for the representation of velars (Subsection 5.2). Other solutions for the representation of velars include van de Weijer (1996) (Subsection 5.3) and Scheer (2004) (Subsection 5.4). The idea that velars are empty-headed, currently the mainstream ET solution, culminates in the study of Huber (2007b) (Subsection 5.5). However, we will maintain that neither this solution nor the ones proposed earlier within the ET model can formally capture the interactions in question. Finally, Subsection 5.6 presents a thorough discussion of Backley's (2011) model. It is illustrated on the example of the English vocalic and consonantal system with the purpose of providing a solid foundation for further empirical and theoretical analysis in the following chapters. Section 6 recapitulates the findings of Chapter One.

2. Segmental phonology

Growing criticism and dissatisfaction with the fundamentals and the general architecture of the phoneme-based models led in the 1950s to the instigation of a new phonological program which replaced phonemes with features. This change marks the birth of a new phonological era which is characterized by the development of distinctive feature theories. Features were announced to be the basic building blocks that play the key role in phonological description, including class affiliation and processing.

The origins of the feature theory go back to Trubetzkoy's (1939) study of oppositions between speech sounds. His ideas were later picked up and developed by Jakobson, who proclaimed a new research model known widely as the distinctive feature theory. Jakobson et al. (1952) assumed that features were mostly binary and were modelled on the human vocal tract shared by all language users (which makes the model universal). The major task of the feature theory was to narrow down segmental contrasts to a small number of feature contrasts.[1] Soon it turned out that features not only could help to define lexical contrasts but, perhaps even more importantly, could also be used to formulate phonological rules. This new role of features becomes evident in Generative Phonology, a model in which distinctive features are assigned both a phonetic and a phonological function. While the phonetic function describes the articulatory and acoustic properties of speech sounds, the phonological function is supposed to classify speech sounds into natural classes. In short, the explana-

[1] Similar achievements in phonology were gained by American researchers, among others by Hockett (1947) and Bloch (1950), who developed their own versions of the feature theory.

tory role of distinctive features have extended in that they could not only define contrasts but also account for sound affiliation and phonotactic restrictions in a fast-growing body of phonological data (Mielke 2011).

It is an ordinary course of events that during their early phase of formulation theoretical models can suffer from some design flaws. In the development of a theory, however, such flaws are often eradicated, corrected, or patched up. This was the case with the feature theory too; the almost immediate criticism that swept through it led in consequence to various modifications and refinements proposed during the 1960s by Morris Halle and James McCawley, among many others. Excluding some radical solutions which aimed at complete replacement of the feature theory, exemplified by Peter Ladefoged's early publications, most researchers simply proposed a new set of features, for instance, Schane (1973), who argues for perceptual correlates of features along with the articulatory and acoustic ones. However, one of the most influential modifications was the replacement of Roman Jakobson's acoustically-based features by the articulatory-based ones carried out by Chomsky and Halle's (1968) *The Sound Pattern of English* (SPE). This rather unexpected change had far-reaching implications for subsequent segmental studies in that the articulatory features dominated segmental models for the next several decades.

A number of revised or totally new phonological theories are rooted in the traditional SPE model in that they still make use of articulatory-based features, for example, various feature geometry models, Lexical Phonology or, more recently, Optimality Theory. On the other hand, along with the development of purely articulatory models of segmental phonology, like SPE and feature geometry (Clements 1985, 1991; Sagey 1986), more abstract models relying on monovalent particles or elements were proposed, like Dependency Phonology (Anderson and Ewen 1987), Particle Phonology (Schane 1984), and Government Phonology (Kaye et al. 1985, 1990). Additionally, the opposite perspective has been chosen by those researchers who look for the building blocks of segmental structure in the speech signal, that is, in theories which are acoustically and perceptually oriented, for instance, Motor Theory of Speech Perception (Liberman et al. 1967; Liberman and Mattingly 1985), Direct Realist Theory of Speech Perception (Fowler 1981, 1984, 2003), or Auditory Enhancement Theory (Diehl and Kluender 1989; Diehl et al. 1990) (see Section 4.3).

The purpose of this short overview of the history of segmental phonology is to emphasize the fact that the study of the internal structure of segments has always been one of the most important issues in phonological investigation. And that the search for the set of phonological primes and the constant revision of their character is definitely worth the effort. This view becomes evident when we browse through the phenomena that are currently being discussed in phonological literature. One hotly debated topic concerns vowel-consonant interactions. Indeed, processes like vowel-triggered palatalizations, which cause the addition of a secondary articulation, the shift in primary place from the velar to coronal place, common interactions between low vowels and uvulars and/or pharyngeals, and the relation between round vowels and labial consonants are of great interest in modern phonology. The ongoing debate can be illustrated by the divergent views on consonant-vowel interactions (see van Oostendorp and van de Weijer 2005). Thus, while some researchers argue for a unified representation of consonant and vowel place – for instance, Clements and Hume (1995) and Harris and Lindsey (1995) – others, such as Padgett (2002), opt for distinct place features for consonants and vowels, and Flemming (2002) postulates the necessity of both articulatory and auditory features to account for consonant-vowel interactions. Another widely discussed issue is the patterning of the articulatorily distant consonant classes, as exemplified by the labial-dorsal phonological interactions, which are the main subject of the present study. Note that both the examples of phonological interactions illustrated above have always been a good testing ground for feature theories and have contributed much to both the development of the traditional approaches and the construction of totally new theories.

Let us summarize the present section with a quotation from van Oostendorp and van de Weijer (2005), who in the introduction to *The Internal Organization of Phonological Segments* write:

> there are still many interesting questions to be asked on segmental structure, (…) there is quite a lively debate on many of the issues concerned, (…) and the field is far from monolithic in its methodological approach (…). (van Oostendorp and van de Weijer 2005: 2)

Finally, as mentioned above, we largely subscribe to the opinion that the status of the phonological primes which constitute the formal apparatus of a theory should be subjected to constant verification and scrutiny. Moreover, since in recent studies we notice a growing interest in nasal and laryngeal features,[2] the chief aim of the present study is to examine place features. More specifically, in this book we investigate the internal structure and phonological patterning of labials and dorsals. Note that the decision to discuss this topic is not dictated by the fact that place features have been neglected in past research. Quite the opposite; as mentioned in the preface, consonantal place features are perhaps best examined of all features. The impetus for this book arises from the observation that relatively little effort has been dedicated to the explanation of the consonant cross-class interactions that encompass consonant-vowel patterning.

[2] Some recent book-length studies of nasality include Ploch (1999), Botma (2004), and Nasukawa (2005). Laryngeal features have been discussed, among others, in Honeybone (2005); Strycharczuk (2012), and Cyran (2014).

Therefore, in the remainder of this chapter we discuss the representation of labial and dorsal place features from the cross-theoretical perspective. This will help us to decide whether there exists a possibility to modify or supplement the theory of segmental structure in such a way as to explain the phonological patterning of two major consonantal classes in question, namely, labials and dorsals. We start the discussion with a general introduction to studies preoccupied with place features.

2.1 Major place features

This section includes some general remarks about the major place features, which will serve as background for a more detailed discussion of labials and dorsals and their mutual interaction.

There is a general consensus across segmental theories concerning the existence of the major places of articulation. For example, Ladefoged and Maddieson (1996: 44) recognize five place labels: labial, coronal, dorsal, radical, and laryngeal. Similarly, Sagey (1990) and Halle et al.'s (2000) (Revised) Articulator Theory distinguishes labial, coronal (tongue blade), dorsal (tongue body), and tongue root or radical places of articulation. Finally, Element Theory (Harris and Lindsey 1995) (see Section 5.2) identifies four places: labial, palatal, coronal, and velar. It follows that despite some minor differences, segmental theories basically recognize the same major place features. Note that all such theories propose separate features to represent labials and dorsals/velars. This view remains mostly unchallenged as it is based on robust evidence that labials and dorsals have radically different articulatory properties.

Furthermore, it is pointed out (Rice 2011: 529) that generally it is dorsals that cause more problems than any other class. For instance, it is common for dorsals to overlap with palatals. In response, a dorsal class has been argued to include several sub-places, such as palatal, velar, and uvular (Ladefoged and Maddieson 1996: 44). This is dictated by the fact that palatal, velar, and uvular consonants use the tongue body rather than the blade as the active articulator. By the same token, the traditional view according to which the palatal label represents a single class has been challenged. This, in consequence, has contributed to different classifications of palatals. Thus, while Chomsky and Halle (1968) classify palatals as non-coronals, Hall (1997) demonstrates some phonetic and phonological evidence for the need to divide palatals into two groups. Briefly, Hall (1997) points out that German fricatives [ç x χ] are in complementary distribution, which may suggest that they share a common feature. Hence, German palatal fricatives are classified as dorsal and are further differentiated by sub-places. Other palatals, on the other hand, are a type of coronal. Finally, a still different view is advocated by Hansson (2010), who points out that dorsal harmony involves only velars and uvulars; hence, only these sub-places should be included in the dorsal class. It follows that despite the general agreement on the major place features detectable in segmental theories, there is an ongoing debate over various interactions among such places of articulation. As for the latter, there are two opposite approaches found in the literature. One supports the view that there is no relationship between the places of articulation. The second argues the contrary, pointing out that some of the places of articulation do enter into a closer relationship with each other. The second approach is not unanimous and is further divided into two camps. As Uffman (2011: 648) observes, one camp assumes that labials and dorsals, to the exclusion of coronals, are grouped together under the feature [grave] or [peripheral] (e.g., Rice 1993; Rice and Avery 1993). The other camp maintains that just because coronals and dorsals, to the exclusion of labials, are specified by the feature [lingual], they should constitute a phonological class (e.g., Rubach 1993; Keyser and Stevens 1994; Lombardi 1996). Additionally, Uffman (2011: 648) points out that the third possibility, which groups together coronals and labials by means of the feature [anterior], has been criticized and finally discarded by most researchers. Crucially for us here, while there exists a large body of robust evidence for an intimate relationship between labials and dorsals (e.g., Jakobson et al. 1952; Jakobson and Halle 1956; Hyman 1973; Campbell 1974; Odden 1978; Rice 1994; Hall 1997, among many others), the class of coronals and dorsals is much less motivated: the evidence comes mostly from consonant-vowel interactions. The above findings are repeatedly confirmed by various new databases which inform us of a close intimacy between labials and velars. For example, Backley and Nasukawa (2009: 6) point out that the UPSID database (UCLA Phonological Segment Inventory Database) records 60 languages with labialized velars but only 2 with labialized coronals.

It should be mentioned here that even though the discussion concerning the interaction of places of articulation and their grouping into classes has always been present in the literature, much of the work has been done within the feature geometry framework (see Section 4.1). However, in recent years, along with the development of new segmental theories, this issue gained a new impetus. It is present even in Optimality Theory (OT) (Prince and Smolensky 1993), which, in principle, is a theory of phonological alternations and linguistic variation rather than a theory of the internal structure of segments; in OT the representation of phonological primitives is mostly dismissed. But even these rare OT attempts point to the conclusion that dorsals and labials, to the exclusion of coronals, are grouped together. For example, de Lacy (2006) proposes markedness constraints on the place of articulation. As a result, his faithfulness constraints, that is, **dorsal* >> **dorsal, labial* >> **dorsal, labial, coronal* >> **dorsal, labial, coronal, laryngeal*, support the view of a closer relation between labials and dorsals in that the class including both types of segments is ranked high in the constraint hierarchy, and thus it is relatively rarely violated.

Finally, note that the complexity of the phonological patterning of articulatorily distant classes and the difficulty in explaining the issue have made some researchers come to a negative conclusion. Ladefoged (2005), for instance, admits that the features which are needed to explain numerous segmental contrasts generate more classes than are actually found in natural language. Flemming's (2005) OT analysis of natural classes ends with the remark that the restrictions on the set of segments which pattern together follow from the nature of the set of universal constraints rather than from the feature set. Similarly, Mielke (2008) argues that many classes involved in sound patterns simply cannot be defined by the generally recognized features. He proposes to solve this impasse by distinguishing a phonologically active class which is feature independent from a phonetically natural one – a class of sounds that share one or more distinctive features. Mielke (2008) argues further that this split is dictated by the illusion created by most segmental theories that articulatory classes are implicitly equated with phonologically active classes.

In our search for the solution to the labial-dorsal interactions, we definitely oppose the above-mentioned pessimistic approach. However, it has now become evident that a discussion which aims at the explanation of the phonological patterning of labials and dorsals must include other major place features. This seems inevitable, because apart from labials, velars are also reported to interact with other dorsal consonants, palatals and, to a much lesser extent, with coronals, too.

The remainder of this chapter provides an overview of available representations of labials and dorsals put forward by various past and present theories of segmental structure. We start with the distinctive feature theory and the acoustic feature [grave] introduced by Jakobson et al. (1952).

3. Labials and dorsals in classical distinctive feature theories

3.1 Auditory-acoustic features (Jakobson, Fant and Halle 1952)

In its early version, the feature theory proposed just twelve distinctive features, which were defined mostly in auditory-acoustic terms, that is, from the hearer's point of view. Although the acoustic underpinning of features was recognized as a dominant one, there was also a smaller group of features which possessed articulatory correlates (Jakobson at al. 1952; Jakobson and Halle 1956). This set of distinctive features was believed to be sufficient to cover all cross-linguistic contrasts.

Jakobson et al. (1952) do not refer to the places of articulation in a direct way; they are derived by means of the combination of a bundle of features rather than perceived as the primitives of phonological structure. It means that the places of articulation are simply the result of the combination of the acoustic features [grave]/[acute] and [compact]/[diffuse]. Labials and velars, which are specified by [grave], are formed with a large undivided oral resonant cavity, resulting in a relatively low frequency region of prominence in their acoustic spectrum in contradistinction to dentals and palatals [acute], which are formed with an oral cavity divided into two smaller resonators, resulting in a relatively high-frequency region of spectral prominence. On the other hand, velars and palatals [compact] are distinguished from labials and dentals which are defined as [diffuse]. The latter two features, that is, [compact] and [diffuse], describe how acoustic energy is distributed across the spectrum. In [compact] sounds, which include low vowels and back consonants, energy is concentrated in the center of the spectrum, whereas in [diffuse] sounds, including high vowels and front consonants, energy is more widely distributed. Crucially, this solution allows for the integrating of two articulatorily distant groups of sounds within one class; for instance, labials and velars are defined by the same acoustic feature [grave].

In a nutshell, early feature theory distinguishes four major place categories with [grave] grouping labials and velars and [diffuse] grouping labials and dentals. Sub-place distinctions are captured with the stridency feature. However, the use of auditory-acoustic features came to a rather unexpected halt after the appearance of SPE, which replaced them with the set of articulatory features.

3.2 Articulatory features (Chomsky and Halle 1968)

Unquestionably one of the most influential contributions to the development of phonological theory was Chomsky and Halle's (1968) *The Sound Pattern of English*. The importance of their work can be assessed by the profound impact it has made upon current phonological models in that the universal feature set proposed in SPE is still being used by various theories of segmental structure. As for the feature theory, the authors of SPE revised the Jakobsonian system (Jakobson et al. 1952; Jakobson and Halle 1956) and, without providing any particular reason, replaced auditory-acoustic features with articulatory ones; the basic ideas, though, remained largely unchanged. This change can be illustrated with the example of resonance features, which were redefined in articulatory terms. For example, the opposition [grave]/[acute] in consonants is replaced by the articulatory feature [coronal] in that [−coronal] corresponds to [grave]. Moreover, palatal consonants, previously grouped with dentals under [acute], are moved to the class defined by the same feature [−coronal]. Later on, palatals were moved back to the [+coronal] group, while [grave] vowels became [+back]. Similarly, the opposition [compact]/[diffuse] in consonants is replaced by the feature [anterior] in that the value [+anterior] in consonants (e.g., for labials and dentals) corresponds to [diffuse]. The feature [anterior] further distinguishes interdental and dental/alveolar from alveo-palatal and retroflex sub-places. Finally, the feature [strident] distinguishes bilabial and labio-dental continuants from interdental and dental/alveolar continuants, while [distributed] distinguishes coronal sub-places. Without going into too much detail, SPE introduces two main consonantal place features: [anterior] and [coronal], which can be supplemented with vocalic features [high], [low], [back], and [round].

Another difference between Jakobson et al. (1952) and SPE is that while the former explicitly used the same features for consonants and vowels, SPE recognizes typically consonantal and vocalic place features: [coronal]/[anterior] vs. [high]/[low]/[back]. In consequence, vowels and consonants are basically represented by separate features. For example, the vowel [u] and the oral stop [k] obtain the following representations (1).

(1) Feature matrices in SPE

$$
\begin{array}{llll}
\text{[u]} & & \text{[k]} & \\
\text{+syllabic} & & -\text{syllabic} & \\
\text{+sonorant} & & -\text{sonorant} & \\
-\text{consonantal} & & \text{+consonantal} & \\
\left.\begin{array}{l}\text{+high}\\ \text{+back}\\ \text{+round}\\ \text{+tense}\\ \text{etc.}\end{array}\right\} & \text{vocalic} & \left.\begin{array}{l}-\text{anterior}\\ -\text{coronal}\\ -\text{continuant}\\ -\text{voice}\\ \text{etc.}\end{array}\right\} & \text{consonantal}
\end{array}
$$

What distinguishes consonants from vowels, as depicted in (1) above, is the major class features. However, in order to give a full specification of segments, the matrices must be supplied with the relevant consonantal or vocalic features. Thus [u] in (1) above is defined by vowel features such as [back] and [round], whereas [k] contains features such as [continuant] and [voice].

Furthermore, as mentioned above, the theory predicts a situation in which vowel place features support consonantal features. This is the case in the representation of secondary articulation and certain place distinctions, like palatals and dorsals (velars, uvulars, and pharyngeals). As for the secondary articulation, vowel place features are responsible for palatalization, velarization or pharyngealization. Moreover, just because consonants are commonly affected by palatalization and velarization in the vicinity of front and back vowels, respectively, it is argued that the place of articulation of palatal and velar consonants is the same as that of high front and high back vowels respectively. The same holds true for other dorsals in that their place of articulation depends on the frontness or backness of neighboring vowels. It follows that the acoustic feature [sharp], which defines palatalized consonants in the Jakobsonian system, is replaced in SPE by the combination of vocalic features [+high, −back]. The vocalic feature [high] is also used to represent velars and velarized segments, which are specified as [+high, +back]. This means that the specification [+high] is assigned to both palatal and velar consonants, and the latter are additionally specified as [+back]. The same feature, that is, [high], is responsible for the distinction between velars [+high] and uvulars [−high]. Furthermore, pharyngeals and pharyngealization, previously defined by the acoustic feature [flat], receive the specification [+low, +back]. Finally, the feature [round] is used for rounding in vowels, and for labialization in consonants. What matters most to us, however, is that in SPE the acoustic feature [grave] is replaced with articulatory features. This shift is responsible for the following correspondences between the two models (2).

(2)	*Jakobson et al. (1952)*	*SPE (1968)*
labials	[+grave]	[+anterior, −coronal]
velars	[+grave]	[−anterior, −coronal] [+back, +high]
back vowels	[+grave]	[+back]
front vowels	[−grave]	[−back]

Since both velars and vowels are specified by the same (vocalic) features, it is argued that what differentiates them is that in the articulation of consonants the tongue rises high enough to constrict or block the air flow.

Apart from strong criticism of particular solutions proposed by Chomsky and Halle (1968), which will be discussed in the immediately following section, the very core of the SPE feature theory, namely, articulatory-based features, has come under heavy fire. For example, it has been pointed out that the inability to articulate speech is basically not a barrier to perceiving speech. It simply means that successful language acquisition must be based on perception. This is a natural consequence of the observation that people with some physical abnormalities preventing them from speaking are still able to acquire a normal grammar. On the other hand, people with various perceptual problems, for example, those who are profoundly deaf and do not perceive language via an auditory-acoustic input, are not able to develop native-like spoken language. Backley (2011: 4) points out that this simple fact proves that speech perception is more fundamental to the development of grammar than speech production. And this, in turn, supports the idea developed by Jakobson et al. (1952) to define features in acoustic rather than in articulatory terms.

3.3 SPE under fire and post-SPE advancement

Chomsky and Halle's (1968) feature theory has provoked strong criticism at both the conceptual and empirical level. A point that has received many critical comments concerns the idea of representing vowels and consonants by entirely disparate sets of features. In consequence, a large number of researchers, such as Reighard (1972), Campbell (1974), Smith (1988), Pulleyblank (1989), and Clements (1991, 1993), among many others, have postulated the need to introduce a unified set of place features for these two categories. Recall that in Jakobson at al. (1952), consonants and vowels are represented by the same set of primitives. In the latter model, high, back (rounded) vowels and labials are both [+grave], while high, front (unrounded) vowels and coronals both share the [+diffuse] feature. However, the whole idea of consonant-vowel relatedness was thrown out with the bathwater when SPE replaced acoustic features with articulatorily-based ones; hence, this move is often described as a "retrograde step," for example by Smith (1988: 234). In the previous section, we have seen that in SPE the interaction between vowels and consonants boils down to a mere addition of the vocalic place features, like [high], [low], and [back], to the primary consonantal place features, that is, [anterior] and [coronal]. This solution is problematic since it precludes a direct interaction of vowels and consonants. For example, SPE is basically unable to make a natural connection between vowel rounding [+round] and consonant labiality [+anterior, −coronal] simply because these segments are specified by different features and this, in turn, gives the false impression that labiality and rounding have nothing in common. Campbell (1974) is far more specific on this matter, pointing out that, on the grounds of SPE, there is no reason why labial consonants should cause vowels to become [+round] or why consonants should become labial in the environment of round vowels. In short, SPE does not provide any explanation for the naturalness of such rules and sound changes, which is part and parcel of the incompatible representation of [+round] vowels (or glides) and [+anterior, −coronal] labial consonants. Furthermore, it is not possible for labials to interact with labialized consonants (including velars) as again they are represented by different features, and so they must be perceived as purely accidental changes.

What has proven seriously problematic for SPE is the very fact that there exist large amounts of data of cross-class relationships which escape explanation in terms of articulatory-based features. For example, SPE represents the dorsal group of sounds basically by vocalic place features, but the interaction between these features and dorsals remains problematic. Even worse, velars are represented as [+back], that is, non-anterior, non-coronal consonants, while palatalized consonants are specified by [–back]. This entails that palatalized velars should be represented as [+back, –back], a combination which must be ruled out as an articulatory absurdity. A similar problem is indicated by Campbell (1974), who points out that it is impossible for SPE to rule out a contrast between palatalized and non-palatalized palatals. More recently, Backley (2011: 179) notes that even though velars and laterals interact in various systems, their interaction cannot be captured in feature theories like SPE, as they simply have little in common. Thus, while velars are defined as [−anterior, −coronal], laterals receive the specification [+anterior, +coronal]; moreover, velars are also [+high, +back] whereas laterals are (redundantly) [−high, −back]. Some other inadequacies concern the inability of [anterior] sounds to pattern as a natural class (see Dixon 1980; Gnanadesikan 1994) and vice versa, the lack of a particular feature which would bring together guttural consonants, that is, uvulars, pharyngeals, and laryngeals (see McCarthy 1991).

Summing up the discussion so far, we have seen that the major problem encountered in SPE with respect to the cross-class sound interactions, including those of vowels and consonants, and the representation of segments with secondary articulation is the specification of consonants and vowels by means of basically separate sets of place features. Much research since the introduction of SPE has been devoted to providing solutions to such weaknesses. In particular, great effort has been made to propose a model with a uniform set of place features for vowels and consonants. Evidence for this view comes, for instance, from syllable structure constraints ruling out particular consonants and particular vowels (see Hume 1992).

The acoustic feature [grave] (see Section 3.1) deserves a separate note. Recall that in the pre-SPE feature theory (Jakobson at al. 1952), it is possible to group velars and labials together into one natural class. Thus, segments such as [p k f], for example, can be isolated by the feature specification [+grave, −voice], but a group containing [p k s] cannot and hence does not constitute a natural class. In other words, Jakobson's feature framework is able to capture labials, velars, and back vowels by means of the feature [+grave] and distinguish them from palatals, dentals, and front vowels, which are defined as [−grave]. In SPE, however, the acoustically motivated feature [grave] is replaced by two articulatory features: [anterior] and [coronal]. This shift almost immediately stirred up strong criticism. For example, Ladefoged (1972) maintains that the acoustic similarity between velars and labials and their morphophonemic relationship could be explained only if the feature [grave] or a similar one is revived. Others, such as Anderson (1971) and Reighard (1972), propose introducing a new feature [labial] and in this way hope to account for common labial-velar interactions. One of the serious consequences of the [−labial, −coronal] specification of velars, however, is that they are given an equal chance to interact with both labials and coronals. In a feature model which recognizes [labial] and [coronal] as the major place features, such interactions receive a natural interpretation as they simply boil down to the acquisition of a positive setting for [−labial] or

[−coronal]. This observation, however, is unfounded cross-linguistically as velars interact more readily with labials than with coronals. Campbell (1974) also examines the possibility of introducing new features, like [labial] and [palatal], to the model. The addition of new features, however, is frequently burdened with the overgenerative power of the model, that is, it makes possible the creation of unnatural classes and predicts rules which are not attested in a natural language. On the other hand, Lass and Anderson (1975) argue that the feature [grave] is undoubtedly better suited for the explanation of the historical velar to labial shifts in OE than the unrelated specifications of velars and labials in the Chomsky and Halle (1968) system. By the same token, Hickey (1984b) maintains that any phonological framework must provide theoretical tools to describe the relationship of labials and velars. He adds that even though the need to reintroduce the feature [grave] is strongly postulated (e.g., Sommerstein 1977; Davidsen-Nielsen and Ørum 1978, among others), no attempt is made to explain the labial-velar interrelation with the exception of Ladefoged (1972). Hickey (1984b) arrives at a negative conclusion, pointing out that most analyses boil down to the simple observation that labials and velars interact or that there is some sort of connection between them (see Schane 1973). The attempt to revive the feature [grave] is very symptomatic as it demonstrates the inability to explain common cross-class interactions in articulatory-based models. Moreover, it proves that not all phonological processes are articulatory-based assimilations, as some of them can be based on acoustic similarity as well. Durand (1990: 63), for example, argues that well-attested phenomena that relate labials and velars cannot be explained in the articulatory-based feature theory as there is no affinity between the lip gesture which defines labials and the rising of the back of the tongue towards the velum, which defines velars. In order to solve this problem, Durand (1990) argues for the need to recognize the feature [labial] as distinct from [round].[3] The feature [labial] stands for constriction at the lips as opposed to the protrusion of the lips associated with [round]. These two articulatory gestures, he argues, must be kept apart. The representation of the major place features proposed by Durand (1990) is given in (3) below.

(3) Major places of articulation in post-SPE feature theory:

labials:	[+labial, −coronal]
coronals:	[−labial, +coronal]
velars:	[−labial, −coronal]

[3] It is Anderson (1974) who proposes two distinct features, that is, [round] and [labial], in response to some critical comments that different muscular mechanisms are involved in the production of labial consonants, round vowels, and glides.

In the feature theory discussed by Durand (1990), velars are marked [−labial, −coronal] which simply means that they are, just like in SPE, defined negatively. In other words, they lack any relevant place of articulation which could be positively specified in feature-based analyses. This is a typical situation which is found in SPE-based feature theories. As we have seen above, it is also the case in much later developments of the SPE approach, like that of Durand (1990). It must be emphasized here that SPE-based models do not recognize an independent [velar] place feature in their inventory; we can find [coronal] with a later addition of [labial], but no feature makes reference to [velar]. Huber (2007b) points out that the closest one can get to the velum in features is [velaric] mentioned by Durand (1990: 58), which is anyway an extremely controversial airstream mechanism. As can be seen, what undermines the traditional SPE solutions for segmental representations is not only the inability to explain common patterning of labials and velars in phonological processes but also some difficulty in the specification of velar consonants. When confronted by this type of dilemma, some researchers (e.g., Blevins 2004; Mielke 2008, forthcoming) choose an extreme solution. As mentioned in Section 2.1 above, instead of patching up and revising the articulatory-based feature theory in order to capture a mismatch between phonologically active classes and the features used for lexical contrast, they argue for an alternative model. This predicts phonological classes which are involved in sound patterns in terms of common sound changes affecting more than one segment. The phonetic parameters which define these classes do not necessarily correspond directly to the parameters that are needed to contrast segments from one another (Mielke 2011).

In response to the above-mentioned weaknesses, the mainstream feature theory, on the other hand, subjected the inventory of features to critical scrutiny again. One of the directions of development involves a revision of the number of values possessed by features. Sagey (1986), for example, proposes that place features are privative (have only one value). The privative approach, in turn, forced the researchers to introduce an independent feature which could define velars. For example, in Clements and Hume's (1995) system, we can find three privative place features [Labial], [Coronal], and [Dorsal]. This direction was further developed by Dependency Phonology (see Section 4.2) and Element Theory (Section 5). However, it was Autosegmental Phonology (Goldsmith 1976, 1990) which contributed most to the development of contemporary privative models and the gestural approaches. Autosegmentalism called into question the linearity of phonological representations (Chomsky and Halle 1968), proposing instead a hierarchical structure of phonological specifications (non-linear approach). In other words, Autosegmental Phonology contributed to a new understanding of a phonological segment. It consists in the replacement of an unordered matrix of distinctive feature values with a hierarchical, three-dimensional display of the segment. In the latter approach, features rest on their own tier and form planes with features to which they are autosegmentally associated (Goldsmith 1976; Clements 1985; Sagey 1986). This new autosegmental perspective on phonology triggered further advancements in feature theories, which wound up with the instigation of feature geometry models. It is to proposals regarding the representation of segments in geometric models that we turn next.

Summing up, we have seen that places of articulation are not directly encoded in the classical feature theories. Moreover, in articulatory-based models, velars are defined as [−anterior, −coronal], which means that no independent feature is assumed which could define velars positively. Even in later developments of SPE, that is, when the importance of the active articulators is acknowledged (e.g., Durand 1990), the velar place of articulation is defined negatively as the absence of both lip-rounding and the rising of the tongue body [−labial, −coronal]. It has been repeatedly stressed that, among many other things, it is the representation of velars which proves problematic for articulatory-based models. In response, some researchers propose to modify the model, while others attempt to revive the acoustic feature [grave]. However, as pointed out by Huber (2007b), the latter solution is not an optimal candidate either as the specification of [grave] crucially does not change in labial-velar alternations. Finally, as Backley (2011) argues, an optimal theory of segmental structure should assume that phonological segments are represented:

> in a way which favours neither the speaker nor the hearer, but rather, captures the linguistic knowledge common to both. This means focusing on the speech signal, which acts as an intermediary between the origin of a sound (the vocal organs of the speaker) and its target (the auditory system of the hearer). (Backley 2011: 4)

This means that neither the [grave] nor the [labial] feature is predisposed to capture labial-velar interactions, and both are doomed to failure. Since neither the Jakobsonian nor the SPE model recognized the place feature elements per se, one of the directions of development of articulatory models was to introduce consonantal constriction features, such as the lower lip [labial], the tongue blade [coronal], the tongue body [dorsal], the tongue root [radical], and the vocal folds [laryngeal], which, as time passed, evolved into privative autosegments in feature geometric structures.

4. Labials and dorsals in contemporary theories

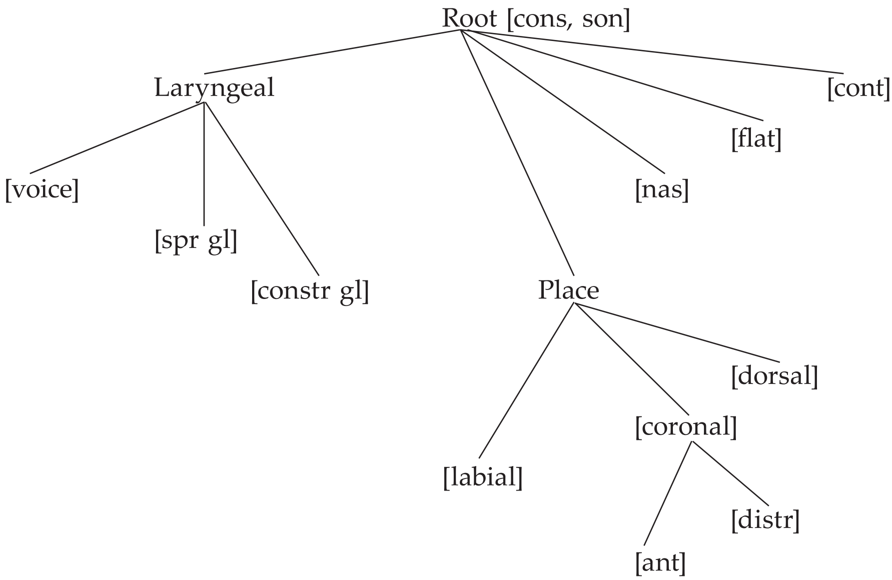
4.1 Feature geometry

This section briefly discusses the models of segment-internal feature organization which, unlike the SPE-like matrix format, arrange distinctive features into a tree hierarchy. When compared to classical distinctive feature theories described above, the hierarchical perspective is a step forward as it works towards the explanation of both consonant-vowel unity and consonant cross-class interactions. For obvious reasons, we will not go into a detailed presentation of major principles of feature geometry; instead, we focus on the discussion of place features, in particular labials and dorsals. Moreover, since the analysis in Chapter Two and Three will encompass not only labial-velar interactions but also the relationship of these categories with vowels and glides, we devote some space in this section to discussing the feature geometry view on consonant-vowel relationship.

As Uffmann (2011: 643) notes, the idea of the hierarchical structure of features was already present in Chomsky and Halle (1968). More specifically, although SPE perceives segments as bundles of unordered distinctive features, its authors envisage that "ultimately the features themselves will be seen to be organized in a hierarchical structure" (Chomsky and Halle 1968: 300). As more data were accumulated, it became evident that phonological processes rarely targeted just a single feature, but rather several at the same time. Furthermore, it was realized that the feature sets affected by various processes were not random but recurred cross-linguistically, and what was more, they shared some phonetic properties. In response to these observations, feature theory came up with the idea that distinctive features were organized hierarchically into groups characterized by similar articulatory properties and by common participation in phonological processes. It other words, the logic behind grouping features under a class node is twofold. While phonological behavior supports the grouping of features that spread or delink together, articulatory phonetics assures that features which share articulatory properties, like place of articulation or laryngeal specifications, likewise should be grouped into a constituent in the hierarchy.

In feature geometry models, all distinctive features are contained within a tree-like structure. Moreover, the segment-internal hierarchical organization of features assumes that the latter reside on different tiers, which is indicated by drawing features at different heights in tree representations. This is illustrated in the tree under (4), which represents the basic feature geometry structure. Furthermore, since features are assumed to function as autosegments, phonological processes are reduced to just two operations. As alluded to previously, both features and nodes can be linked or delinked. For example, the spreading of place features independently of other features is a clear indication that they are grouped under a common node, as in (4) below.

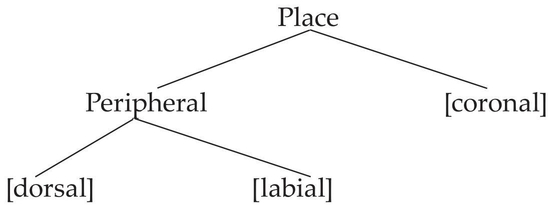
(4) A basic feature geometry (Uffmann 2011: 647)



The structure of the feature geometry tree in (4) has undergone several changes and modifications.[4] However, in what follows we concentrate only on those developments that are directly relevant to our discussion, namely, the ones that concern the Place node. Thus, Keyser and Stevens (1994), Clements and Hume (1995), and Hume (1996) argue that the Place node should be further subdivided to contain the Lingual node, which groups [coronal] and [dorsal] together. Others, such as Halle (1992, 1995), indicate that gutturals (uvular, pharyngeal, and laryngeal segments) should be attached as a separate Guttural node under the Laryngeal rather than the Place node. According to a still different proposal (Avery and Rice 1989; Rice 1994), [labial] and [dorsal] features, which correspond to the traditional feature [grave], are grouped together under the Peripheral node. In the latter solution, the Peripheral node, which is subordinate to the Place node, is further divided into [dorsal] (representing velar consonants) and [labial] (representing labial consonants). The feature [coronal], on the other hand, is directly dominated by the Place node. This situation is represented in (5), where only the relevant part of the tree hierarchy is provided.

[4] For a detailed discussion of the history and development of feature geometry models, see, for example, Uffmann (2011).

(5) Modification of the Place node (Rice 1994)

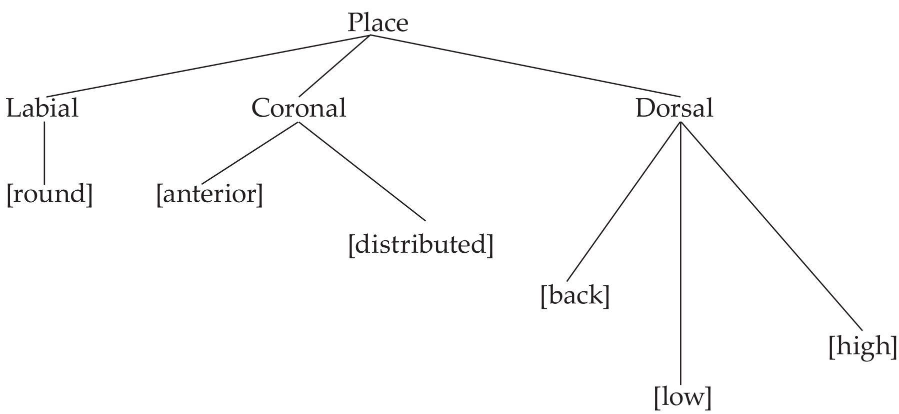


Note that the Peripheral node makes it possible to refer to non-coronals as a group without having to involve the negative feature [−coronal]. This is a step forward when compared to the SPE solution, as it allows the grammar to describe processes which target labials and velars but not coronals.

Another direction of development of the basic feature geometry tree in (4) concerns the unified representation of vowels and consonants. It was realized that since consonants and vowels interact with great frequency, they should be built with the same material. However, two opposing principles can be employed in establishing unified features for both classes. The first is based on articulation, while the other on phonological patterning. These two directions of the search for the unified features resulted in the development of two main versions of feature geometry models: Articulator Theory (see Sagey 1986; Halle 1992, 1995; Halle et al. 2000; Avery and Idsardi 2001) and Unified Feature Theory (e.g., Hume 1990, 1992, 1996; Clements 1991; Odden 1991, 1994; Clements and Hume 1995). While the former holds that the feature tree is grounded in articulation, in the latter priority is given to phonological behavior.

To put it differently, in Articulator Theory the grouping of features in the geometry is based on articulatory considerations. The feature tree in this model assumes the following structure, illustrated in (6) below.

(6) Place node in the Articulator Theory, adapted from Uffmann (2011: 650)



One of the innovations Articulator Theory has introduced into the feature geometry is that the features [coronal, labial, dorsal] are promoted to class node status (6). The representation of place features proposed by feature geometry is a significant improvement when compared to the one in SPE. Recall that in the latter model, two binary features [coronal] and [anterior] defined four primary places of articulation: labial, coronal, palatal, and dorsal. In Articulator Theory, the class nodes Labial, Coronal, and Dorsal function like monovalent features, which makes this model inherently more restrictive. As for the weak points, Articulator Theory assumes that vowel features are distributed across the overall geometry, depending on the articulator with which they are executed. This means that the features which use the tongue body as the active articulator, that is, [high, low, back], are dominated by the Dorsal node; Labial dominates [round]. Note that the features [ATR, RTR] have not been depicted in (6) above simply because they are dependents of the Tongue Root node, which itself is a daughter of the Guttural node dominated by the Root. This solution for the representation of vowel features received severe criticism (e.g., Odden 1991), as it was not able to explain why vowel features formed a homogenous group in phonological processes. In other words, Articulator Theory makes incorrect predictions concerning the phonological behavior of vowel features. For example, it predicts a situation in which the features [high, low, back], to the exclusion of [round], spread together. What creates this scenario is the assumption that the former features belong to the Dorsal node, but the latter one is dominated by the Labial node. The problem is, however, that the above situation is either rare or downright impossible in phonological processes. Even worse, Odden (1991) shows that just because [back] and [round] are dominated by different class nodes, it is not possible for them to spread simultaneously in one single operation, which is a common phonological phenomenon, anyway. It follows that the main criticism directed at Articulator Theory is based on the observation that in assigning features to a particular group it relies only on articulatory considerations, neglecting phonological patterning. Odden (1991) proposes to remedy this shortcoming by the introduction of the V-Place node which groups together all vowel features. Corroborating evidence in his account comes from both phonological patterning and phonetic similarity. The latter, though, is grounded in acoustics and perception, rather than articulation.

The same idea lies behind Clements and Hume's research program of constriction-based feature geometry (Hume 1990, 1992, 1996; Clements 1991; Clements and Hume 1995). Like Odden (1991), they assume two distinct nodes, that is, the V-Place and the C-Place node. However, the breakthrough innovation in their proposal consists in the replacement of vowel features by consonantal place features. To put it differently, they redefine the traditional vowel place features, like [back, round, low], in terms of consonantal place features (7). This redefinition is a consequence of the cross-linguistic observation of the intimate phonological relationship between consonants and vowels evidenced by, for example, the interaction of round vowels with labial consonants, or back vowels with velars.

(7) The unified features (Clements and Hume 1995)

[labial]	–	labial consonants and rounded vowels
[coronal]	–	coronal consonants and front vowels
[dorsal]	–	velar consonants and back vowels
[pharyngeal]	–	pharyngeal consonants and low vowels

As depicted in (7), consonants and vowels are defined by the same place features, whose phonetic realization depends on the affiliation, that is, whether they are dominated by the C-Place or the V-Place node. One of the unquestionable advantages of the Unified Feature Theory over SPE is that the former is able to provide a more coherent and logical explanation of the vowel-consonant interaction. Aside from its important contribution to segmental study, Unified Feature Theory suffers from some weaknesses, too. For example, it has been pointed out that the unified features offered by this model could describe only place properties (see Uffmann 2011). This is the consequence of the articulatory perspective adopted by Clements and Hume (1995). Since articulatory properties other than place are not usually shared between consonants and vowels, a feature system with unified place features must additionally use non-unified features in order to describe other segmental properties. Interestingly, feature geometry, just like its SPE predecessor much earlier, stumbles over the same persistent problem – the representation of vowels. While geometrical models take a step forward by proposing unified features for consonants and vowels, they still cannot handle the simple fact that articulatorily diverse groups of vowel features form phonological constituents, for instance, vocalic features [back] and [round]. More generally, the two main organizing principles of feature geometry mentioned above, namely, articulatory similarity and phonological patterning, do not always match up perfectly. As Uffmann (2011) observes, even though the basic structure of the geometry remains fairly uncontroversial, there are various incompatible proposals concerning the details of feature organization. Therefore, in the mid-1990s, there was growing skepticism about feature geometry's abilities to reach the goal of finding a universal hierarchy of features; and this in consequence led to a shift in interest from feature geometry to a totally new model – Optimality Theory.

The advent of Optimality Theory in the 1990s (Prince and Smolensky 1993) revived hopes and infused researchers with enthusiasm. Much work has been done towards finding out whether the feature-geometric dilemmas could be solved more accurately within the constraint-ranking theory. However, as already mentioned in Section 2.1, OT is firstly a theory of violable constraints and only secondly, a theory of representation. It follows that any theory of segmental structure can be made compatible with OT. Moreover, the main principles, according to which representations should be as simple as possible and cross-linguistic generalizations should follow from constraint interaction only, moved OT, at first, back to SPE times, that is, to unordered feature matrix format. Recently we can observe a return to the question of feature organization in OT, for instance in Flemming (2005), de Lacy (2006), and the serial versions of OT, such as Harmonic Serialism (McCarthy 2008a) or Candidate Chain theory (McCarthy 2007a, 2007b). McCarthy (2008b), for example, adopts two signal achievements of autosegmental phonology, namely, privative features and tier independence, as a component of Optimality Theory. However, there are two major points which disqualify OT as a potential candidate for the analysis of the internal structure of labials and velars (or any segment, for that matter). These are, firstly, the lack of any coherent theory of representation within OT and, secondly, the unresolved question of the division of labor between phonological representations and phonological operations.

Summing up, the advances in autosegmental phonology and the growing demand for the unified representation of vowels and consonants have led to the development of various feature geometry models designed with the aim of providing a universal organization of distinctive features. The motivation for a hierarchical organization of features is manifold. Among others, it includes economy, which assures that spreading or delinking of a whole group of features can be captured as a single operation, and class behavior, which explains why some features (often articulatorily distant) consistently behave as a natural class, cross-linguistically. As for the explanation of vowel-consonant interactions, two competing models have evolved: Sagey's (1986) Articulator Theory and Clements and Hume's (1995) Unified Feature Theory. The two approaches make quite different predictions. In the former approach, major consonant places dominate vowel features, that is, Labial dominates [round] in vowels, while Dorsal dominates [back], [high] and [low]. In the latter approach, on the other hand, consonant and vowel places are defined by the same set of features: [labial, coronal, dorsal] for both consonants and vowels. Finally, in recent years, there have been some attempts to combine the results achieved by feature geometry with a model of violable constrains. However, neither feature geometry nor Optimality Theory account can be finalized, as both theories make the erroneous assumption that the description of phonological segments is based on articulation – a direct inheritance from SPE times. Therefore, in what follows we look at some alternative proposals to the distinctive-feature theories, starting with Dependency Phonology. This model employs a measure of abstraction in that it shifts away from (phonetic) articulatory-based features to (phonological) unary components.

4.2 Dependency Phonology

Dependency Phonology (DP) (Anderson and Ewen 1987; Smith 2000) is a model which has been evolving parallel to feature geometry but which stands in sharp opposition to the mainstream development of the SPE-type frameworks in that it is basically a theory of phonological representations. Like other approaches to phonological representation contemporary with DP, such as Particle Phonology (Schane 1984, 1995), Government Phonology (Kaye et al. 1985, 1990) and Radical CV Phonology (van der Hulst 1989, 1995), it presents a proposal for a set of basic (unary) building blocks of phonological segments, often referred to as components, and for their relationship within segments.[5] In order to motivate the set of components and their combinability, DP is driven mainly by contrastivity but at the same time aspires to express minor, non-contrastive phonetic differences, which occur both cross-dialectally and cross-linguistically. DP agrees with some versions of feature geometry (Odden 1991; Clements and Hume 1995) in that it bases its arguments for the adoption of components on phonological processes. At the same time, however, it argues, contrary to feature geometry, for single-valued features (components) only, which receive phonetic interpretation in acoustic and articulatory terms. The framework, therefore, seeks to unite insights from acoustically-based models, like that of Jakobson et al. (1952), and articulatory-based models, like that of Chomsky and Halle (1968).

In DP, a segment is assumed to be composed of several constituents called gestures, for example, categorial, articulatory, and tonological, which are further divided into subgestures, for instance, initiatory, phonatory, oro-nasal, and locational. The place components are situated under locational subgesture, which is, together with the oro-nasal subgesture, a part of articulatory gesture. Moreover, the phonological components occur with variable dependency relations (head-dependent or symmetrical relations) when combined within a subgesture. This simply means that the components can either occur in a symmetrical combination (mutual dependency relation denoted by the colon :) or enter into a relationship in which one component plays the function of the head while the other is the dependent (represented as the semicolon ; or the arrow pointing to the dependent =>). The major class and manner distinctions are represented by the combination of two antagonistic components |V| and |C|, which are defined acoustically as "relatively periodic" and "periodic energy reduction," respectively.[6] For example, the distinction between voiceless and voiced fricatives is rendered respectively as |V:C| and |V:C=>V|. As for the place components, DP proposes the following list of primes (8):

[5] It must be emphasized here that DP is a complete theory, covering the full range of phonological structure at both the segmental and the prosodic level.

[6] For the advantages of this solution over SPE, see van der Hulst (2006).

(8) Anderson and Ewen's (1987) place components

|i|	palatality, acuteness/sharpness	|l|	linguality
|u|	roundness, gravity/flatness	|t|	apicality
|a|	lowness, sonority	|d|	dentality
|@|	centrality	|r|	RTR (retracted tongue root)
|T|	ATR (advanced tongue root)	|L|	laterality

As noted by van der Hulst (2006), only some of the components in (8) receive the status of basic primes in that they play the primary role in segments. The set of key components includes the |i|, |a|, |u| subset, which appears in both consonants and vowels. Additionally, the set in (8) contains two supplementary vowel components of lesser importance, that is, |@|, which defines central or back unrounded vowels, and |T|, representing expanded/contracted pharynx. The second column of (8) depicts a set of components which are mainly or exclusively used for consonants. Now, the cross-linguistic vocalic systems are defined by the triplet set: |i|, |a|, |u|. Such systems are further differentiated by the presence vs. absence of vocalic components or by various dependency relations between them. For example, DP represents a common five-vowel system /i, e, a, o, u/ as |i|, |i;a|, |a|, |u;a| and |u|.[7] While also based on the |i|, |u|, |a| set, the consonantal place distinction is further expanded by typical consonantal components. The major consonantal places of articulation are represented as in (9) below.

(9) Representation of consonants in DP (place components only)

|u|	labials
|l|	coronals
|l,i|	palatals
|l, u|	velars
|l, u, a|	uvulars

Some additional components are used to capture minor consonantal distinctions; for instance, |t| represents contrast between apical and laminal coronals, |d| distinguishes dentals from alveolars, |r| defines pharyngeals, and finally |L| captures laterality as in, for example, lateral fricatives. Note that

[7] The adoption of |i|, |u|, |a| as the basic set of unary primes is characteristic of a number of other current approaches to segmental structure, such as Particle Phonology (Schane 1985), Government Phonology (Kaye et al. 1985, 1990), and Radical CV Phonology (van der Hulst 1989, 1994). They differ, however, in the identity of the components, their combinability, and other aspects of their organization.

although the components used for the representation of place in consonants and vowels are not entirely different, the distinction of the major places of articulation is, in fact, limited to the single component |u|, which occurs in labials and velars. In order to represent coronals, an additional component is proposed, namely, linguality |l|. Finally, velars are represented by two components |l, u|.

Although appealing for various reasons, this proposal suffers from some inherent weaknesses, too. One of the DP's unquestionable strengths is the claim that dorsals are more complex than either labials or coronals. This may explain the acquisition pattern according to which dorsals, among the primary place categories, are acquired last by children (Jakobson [1941] 1968). On the other hand, however, the idea that dorsals are more complex than labials or coronals is not borne out by cross-linguistic statistics, as all three major places occur at over 99% of segment inventories (Maddieson 1984: 32). Secondly, and more importantly for us, this proposal expresses the natural class of labials and dorsals, which share the component |u| (gravity, grave consonants, see Section 3.1). Finally, it also captures the class of coronals and dorsals, which, as is well documented, are the consonants typically affected by palatalization; in DP they share the lingual element |l|.

As mentioned above, there are also some problems with the DP proposal, and van de Weijer (1996) pinpoints the major disadvantages to the representation of place. For instance, since front vowels and coronals are defined by different components, the widely known interactions between both classes (see van de Weijer 1996) receive no explanation whatsoever. The only feature used for consonants and vowels alike, as already signaled above, is |u|, characterizing roundness in vowels and labiality in consonants. Secondly, as noted by van de Weijer (1996), even if the lingual component were replaced by a newly proposed coronal one, the representation of velars would still remain inadequate. Finally, the place components in (8) above allow the expression of a number of highly unexpected rules as simple spreading operations. For instance, the model predicts that a labial consonant may change into a dorsal after a coronal by the spreading of the |l| component. The latter observation is just a single example of a more general argument against DP – overgeneration. In order to curb the overgenerating power of the theory, van der Hulst (1989, 1994) comes up with a modified version of DP, that is, Radical CV Phonology. This model is designed primarily to reduce the number of components and their combinatorial possibilities. Among many other modifications, including the reduction in the interactions between gestures (e.g., the categorial and articulatory gestures) and the components of certain subgestures (e.g., the initiatory subgesture), van der Hulst (1994) offers major changes in the locational subgesture (the one where the place components are situated), dividing it further into primary and secondary location subgestures. The most revolutionary innovation, however, is the idea that all subgestures contain exactly two components: |C| and |V|. Like DP components, they receive a phonetic interpretation in acoustic and articulatory terms. Furthermore, the interpretation of |C| and |V| depends on their structural position within a gesture and subgesture. Without going into a detailed presentation of the basic principles and concepts of the model (see van der Hulst 1994), we confine the discussion to a single observation concerning the representation of velars. Recall that DP argues for a complex representation of velars which contain the labial and coronal components, that is, |l, u|. This solution is rejected by the Radical CV approach, which instead proposes that high-centrality (for vowels) and dorsality (for consonants) do not contain any components. In other words, dorsals (velars) are represented as empty primary subgesture, though they can have secondary locational properties to indicate palatalized or labialized dorsals. In order to support his solution, van der Hulst (1994) points out that, just like central vowels, dorsal is the weakest place of articulation, which often forms the last phase in reduction processes (leading to debuccalization) and is the easiest target for weakening. Note, however, that in this solution the common cross-linguistic labial-velar interactions must be relegated to the background, as there is no formal way to directly capture both categories. Summing up, while coronals have |C| and labials $|C_v|$ component in the primary location subgesture, velars are empty |_|. This solution was later adopted by Element Theory (see Section 5). Finally, note that there are many offshoots of hybrid models which try to combine the findings of both Dependency Phonology and Element Phonology, for example, van de Weijer (1996) (see Section 5.3) and Botma (2004) (Element-based Dependency). However, before we discuss Element Theory, we should first look at the segmental structure from still a different, auditory-acoustic perspective.

4.3 Perceptually-oriented theories

At the beginning of this chapter, we have noted that the first attempts to work out the internal structure of segments were in terms of auditory-acoustic properties (Jakobson et al. 1952). Although this perspective switched to speech articulation together with the advent of SPE, there were some alternative theories developing parallel to the mainstream SPE-type models, which returned to acoustically defined primes, for example, Dependency Phonology, Radical CV Phonology, or Particle Phonology.[8] However, at the same time other researchers turned entirely to speech signal in an attempt to establish the primitives of

[8] Note that in these theories the phonological primes receive both acoustic and articulatory interpretation.

segmental structure, which resulted in the appearance of acoustically and perceptually oriented theories, such as Motor Theory of Speech Perception (Liberman et al. 1967; Liberman and Mattingly 1985), Direct Realist Theory of Speech Perception (Fowler 1981, 1984, 2003), and Auditory Enhancement Theory (Diehl and Kluender 1989; Diehl et al. 1990), among many others.[9]

In order to emphasize the superiority of the acoustically-based approach over the articulatorily-based one, the acoustic studies, from the very outset, readily referred to the interaction of articulatorily distant classes. For example, in order to capture natural classes which cannot be expressed by articulatorily-defined primes, Flemming (1995: 6) offers features with clear acoustic correlates. They include high F2, low F2, low F3, intensity, formant structure, low noise frequency, low noise intensity, and diffuse spectrum. The articulatorily-distant class discussed by Flemming (1995) includes labial and retroflex consonants which condition rounding or retroflexion of front vowels in Wembawemba and Wergaia (see Hercus 1969). The conclusion Flemming (1995) arrives at is that despite their articulatory distance, labiality and retroflexion pattern together because they share the acoustic correlate of low F3.

The interaction of labials and velars is another example of the articulatorily-distant class of segments which pattern phonologically. Quite unsurprisingly then, they have not escaped the attention of researchers, but have become a common point of reference in acoustic studies. Recall that the acoustic similarity of labials and velars motivated Jakobson et al. (1952) to postulate the acoustic feature [grave], defined as having predominantly low frequency energy. Thus, since the 1950s, linguists have had a choice of describing velar-labial changes in both articulatory and acoustic terms. Bonebrake (1979) warns, however, that the attempts to incorporate both articulation and acoustics into the description may lead to contradiction. In other words, the explanation in articulatory terms should not make use of acoustic features, as was the case in some early accounts (e.g., Flemming 1995; Boersma 1998). Bonebrake (1979: 158) mentions Hasegawa (1963), who, besides the explanation in articulatory terms, refers to the acoustic feature [grave] in order to capture both the labial and velar places of articulation and the back vowels. Putting inconsistency problems aside, the early acoustic studies and auditory experiments teemed with analyses encompassing velars and labials, such as Cooper et al. (1952), Fischer-Jørgensen (1954), Miller and Nicely (1955), Ladefoged (1972), Fant (1973), Lindblom (1975), and Ohala and Lorentz (1977), among others.[10] Even though these analyses are rather outdated, they reflect the enduring presence of labials

[9] For a short introduction to the development of acoustic studies and speech perception theories, see, for example, Rojczyk (2010).

[10] For a more thorough discussion concerning velars and labials in early acoustic studies, see Bonebrake (1979).

and velars in acoustic studies. Along with the accumulation of new evidence showing that distant or physically unrelated articulatory events work together, the number of studies emphasizing the relevance of the auditory-acoustic information in explaining the phonological behavior of segments has grown rapidly. For instance, while discussing the acoustic affinity of velars, labials, and labio-velars, Ohala and Lorentz (1977) point out that all these consonants are characterized by a low second formant. In effect, this explains why both labials and velars interact with the labio-velar glide; it is because their formant transitions resemble those of [w]. Moreover, the authors apply acoustics in order to explain the preponderance of cases where [w] interacts with velars rather than labials or dentals (the interaction with the latter being very rare). They base it on the shape of the vocal tract and the factors which create resonances and anti-resonances in the vocal tract (Ohala and Lorentz 1977: 585ff). Similarly, Riordan (1977) shows that lip-rounding and larynx height work together to lower F2 to produce a grave sound (see Plauché 2001). In yet another study, Blumstein (1986) examines the acoustic structure of voiceless velar and palatal stops in the environment of [i] and [u] in Hungarian (see Plauché 2001: 28). The shift from [ki] to [ci] is analyzed as an assimilation of the acoustic property from the vowel to the preceding consonant. Blumstein (1986) points to the similarity between the consonant spectra and the following vowel spectra, which share a predominant energy peak in the same frequency region. Moreover, the spectrum of the burst for the velar and the palatal in the environment of [i] is identical, although the frequency of the peak is higher in the case of the palatal. Note, however, that the assimilation from [cu] to [ku] does not take place, presumably due to the lack of shared acoustic properties between neighboring sounds.

Acoustic similarity has also been analyzed as a key factor in historical sound changes, for example, in Durand (1956) and Herbert (1975). Moreover, many sound change theories have grown on the acoustic/perception studies, of which the most important include Ohala's (1981) theory of sound change and Lindblom's (1986) H&H theory of sound change. Both theories, as Plauché (2001) notes, emphasize the great relevance of the auditory-acoustic signal for speech perception. Moreover, they accept the hypothesis that laboratory confusions can simulate phonetically motivated historical sound change. More specifically, it is claimed that common cross-linguistic sound changes are likely to arise from language-universal factors, such as the physics and physiology of the vocal tract and the nature of the human perceptual system. For example, the historical stop consonant shifts are likely to be due to the same acoustic and perceptual factors found in the laboratory studies of consonant confusions which report on parallel trends in places of articulation of the oral stops. Crucially, both theories assume that speech is perceived directly from the acoustic information, in opposition to models of speech perception that assume an intermediate articulatory representation, such as Analysis-by-Synthesis (Stevens 1960), the Motor Theory of Speech Perception (Liberman and Mattingly 1985), and the Direct Realist Theory of Speech Perception (Fowler 1994).

The view that the acoustic and perceptual studies can shed some light on historical consonant changes and, more generally, on the patterning of articulatorily distant classes, triggered a considerable increase in laboratory analyses. This was especially the case in the laboratory studies of consonant confusion, which were believed to reflect the historical (articulatorily unexpected) developments. Therefore, the remainder of this section provides a sample of a particular laboratory study of consonant confusion conducted by Plauché (2001), who analyzes the place of articulation of English stops. In her work, Plauché (2001) focuses on English voiceless, unaspirated stop consonants [p t k] that occur primarily in [s]-initial clusters. Since her analysis encompasses voiceless unaspirated stop consonants in the pre-vocalic position only, that is, #sTV (where T stands for a voiceless plosive), we confine the discussion to selected acoustic characteristics of English stop production, with a particular emphasis laid on bilabial and velar stops. It must be borne in mind, though, that since the acoustic properties of sounds are inseparably linked to the environment, it is not possible to give unique place cues of velars and labials (or any other sound for that matter). Rather, speech scientists concentrate on certain characteristics of studied segments in selected contexts. Thus, although many of the cues to place are shared by the plosive in general, there are also considerable cross-contextual differences, and the cues do differ in voiced stops, word initial voiceless stops, word-final and intervocalic stops, etc. Moreover, all of the acoustic events associated with stop consonant production are highly variable depending on the following vocalic context.

Cues for the place of articulation of stop consonants lie in several acoustic events which directly correspond to articulatory movements. The acoustic events include, for example, the duration, amplitude, formant transition, voicing onset, gross spectral shape of the burst, and following frication, among others. The production of stops at the three major places of articulation share the general sequence of articulatory events and corresponding acoustic consequences. However, each of these acoustic events assumes different spectral and temporal characteristics, depending on the place of articulation of the closure. This is illustrated in (10) below, which summarizes Plauché's (2001) findings.[11]

[11] The full description and interpretation of all the acoustic cues for the production of stops in general can be found in Plauché (2001: 5).

(10) Place of articulation cues for English stops in #sTV context (Plauché 2001: 21)

Cues for stop place	Bilabial	Alveolar	Velar
burst amplitude	low	high	[u] – low [i a] – high
gross spectral shape at burst	falling	rising	[a u] – compact [i] – rising
spectral center at burst	low	high	[a u] – low [i] – mid
F2 onset	[i] – high [a] – mid [u] – low	high	[i] – high [a] – mid [u] – low
F2 transition	rising	[u a] – falling [i] – rising	falling
F3 onset	low	high	low
VOT	[a] – short [i u] – short/med	[a] – med [i u] – med/long	long
multiple bursts	[a] – rare [i u] – rare/occurs	[a u] – occurs [i] – occurs/common	common

One explanatory note is in place here: in the second line, gross spectral shape at burst, *falling* refers to a spectrum with the majority of energy in the low frequencies, *rising* to the majority of energy in the high frequencies, and *compact* to the majority of energy in the mid-frequencies.

A general conclusion emerging from the data in (10) is that the acoustic cues are influenced by the following vowel, as expected. This becomes evident when we look at all the places of articulation above. More crucially for us here, velars followed by the vowels [a u] share more characteristics with labials, but when followed by [i], with alveolars. This observation concerns the spectral shape values and also F2 and F3. Furthermore, labials and velars share similar frequencies (depending on the following vowel) at the spectral peak of the burst (third line) and the onset of F2 and F3. It follows that even in this short fragment of acoustic descriptions of stop places in a strictly defined context, there are more similarities between labials and velars than between both these categories and alveolars. This fact, Plauché (2001) maintains, is responsible for common confusions of place among the subjects of the experiments she conducted.

Plauché (2001) reports on similar findings which have been obtained in other experiments. The broad conclusion to emerge from these studies is that alveolar stops are less likely to be confused than velar and bilabial stops. The confusion is predominantly triggered by the vocalic context, and it is [i] that causes the highest rate of such confusions, which are usually asymmetric. Interestingly, in confusion studies, velar stops in pre-vocalic position across all vowel contexts generally cause the highest confusion rates when presented to English listeners. Additionally, Plauché (2001) reports on some experiments (Wintiz et al. 1972; Repp and Lin 1989) in which the velar stop [k] is more often misclassified as [p] when followed by the round vowel [u]. In Wintiz et al. (1972), the confusion rates are searched for voiceless stops in the context of three vowels [i a u]. The findings reveal that the alveolar [t] has the highest identification rates. Moreover, the sequence [ki] is identified as such very rarely; it is most often interpreted as [ti]. Velars in other contexts, that is, before [a u], are identified at rates comparable to bilabials. The sequence [pi] is often confused for [ti], and this confusion is asymmetrical, as the reverse is not true. Finally, bilabials and velars are often confused for each other in the context of [u]. These findings have been confirmed by a similar experiment in Italian (Delogu et al. 1995). In this experiment, the sequence [pu] is often heard as [ku], but the reverse is not true. Furthermore, [pi] and [ki] are both asymmetrically confused for [ti]. Such asymmetric confusions, that is, [ki]/[pi] > [ti], have been subject to numerous studies.

To sum up the discussion so far, we have seen that velars following high front vowels are commonly misidentified as alveolars [ki] > [ti], but alveolars in the same context are not subject to the same confusion rates by listeners. In the same context, listeners often interpret bilabials as alveolars [pi] > [ti], the reverse not being true. On the other hand, English velars and bilabials that precede [u] are confused for one another at comparable rates.

In order to account for such asymmetries, speech scientists often refer to the notion of similarity of the acoustic signal. For example, the misidentification of labial and velar consonants as alveolars in the context of high front vowels [i e] has been explained by the relatively high-frequency onset of F2 and F3 for both places of articulation in the environment of these vowels. Such findings have led Repp and Lin (1989; after Plauché 2001: 29) to propose that certain vowels may have affinities with certain consonant places simply because they share some articulatory and spectral properties. Without going into unnecessary detail, they propose that the round back vowels [u o] are most similar to labial stops, while high front vowels [i e] are closely related to alveolar stops. Although such affinities between vowels and consonant places may explain a number of the asymmetries discussed above, they cannot account for the more symmetric confusion between [k] and [p] in the context of [u]. Plauché (2001: 29) concludes that the exact perceptual mechanism which is responsible for this switch remains unclear.

The conclusion emerging from the meticulous analyses of various acoustic-phonetic criteria, like formant transition, aspiration burst, intensity, frequency of the burst, acoustic sonority, etc., is rather weak, as it comes down to a simple observation that velars and labials share some acoustic characteristics in opposition to coronals/dentals. Broadly speaking, speech perception analyses face a more general problem, namely, the lack of a one-to-one correspondence between the acoustic signal and phonological segments which human beings perceive. The same refers to the opposite situation, that is, the lack of direct mapping between the acoustics of the speech signal and the segments intended by the speaker. All that perceptually-oriented studies have managed to determine is that the human auditory system is highly sensitive to dynamic cues and that the ear is most sensitive to frequencies between 100Hz and 10000Hz. Furthermore, it is broadly agreed that the perceptual system is equipped with an event-detector, a mechanism which detects periods of abrupt spectral change, such as stop closures and bursts, and voicing onset (Blumstein and Stevens 1981; Stevens 1999). When an acoustic event is detected, the perceptual system is assumed to pinpoint the relevant portions of the signal which help to identify the segment. However, the perception of speech signal, which can be defined as the task of "transforming a constant borderless flow of acoustic input into discrete segments" (Rojczyk 2010: 15), is further complicated by the fact that the production of a single segment is subject to considerable acoustic variation, such as phonetic context, stress, physiology of the speaker, sociological characteristics of the speaker, token-to-token variation, and the environment of the utterance. Thus, as Plauché (2001) observes, one is forced to admit that despite the increased effort and much research on the characteristics of the human auditory system, our knowledge boils down to the observation that both the environment and the auditory system cause various transformations to the acoustic signal. The fact that a human being can identify segments from continuous speech with high accuracy while ignoring at the same time the omnipresent variation and the overlapping property of the speech signal still presents a puzzle. Let me finish this section, though, on a slightly more optimistic note. Summing up her analysis, Bonebrake (1979: 208) observes that "many significant results have been contributed by phoneticians which have not yet been utilized by theoreticians." However, her study was conducted in the late 1970s, and so significant progress has been made in the field since then. Theoretical phonologists have learned the acoustic lesson and have started incorporating the research findings of laboratory analyses and acoustic studies into the design of new segmental theories. In search for the exact nature of the linguistically significant categories, however, segmental theories can rely neither on the articulatory features inherited from SPE nor on the acoustic ones based on the parameters of machine spectography (Harris and Lindsey 2000: 189). In the immediately following section, we look at one such attempt, the model that is broadly known as Element Theory.

5. Element Theory

This section outlines the theory of feature organization which radically departs from the orthodox feature theory (SPE-style models discussed in Sections 3.2, 3.3, and 4.1). The radicalness of this model is associated with a proposal which completely replaces the traditional, articulatorily-based, binary features with a set of monovalent cognitive elements. The model in question is widely known as Element Theory (ET) (Harris and Lindsey 1995, 2000; Backley 2011) and since it will be adopted for the data analysis in Chapter Three, we devote the whole section to a thorough presentation of its core assumptions and fundamental ideas. After a general introduction to the model, we present a more detailed discussion concerning the representation of labials and dorsals offered by a number of researchers working within ET. In the discussion that follows, we draw heavily on Backley's (2011) book-length introduction to ET.

Element Theory is assumed to originate from Government Phonology (GP) (Kaye et al. 1985, 1990), which adopts monovalent elements in the representation of segments. As we have seen above, however, there is no necessary connection between GP and elements advocated by ET. Recall that elements can be tracked back to similar primes set up by theories which predate GP, such as Particle Phonology and Dependency Phonology (see Section 4.2). Backley (2011: xii) simply admits that "despite their historical connection with GP, elements are, in principle, flexible enough to be used in any phonological theory." To put it differently, ET has become fully independent of GP and is currently seen as an autonomous segmental theory. However, like most of its predecessors, ET too comes in several versions. Although these different versions share core principles, like the monovalent character of primes and consonant-vowel unity, they diverge on other issues, including the representation of particular place contrasts and the role of headedness, both of which are a matter of ongoing debate.

To begin with the generally shared views, ET is a model in which "the mental representation of speech sounds is coded neither in tongue heights nor in formant heights or basilar stimulation points. Instead it is coded in information-bearing patterns which humans perceive in speech signal" (Harris and Lindsey 2000: 186). In other words, internalized patterns (auditory images) called elements are directly associated with certain acoustic properties in the speech signal. And since elements are based on the speech signal rather than on auditory (Jakobson et al. 1952) or articulatory (Chomsky and Halle 1968) properties, the model can encompass the linguistic knowledge shared by both parties, that is, speakers and hearers alike. It follows that even though the speech signal is physical and thus describable – we can refer to acoustic properties, such as change in amplitude, rapid formant transitions, frequency of the burst, etc. – the precise measurements are mostly irrelevant to the grammar and as such do not need to be represented by elements. In other words, phonetic data such as noise burst or amplitude can be used to describe and classify speech sounds, but such acoustic properties mostly do not count as linguistic knowledge, and so are not reflected in segmental structure. Similarly, even though one of the primary objectives of elements is to function as target patterns for speakers, they do not contain the specifics of how to achieve this target, that is, tongue position, glottal state, lip position, etc. are not part of linguistic knowledge (Backley 2011). In short, speech production is not controlled by the grammar. Infants learn to articulate sounds by experience and experimentation during the acquisition period. To conclude, neither auditory-acoustic details nor articulation is used as a code in terms of which the information is compiled; speech production is responsible only for delivering the speech signal and for carrying the linguistic message. Instead, ET assumes that language users are able to extract from the speech signal the acoustic patterns that carry linguistically relevant information, while everything else is filtered out. Since these patterns contain linguistic information, there is a direct mapping between them and phonological categories in the grammar, that is, elements. This means that elements have a double association: they are associated with physical patterns in the acoustic signal and also with segmental representations in the mental grammar. In brief, they function as both mental auditory images and physical objects.

To sum up the discussion so far, we have seen that elements are associated with neither articulation nor perception but rather refer directly to certain acoustic properties of the speech signal. Moreover, unlike traditional features, elements are inherently monovalent, that is, they are independently pronounceable and do not need any redundancy fill-in machinery. In short, contrary to SPE-style models, in which a single feature such as [+high] cannot be phonetically realized on its own, ET maintains that each element, being acoustically specified, can be pronounced in isolation, without any support from other elements. This is what differentiates ET not only from the traditional models but also from the more recent ones, like Dependency Phonology (Section 4.2), which does not predict components to be interpreted in isolation. This autonomous interpretation principle predicts a segment to be comprised of a single element, of course without precluding the possibility of a segment containing several elements. Backley (2011) observes that the autonomous interpretation leads in consequence to a situation in which grammar is liberated from a separate level of phonetic representation and where phonological processes do not control pronunciation but rather phonological representations. Moreover, since phonological processes operate within the domain of competence only, phonology becomes totally cognitive or competence-based. Instead of converting an abstract form into a physical one, the processes ensure that phonological regularities are observed by lexical representations, that is, they produce output forms which are just as abstract as their input forms. Note that since phonology operates on independently interpretable elements and guarantees the well-formedness of lexical representations, it is theoretically possible for a speaker to phonetically realize an ungrammatical form (phonologically unmodified). For example, in languages like German, Dutch, Russian, or Polish, in which the final devoicing constraint ensures that obstruent must be devoiced when final, as in Polish [xlep] – [xleba] 'bread, – gen.sg.,' the form with the voiced [b], that is, *[xleb], although ungrammatical, could be deliberately pronounced by a native speaker of Polish.

Unlike standard phonology, which establishes a link between the cognitive and the physical world by modifying lexical forms to generate phonetic ones, ET is purely cognitive in that it deals exclusively with abstract or cognitive objects. However, the link with the physical world is retained in the form of the phonetic interpretability of elements. The cognitive approach, as pointed out by Backley (2011), results in relegating phonetics and, more specifically, speech production to the role of language transmitter. To quote Harris and Lindsey (2000: 1), "while articulations constitute a delivery system for linguistic information, they are not of themselves information-bearing." Thus, both speech production and writing serve as media for delivering linguistic information and just as the inability to write does not prevent a person from acquiring a normal grammar, the inability to speak is not a barrier to developing a normal language competence. Summing up, since phonology is a component of the mental grammar, it does not have much to do with phonetic details, which are simply not included in phonological representations. Furthermore, the cognitive perspective on the nature of elements determines the way they are handled: for example, to establish which elements are included in a segment, researchers focus on its phonological behavior rather than on its acoustic properties.

In the version of ET offered by Backley (2011), the number of elements has been limited to a set of just six primes. These can be, rather informally, divided into two groups. One group contains the elements |I U A|, which are primarily associated with vowel structure, and in the second one we can find elements which mostly describe consonant structure, that is, |? H L|. Bear in mind, however, that just as vowel elements regularly appear in consonants, consonant elements can appear in vowels. Now, since elements are directly associated with acoustic patterns in the speech signal, they can get an acoustic definition. This is not to say, however, that elements cannot be articulatorily rendered, too. For example, the acoustic properties of the element |U| are characterized by a concentration of energy at lower frequencies. In the spectogram, all formants are lowered: F1 occurs at around 500Hz, and F2 at around 1kHz. Now, one of the ways of producing this falling pattern is to round the lips. It follows that the |U| element is present in all round vowels. However, the idea that |I U A| are the basic building blocks of the vocalic systems is supported by phonological behavior and language typology rather than by phonetic properties or articulatory details. It is a well-known fact that vowel systems cross-linguistically demonstrate a tendency towards triangular patterns based on the corner vowels [i u a]. Such basic systems are recurrently extended to the universally unmarked five-vowel sets containing [i u e o a]. In such systems, [i u a] behave as basic vowels in opposition to [e o]. This can be confirmed by positional neutralization of vowel contrasts in that the canonical five-term system is reduced to [i u a] in unstressed positions (Harris and Lindsey 2000: 189). Furthermore, the term basic refers to the indivisibility of [i u a], which are each represented by a single element |I U A| respectively. On the other hand, the mid vowels [e o] do not behave as basic vowels, as they are not present in all vowel systems. One immediate conclusion is that elements must be allowed to combine and form compound expressions. Based on phonological evidence, it is proposed that each of the mid vowels contains two elements in its structure – [e] is composed of |I A| and [o] of the compound |U A|. Note that this proposal can be additionally confirmed by the spectral patterns of these vowels: [e] has a conflated spectral pattern that incorporates the acoustic properties of both |I| and |A|; similarly, [o] is a combination of |U| and |A|. Importantly, the individual elements in a compound expression can be disclosed when they are targeted by phonological processes, like monophthongization, diphthongization, vowel coalescence, harmony, or vowel weakening. For instance, the diphthongization examples found in the history of English, such as [e] > [ai] and [o] > [au], illustrate the process of breaking up the complex structure of mid vowels into a sequence of two simplex vowels. In other words, the phonological behavior can sometimes uncover the elemental make-up of segmental structure. To sum up, the corner vowels [i u a] are structurally simplex, but [e o] have compound structures. The basic vowels are unquestionably the most common cross-linguistically and in languages with very small vocalic systems, they are the only vowels present. To repeat a point made earlier, it is phonological behavior that determines element identity and segmental structure in ET. Another consequence of this assumption is that two phonetically different vowels in two different systems do not necessarily differ phonologically. This can be illustrated with the example of Spanish and Zulu, both of which are five-vowel systems: the former contains [a i u e o], while the latter [a i u ɛ ɔ]. Now, even though Spanish [e] and Zulu [ɛ] are phonetically different, they are represented by the same elements |I A|. And since elements are cognitive phonological objects, both languages choose slightly different phonetic interpretation of these categories.[12] This situation, as Backley (2011) points out, is responsible for the fact that language users tolerate

[12] The reverse situation is also possible, that is, what is characterized as the same sound from a phonetic perspective can show different phonological patterning – segmental double agents (cf. Gussmann 2002, 2007; Cyran 2010, 2014).

a certain amount of phonetic variation and signal distortion when they hear or produce sounds.

Following autosegmental phonology, ET adopts the representation in which elements reside on separate tiers, or levels, in the segmental structure. This solution allows for distinguishing between elements which can combine as they belong to different tiers and elements which cannot, as they reside on the same tier. For instance, in the five-vowel system [i e a o u], |I A| and |U A| are possible compound expressions, whereas |I U| is not. This is captured by the representation in which the |I| and |U| tiers are conflated into one. Needless to say, the combination of |I| and |U| is allowed in some larger and more marked vocalic systems which contain front rounded vowels. Thus, the high front rounded [y] is represented as |I U| and the mid front rounded [ø] as |I U A|.

There are two main solutions which increase the expressive power of ET; one allows for element combination to form compound expressions, while the other one grants the elements in compounds asymmetric status. As in Dependency Phonology (Section 4.2), this asymmetry is expressed in terms of head-dependency relations. For example, in the English vocalic system, which contrasts [e] and [æ], the former vowel is represented as |$\underline{\text{I}}$ A|, while the latter as |I $\underline{\text{A}}$| (the underlined elements function as heads). Backley (2011: 42) points out that there are various views on element headedness within the ET model. While some researchers allow the segments to contain non-headed expressions, others argue that all segments must contain a headed element. Backley (2011) opts for the latter solution, indicating that even a single element in a phonological expression should always be headed as its acoustic pattern entirely dominates the expression. Headedness has additional function to play, namely, it informs us about the element strength in the sense that a head element displays a stronger and more prominent acoustic pattern than a dependent element.

Basically, there are two indicators of segmental strength in ET: complexity and headedness. Thus, complex expressions are assumed to be stronger than simplex ones, just as headed expressions are stronger than non-headed ones. Additionally, Backley (2011) argues that segmental strength relates to prosodic strength in that strong segments are attracted to prosodically strong positions, while weak segments are preferred in weak positions (in the word-final, preconsonantal, and intervocalic position). In short, the distribution of segments depends on several factors, such as which elements a segment contains, the number of elements it contains, or the presence or absence of a headed element. Since strong positions, in opposition to weak ones, are rich in segmental information in that they support a broader range of contrasts, they provide language users with information about prosodic structure. For example, they invariably mark the left edge of prosodic domains, like the syllable and the word. In this way, strong positions facilitate the process of both breaking up the speech stream and language acquisition. This situation explains why certain elements and element combinations (certain acoustic cues) are favored in strong positions but suppressed in weak positions. In other words, lenition processes function as mechanisms which suppress certain acoustic cues in prosodically weak positions as the latter have no prosodic marking function to perform.[13]

Before getting down to the specifics in the following sections, and especially in Section 5.6, let us briefly mention another general assumption which underpins ET, namely, vowel-consonant unity. In this model, as noted above, the same elements are used to represent consonants and vowels. For example, the same resonance properties which are associated with vowel quality, that is, |I U A|, provide information about the place of articulation in consonants. It follows that the difference between [p] and [ʃ], for example, expressed in acoustic terms, boils down to the distinction between |U| resonance and |I| resonance (labial and palatal in articulatory terms). Note, however, that the distinction between consonants and vowels can still be expressed by syllabic affiliation of segments. Vowels occupy the syllable nucleus (the vocalic slot), while consonants belong to non-nuclear positions (the consonantal slot). One of the immediate consequences of the consonant-vowel unity is that each element must have at least two different interpretations depending on the affiliation: a vocalic interpretation and a consonantal one. This becomes evident in the representation of glides and vowels, the discussion of which is postponed until Section 5.6 below.

In the remainder of this chapter, we peruse different proposals available within the ET model in search of a potential solution which could capture both labial-dorsal interactions and the interaction between the latter and back vowels and the labio-velar glide. Thus, in what follows, particular emphasis is laid on the resonance elements |I U A|, as it is they which predominantly account for the consonant-vowel interactions and the consonantal class membership (places of articulation in articulatory terms).

5.1 Kaye, Lowenstamm and Vergnaud (1985, 1990)

The first and most basic approximation to the segmental structure in terms of elements is exposed in Kaye et al. (1985). As in current ET versions, phonological segments are proposed to be formed out of a small set of monovalent elements. Elements may occur alone or in combination. The combinatorial possibilities, however, are defined in terms of a property called charm which is assumed to have two values: positive and negative. Since Kaye et al. (1985) focus on vocalic segments only (no reference is made to consonants), and since they apply basi-

[13] For a theory of lenition in Government Phonology and in the Strict CV model, see, e.g., Harris (1997); Scheer (2004); Scheer and Ségéral (2008) and Ziková and Scheer (2010).

cally the same vocalic elements as in current ET versions, that is, |I U A|, we will not go into a detailed discussion of this early version but instead proceed directly to their subsequent study, published as Kaye et al. (1990). In this work, the Charm Theory[14] is extended to operate with three values: negative, positive and neutral (charmless). This step is dictated by the inclusion of non-nuclear segments (consonants) in the discussion. Thus, some of the vocalic elements are used here to define consonants. The element |I| defines high front vowels and palatality, while |U| defines roundness in vowels and labiality in consonants. The neutral element |v| contributes velarity when it occurs as the head of a compound consonant. Finally, in order to characterize the coronal and manner dimensions of consonants, three additional elements are introduced: |R|, |ʔ|, and |h|. Fine details aside, obstruents are generally negatively charmed, while liquids and glides are charmless (vowels remain positively charmed). The analysis presented by Kaye et al. (1990) predominantly concerns syllable structure and phonotactic constraints within syllabic constituents and between them, and it is the Charm Theory that is responsible for governing relations and hence the distribution of segments in syllabic constituents. Importantly, Kaye et al. (1990) supplement the Charm Theory with the complexity condition developed by Harris (1990). Later the Charm Theory was dismissed altogether and replaced by licensing constraints (Rennison 1990; Cobb 1993; Charette and Göksel 1996, among many others).

In the course of the development of the theory, a number of early solutions are later modified or dispensed with altogether. For instance, the representation of velars by means of the neutral element |v| or the element |R|, which is used to represent coronals (Harris 1990), are relatively early questioned and the attempt is made to dispense with them (Broadbent 1991; Ploch 1993; Backley 1993; and Cyran 1997, among others).

Summing up, since velarity and labiality are represented by two different elements, it is not possible to formally capture their phonological patterning. The same holds true for the common interactions between velars and back rounded vowels or the glide [w].

5.2 Harris and Lindsey (1995)

In their study, Harris and Lindsey (1995) further develop the model of segmental structure initiated by Kaye et al. (1985, 1990), putting particular emphasis on consonant-vowel unity. Without going into unnecessary detail, they propose to represent high front vowels and palatal/palatalized consonants by the |I|

[14] For a short introduction to and critical discussion of the Charm Theory, see Bloch-Rozmej (2008).

element. Next, the element |A| defines low vowels and uvular and pharyngeal consonants, whereas |U| appears in both rounded vowels and labial consonants. Although Harris and Lindsey (1995) are fully aware of the fact that the element |R| is problematic as it never defines vowels, they must use it, apparently for want of an alternative, to represent coronals. In their study, the vowel-consonant interactions are straightforwardly accounted for in terms of element spreading, for example, the element |I| is responsible for palatalization of consonants before front vowels. By the same token, |U| triggers consonant labialization or vowel rounding, and |A| has the ability to lower vowels which occur in the context of uvular or pharyngeal consonants. However, even though the resonance elements |A I U| are used to define the primary and secondary places of articulation in consonants, velars are somewhat exceptional as they require an additional resonance element, that is, |@|. This element is argued to possess a special status in that it is latently present in all segmental expressions, and it does not reside on an independent autosegmental tier. Furthermore, the only situation in which this element can contribute anything to the phonetic interpretation of a compound expression is when it plays the function of the head or is appointed to this function due to other elements' suppression or relegation to dependent status.

The introduction of the fourth resonance element is not unprecedented as it directly corresponds to the centrality component in Dependency Phonology (Anderson and Ewen 1987), to the "cold" vowel in Government Phonology (Kaye et al. 1985), and to an empty segment which lacks any content in the primary subgesture in Radical CV Phonology (van der Hulst 1989). Harris and Lindsey (1995) discuss the resonating characteristics of the neutral element |@| in the context of vocalic systems, making it responsible for the difference between ATR and non-ATR vowels. In the former, |@| is just a dependent, while in the latter it functions as the head, for instance, [i] |$\underline{\text{I}}$ @| vs. [ɪ] |I $\underline{\text{@}}$|. Now, while discussing the representation of consonants, Harris and Lindsey (1995) argue that since the articulatory exponence of |@| refers to non-coronal, non-palatal, non-labial, and non-low, it should be considered the resonance element in velar consonants. One immediate weakness of this solution is that it predicts the interaction of non-ATR vowels with velars, both of which are represented by the headed |$\underline{\text{@}}$|. Since such relatedness is not found across languages, Harris and Lindsey (1995) simply make no reference to velars while analyzing the range of vowel-consonant assimilatory processes. They refer to velars much later, namely, in their discussion of another mechanism which makes the internal structure of segments available for inspection – vocalization (lenition), consisting in the reduction of a consonant to its homorganic vocalic counterpart. While labials, palatals, and coronals usually vocalize to homorganic glides, that is, [w], [j] and [r] respectively, velars, it is argued, typically result in reduction to zero, sometimes via the approximant [ɣ] stage, which is claimed to be represented by the single neutral element |@|. Thus, [k] > [ɣ] > ø is interpreted as the suppression of consecutive elements |@ ʔ h| > |@ ʔ h| > |@ ʔ h|. This is, however, only partially true, as velars vocalize not only to zero (which is deletion rather than vocalization) but also to the glide [w] or even to a back rounded vowel [u], as will be illustrated in Chapter Two. Summing up, since labials are viewed as |U| segments and velars are represented by the neutral element, the problem faced by the early version of ET (previous section) still stands unshaken. Even worse, the decision to represent velars as |@| segments precludes their interactions with uvulars (defined by |A|) and predicts a close relationship with non-ATR vowels.

5.3 Van de Weijer (1996)

Although van de Weijer (1996) admits that his study is couched in the DP approach, he makes use of some ET advances concerning the vowel-consonant unity. Basically, he adopts the DP primes |I A U| representing vowels and extends this set to the representation of consonants. Recall (Section 4.2) that DP proposes a number of additional consonantal components, like |l|, for example, which is used to define coronals but never appears in vowels.[15] Thus van de Weijer's (1996) approach is a hybrid model combining the results of both DP and ET. The author adopts the same set of elements as ET does to represent vowels and to define consonants (major places of articulation). In his approach, labials, coronals, and velars are represented by |U|, |I|, and |A| elements, respectively. However, since front and back non-high vowels are represented by |A|, velars are predicted to exert a lowering effect on neighboring vowels, just as low vowels are predicted to retract consonants. As admitted by van de Weijer (1996: 48) himself, "(t)hese predictions are not fully borne out (…) the evidence concerning the element |A| is generally much less clear than for the other two elements, |I| and |U|." This solution is then extended to cover the class of dorsals (velars, uvulars, and pharyngeals), which are all represented by the element |A|.[16] This solution is dictated by the observation that velars and uvulars interact phonologically across languages, for example, they both pattern with back vowels, and velars often develop into uvulars in a specific vocalic context. The same line of thought is then followed by van der Torre (2003), who represents dorsals

[15] This is also the case in the early version of ET, in that the coronals are represented by the |R| element, which never finds its way into the internal structure of vowels; cf. the discussion in the above section.

[16] Since van de Weijer (1996) does not adopt the concept of headedness, the differences among dorsal consonants are obtained structurally, that is, as the repetition of the same element |A| twice (pharyngeals) or as a two-root segment, each root containing the element |A| (uvulars).

as |A| segments. To recapitulate, on the one hand, the proposal offered by van de Weijer (1996) captures the cross-linguistically common interactions of velars and other dorsal consonants (they all share the element |A|). On the other hand, this is a rather costly solution as other cross-linguistically common patterns are simply lost, like the labial-velar interactions or the relationship between velars and rounded vowels/glides. This is the consequence of representing labials and velars by two different elements: |U| and |A|.

5.4 Scheer (2004)

Scheer (2004) draws attention to one interesting fact concerning the representation of velars, namely, that although in the ET tradition the element |U| has always been combined with the labiality (roundness), its exact articulatory characteristics, that is, the high back tongue body position, describe velarity. Scheer (2004: 48) argues that the conflation of velarity and roundness into one single element has been conditioned by the observation that in the vast majority of languages, vowel backness goes hand in hand with roundness, whereas there is not a single language in which front vowels are automatically rounded. In consequence, one of these characteristics (velarity or roundness) is made redundant in the definition of back vowels. This conclusion contributed, in turn, to a proposal according to which the element that defines the velar tongue body position, that is, |U|, is absent from unrounded velar articulations. In other words, the resonance element responsible for velarity has been replaced by a questionable neutral element |@| (Harris 1990; Harris and Lindsey 1995) (see Section 5.2). As pointed out by Scheer (2004), this move encounters a number of problems, including, among others, the existence of back unrounded vowels [ɯ ʌ ɤ] and, more importantly, the basic phonetic observation that all velar consonants [k g x ɣ] are unrounded.

In search of an alternative solution, Scheer (2004) puts forward a proposal which is based both on his cross-linguistic survey (Scheer 1999, 2004) and the ideas developed in Lass (1984) and Rennison (1990). Very briefly, Scheer (2004: 48) claims that velarity and roundness are two distinct phonological elements. The prime defining velarity |U| is present in all velar articulations (rounded and unrounded). On the other hand, the prime that carries information concerning labiality/roundness, that is, |B|, is present in all rounded and labial articulations. This fact may explain why in certain systems [w] interacts with both labials and velars. This is so because [w] is claimed to include two elements: |U| and |B|.[17] The tentative system (velars and labials only) proposed by Scheer (2004) is represented in (11).

[17] More evidence supporting this solution is contained in Scheer (1996, 1998, 1999).

(11) Representation of labials and velars (resonance elements only) Scheer (2004: 50)

labials		velars	labio-velars
bilabials	labio-dentals		
|B|	|B A|	|U|	|U B|

Note, however, that the idea of introducing one additional element |B| is problematic as it enlarges the element inventory and so the generative power of the theory. Moreover, while the element |B| directly refers to the articulatory characteristic, namely, labiality/roundness, its proper acoustic specification remains veiled. Interestingly, Scheer (2004: 50) is fully aware of the fact that the element addition causes some problems, because on the same page he admits in a footnote that "the very existence of this prime may appear awkward, and I would myself prefer a system where one single prime covers labiality, roundness and velarity." In the same footnote, Scheer (2004: 50) mentions the solution offered by Broadbent (1996), who argues for the presence of the element |U| in the content of both velars and labials. For some reason, however, Scheer (2004) does not explore this idea, leaving it for future studies.

5.5 Huber (2007b)

The idea that velars are empty-headed segments, that is, expressions having empty resonance, has been tentatively suggested in a number of ET studies, for example, Harris and Lindsey (1995) and Cyran (1997, 2010). This tradition, however, goes as far back as Particle Phonology (Schane 1984) and Radical CV Phonology (van der Hulst 1989). Recall that in the latter model, velars are proposed to be represented as empty segments which lack any content in the primary subgesture (see Section 4.2). Empty-headedness can be also perceived as a natural consequence of the ET progression. Note that empty-headedness relates directly to the cold vowel and the neutral element in the early version of ET. Along with the development of the model, however, both elements have been dispensed with altogether, leaving velars empty-headed. This idea has been developed by Huber (2003, 2004, 2007a, b), who has become the main promoter and propagator of the empty-headedness of velars, a point of view which finds its fullest expression in Huber (2007b), where the author defends his thesis in a book-length study.

According to Huber (2007b), velars contain the empty-head position which functions as a hosting site for incoming elements from neighboring segments via spreading. Other major places of articulation, that is, labial and coronal, also possess this hosting site but it is taken by a resonance element. In order to justify the assumption that velars lack a phonologically relevant place element, Huber (2007b) refers back to the classic SPE distinctive feature theories. He argues that since in SPE velars are specified negatively as [−anterior, −coronal], it means that they lack these gestures, and so the same should be true of resonance elements. In other words, what makes velars phonologically distinct from labials and coronals is that they are neither of them. One immediate implication of this observation is that no phonological rule can ever make a direct reference to a velar place.

Huber (2007b) generally follows the ET tradition in representing vowels and consonants (major places of articulation) by the same set of resonance elements |I U A|. In his system, labials are represented by the resonance element |U|, while velars are empty-headed |_|.[18] Note further that this solution can only partially capture the observed patterns. Thus, the labial > velar changes get a straightforward explanation as the element suppression |U| > |_|, but the opposite direction of change, that is, velar > labial, is predicted to be impossible as it would require the unmotivated element addition to the structure of velars, namely, |_| > |U|. Huber (2007b) claims that this kind of change is possible only in the context of a labial segment. In Chapter Two, however, we will see that the velar > labial developments can also occur context independently, which seriously undermines the empty-headedness solution.

It is worth noting that in order to defend the representation of velars as empty-headed expressions, Huber (2007b) has to struggle with the generative tradition, which combines placelessness with unmarkedness. Note that it is coronals which have generally been recognized as unmarked and hence placeless (see Paradis and Prunet 1991). Thus, he makes much effort to demonstrate, contrary to a strongly held view, that coronals are not empty but still unmarked. In other words, he argues that placelessness and unmarkedness do not go hand in hand. Nevertheless, there is some inconsistency in Huber's (2007b) argumentation. On the one hand, he agrees with Clements and Hume (1995) that both coronals and front vowels share the [coronal] feature, which is supposed to confirm that coronals are not placeless. On the other hand, however, he discards their idea that velars and back vowels are both represented as [dorsal] segments (see Section

[18] Throughout this book, the main emphasis is put on the resonance elements |I U A| shared by consonants and vowels. In the case of consonants, the articulatory definition of the elements covers the major places of articulation. However, consonants (but also vowels) can contain other elements, such as |ʔ H L|, which add non-resonance (manner) properties, such as occlusion, aspiration, frication, voicing, and nasality. Thus, the neutral labial and velar stops are usually represented as, respectively, |$\underline{\text{U}}$ ʔ H|, and |_ ʔ H|. When occuring in vocalic segments, the same elements represent laryngealized (creaky voice) vowels |ʔ| and the high and low tone or vowel nasalization, |H| and |L|, respectively.

4.1), arguing instead that velars must be empty-headed. We leave the discussion at this point and postpone a critical analysis of Huber's (2007b) analysis until Chapter Three (Section 3). In the last section of the present chapter, we look in greater detail at Backley's (2011) version of ET, as it contains an alternative, anti-mainstream solution to the problem of labial-dorsal interactions.

5.6 Backley (2011)

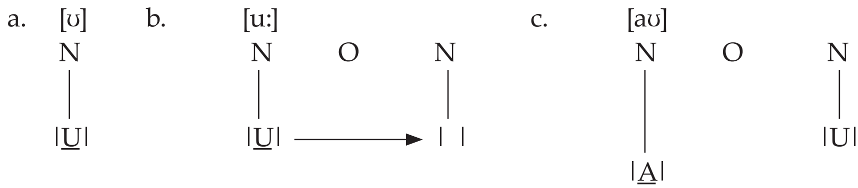
As has already been mentioned in Section 5, the version of ET proposed by Backley (2011) uses a set of six elements |I U A ʔ H L| to represent both vocalic and consonantal systems. Now, since the resonance elements are responsible for vowel contrasts and, at the same time, define major places of articulation in consonants, in what follows we concentrate on |I U A|, discussing their function in both systems, that is, vocalic and consonantal. Finally, we adopt English for illustrative purposes simply because a considerable amount of the data analyzed in Chapter Three come from this language.

Since English possesses a complex vowel system, the elements in this language must combine asymmetrically to form head-dependent relations within a segment. Headed expressions are strong and represent full vowels, whereas non-headed expressions are much weaker, and so they usually appear in weak positions, like unstressed syllables or as the second part of a diphthong. Interestingly, Backley (2011: 45) argues that the phonological contrast between English long and short vowels is based on the length only. It means that although [uː] and [ʊ] differ in quantity, they still have the same element structure, which is |$\underline{\text{U}}$|. This holds true even if in most dialects of English the length difference between [uː] and [ʊ] is accompanied by a difference in vowel quality (tenseness).[19] Thus, the same phonological expression, in this case |$\underline{\text{U}}$|, can be interpreted differently depending on whether it is associated with one or two vocalic slots. It follows that Backley (2011) proposes a different melodic content for tense (ATR) and lax (non-ATR) vowels only in those languages which actively use this element in a phonological process of ATR vowel harmony, that is, some African languages. This, however, is not necessarily the case in Germanic languages, where tenseness is directly related to prosodic (nucleus) structure. Thus, even though English exhibits vowel tensing effects, there are no processes of tenseness assimilation. And since tenseness is rarely active phonologically in English, it is assumed to be just the phonetic effect used by speakers to emphasize the

[19] Note that in other ET versions (e.g., Harris 1994; Harris and Lindsey 1995), the quality difference is the main distinguishing property which separates tense vowels from lax ones. Backley (2011), however, argues that this difference is a matter of phonetic interpretation rather than phonological structure.

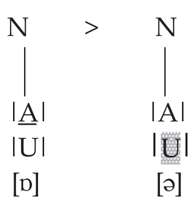
linguistic distinction between simplex and complex nuclei. To sum up the discussion so far, consider the representations in (12) illustrating selected vowels in English.

(12) Representation of English vowels (Backley 2011)



As we can see above, the element $|\underline{U}|$ defines both the lax [ʊ] and tense [u:]; while in the former vowel it is associated with a single nuclear slot (12a), in the latter its scope of operation extends to two nuclear positions (12b). The structure in (12c) represents the closing diphthong [aʊ]. Note that the second part of the diphthong contains the non-headed |U|, where non-headedness represents weakness. Segmental weakness, broadly associated with a lack of prominence, is expressed in two ways: a weak vowel is non-headed, and additionally, it contains only one element in its representation. To put it differently, non-heads play a less important role than heads because they contain less linguistic information. Furthermore, Backley (2011: 51) recognizes three effects of segment (vowel) reduction. These include vowel length, the switch/loss of headedness, and element suppression. The first two mechanisms can be observed in the alternation between *drama* > *dramatic*, which can be captured formally as [a:] $|\underline{A}|$ > [ə] |A|. The element suppression can be illustrated by *congress* > *congressional* [ɒ] $|\underline{A}$ U| > [ə] |A U| (13).

(13) Element suppression [ɒ] $|\underline{A}$ U| > [ə] |A U| (Backley 2011: 53)



In (13), the element |U| is suppressed and, additionally, |A| is demoted to a dependent function. What is left is a single non-headed element which gets the phonetic interpretation of the schwa – the weak vowel. Note further that since glides and vowels have identical internal structure |I U A|, they are distinguished mainly by their affiliation: vowels are dominated by the syllable nucleus, while glides are linked to non-nuclear positions (14).

(14) Representation of vowel-glide pairs

a.		b.		c.	
N	O	N	O	N	O
|I̲|	|I̲|	|U̲|	|U̲|	|A|	|A|
[i]	[j]	[u]	[w]	[ə]	[ɹ]

As depicted in (14), each vowel-glide pair is represented by the same (single) element. Moreover, the weak vowels [ə], [ɪ], and [ʊ] are represented by a non-headed element each, that is, |A|, |I|, and |U| respectively. Since the schwa is a weak vowel, it is found together with [ɪ] and [ʊ] in prosodically weak positions. Backley (2011) represents English [ɹ] as containing the non-headed |A| element. Note that it can capture common alternations between [ə] and [ɹ] in various historical processes and contemporary linking and intrusive phenomena (see Section 2.1.2 in Chapter Three). The latter two can be given a similar explanation to glide formation, which is a common situation in English, for instance, *high*[j]*up* and *go*[w]*away*.

When they appear in consonantal compound expressions, the resonance elements |I U A| function as place definers, that is, they can be rendered articulatorily as the major places of articulation. The element |I| is assumed to contribute palatal resonance to any consonant in which it appears. Recall that a single |I̲| in the consonantal slot is interpreted as the palatal glide [j]. Therefore, headed |I̲| defines the natural class of palatals and is present in palatal and palatalized segments, such as [ç ɟ ʃ kʲ ɲ j ʎ]. By the same token, since we know that headed |U̲| is associated with labiality because in the consonantal slot it gets the interpretation of the labial glide [w], we can assume that headed |U̲| defines the natural class of labials and is present in labial and labialized consonants, such as [ɸ b f kʷ m w β]. This representation is evidenced by cross-linguistic interactions of labials with round vowels, which are represented by the same element |U|. Labio-dentals, like [f ɱ], are claimed to be more complex in that they contain an additional non-headed |A|, hence |U̲ A|. Since coronals cover a wide range of places, including dental, alveolar, postalveolar, palato-alveolar, and retroflex, Backley (2011) proposes to represent the coronal class by either non-headed |I| or |A|, depending on their behavior in a particular system. In other words, Backley (2011) recognizes two different kinds of coronals, |I| coronals and |A| coronals, and proposes that languages can be divided on the basis of coronals they possess. Furthermore, it is emphasized that just because some coronals in a language contain |A|, it is not necessarily the case that all coronals are represented by this element. To put it differently, it is predicted by the model that in the same system, we may find a group of |A| coronals and, additionally, another group of coronals behaving as |I| segments. This observation is in line with the point made earlier (see Section 5, footnote 12) that two sounds which apparently have the same phonetic place of articulation do not always share the same phonological properties. Backley (2011) argues that proposing the two types of coronals does not undermine the main principles of generative grammar because they are not the same category. They are represented differently because they display different phonological behavior. As is repeatedly stressed throughout his study, one can only determine how a segment is structured by observing its phonological behavior. Building on some earlier proposals (Broadbent 1996; Backley and Nasukawa 2009) and on the fact that in many languages velars and labials pattern together as a natural class in phonological processes, Backley (2011) suggests that velars, like labials, contain the element |U|. This is confirmed by common, cross-linguistic labial-velar interactions and their similar acoustic properties (see Sections 3.1 and 4.3). It follows that the element |U|, just like earlier the feature [grave] (Jakobson et al. 1952), captures the acoustic similarity of labials and velars. The element is associated with the predominance of a low-frequency energy pattern which produces the falling spectral slope and in this way functions as a cue for the |U| element. This pattern can be found in round vowels and labial consonants, and additionally in velars, thus confirming that they too have |U| resonance. Since in most systems labials and velars are contrastive, Backley (2011) proposes to distinguish them by headedness; headed |$\underline{\text{U}}$| is interpreted as labial resonance and non-headed |U| as velar resonance. Furthermore, it is velars rather than labials that are proposed to contain non-headed |U| because they are weak and regularly targeted by assimilation processes, or they are the result of neutralization. Note that coronals, which like velars are represented by a non-headed resonance element, are also susceptible to various assimilation and lenition processes. To repeat a point made earlier, ET uses non-headedness to represent phonological weakness, which may explain the behavior of velars and coronals in opposition to, for example, palatals. Finally, the headed element |$\underline{\text{A}}$| is used to represent pharyngeals [ħ ʕ] and uvulars [q ɢ χ ʁ]. Since uvulars very often interact with velars, they additionally contain non-headed |U|, which grants them the representation of |$\underline{\text{A}}$ U|. Crucially, Backley (2011) predicts that in some systems, the representation of uvulars as non-headed |A U| segments is also possible and can only be established by the meticulous analysis of their phonological behavior in a particular language. Such uvulars are assumed to be velar segments modified by the addition of |A|. This element provides them with a darker acoustic quality, which, in articulatory terms, means they are more retracted than regular velars. In order to complete our discussion of the representation of places of articulation, we quote Backley's (2011: 108) table, where the above findings are brought together. The table in (15) contains some additional places, intentionally excluded from this short introduction as irrelevant for the discussion in the following chapters.

(15) Places of articulation according to Backley (2011)

Labial	Labio-dental	Dental	Alveolar	Retroflex	Alveolo-palatal	Palatal	Palato-velar	Velar	Uvular	Pharyngeal
[p ɸ]	[f ɱ]	[t ts s θ]		[ʈ ʂ]	[tɕ ɕ]	[tʃ j]	[c ç]	[k x]	[q χ]	[ħ ʕ]
|U̲|	|U̲ A|	|I| or |A|		|A̲|	|I̲ A|	|I̲|	|I̲ U|	|U|	|U A̲| or |U A|	|A̲|

It must be emphasized here again that these structures are abstract phonological categories which can get different phonetic interpretation cross-linguistically. The opposite is also true, that is, although two segments appear to have phonetically the same place property (e.g., coronals or uvulars), it does not always mean they will show the same phonological structure and thus the same phonological behavior.

At this juncture, a word or two concerning the representation of English lateral is in order. In Backley's (2011) version, laterals are assumed to be complex glides containing |A| and another resonance element. They are classified as glides because like other glides mentioned above, that is, [j w ɹ], they have only resonance elements in their structure.[20] And they are complex, as represented by |A I| or |A U|, depending on the language and the phonological context. These two representations may refer to the difference between clear [l] and dark [ɫ]. Backley (2011) argues that clear [l] is purely coronal and therefore has the representation |A I|, in opposition to dark or velarized [ɫ], which has both coronal and velar characteristics and as such has the structure |A U|. Interestingly, contrary to the traditional assumption according to which English clear *l* precedes a vowel while the dark variant appears elsewhere, Backley (2011) claims that the clear *l* precedes the |I| vowels [ɪ e æ iː eɪ ɪə] and [j], as in *limb*, *let*, *land*, *lean*, *late*, *leer*, *value*, while dark *l* appears in all other positions. This view stands in the opposition to standard descriptions, as it assumes the presence of the dark variant in the following examples: *luck*, *lock*, *look*, *alarm*, *law*, *lose*, *learn*, *film* and *fall*. To put it differently, the lateral in English has been claimed to be a complex, bi-elemental expression containing |A U|. Now, the |U| element is displaced by the incoming |I| in certain contexts simply because in English these elements do not combine easily. The representation of laterals completes the survey of the internal structure of segments which are crucial from the perspective of this study. Some finer details and, if necessary, refinements concern-

[20] In certain systems, laterals can pattern with stops, in which case they are assumed to additionally contain the occlusion element |ʔ|.

ing the intrasegmental structure of particular sounds will be provided when appropriate.

6. Summary and conclusions

This chapter has outlined various theories of intrasegmental structure with the purpose of signalling the problematic character of labial-dorsal interactions. A close scrutiny of previous theoretical work on the internal structure of segments indicates that the formal approaches to cross-class interactions, like labial-dorsal or dorsal-back vowel/glide, are unable to provide a convincing explanation of the observed facts. The elusiveness of the interactions in question is clearly visible in the traditional articulatory-based models of the SPE-type. The feature specification used in the orthodox SPE theory to define velars and labials as, respectively, [−anterior, −coronal] and [+anterior, −coronal] makes it difficult, if not impossible, to relate both classes. Even worse, the model is not able to account for common phonological patterning of labials and velars with back rounded vowels and glides. Broadly speaking, along with new data accumulation it has become evident that peripheral consonants (labials and velars), just like medial ones (alveolars/dentals and palatals), pattern alike. Moreover, back vowels pattern with peripheral consonants, while front vowels pattern with medial ones. Such findings contributed to the observation that phonological theory had reached a point at which it urgently required new theoretical tools. This conclusion has directed the discussion to contemporary models, which have contributed remarkably to the consonant-vowel unity in general and to the internal structure of velars and labials in particular. For example, in feature geometrical models, phonological patterning of velars and labials is explained by postulating the node peripheral (Rice 1994), while consonant-vowel unity is captured by introducing the same set of unary place features (Clements and Hume 1995). Although feature geometries have unquestionably contributed to the understanding of the complexity of the problem, they are unable to cope with it because they suffer from one main design flaw – articulation-based features. Therefore, other theories follow the opposite track, adopt the auditory-acoustic perspective, and seek for the explanation in the speech signal. Acoustic studies argue that if labial-velar interactions cannot be attributed to assimilations on the production side, it must be the acoustic similarity that is responsible for their phonological patterning. Numerous laboratory studies providing detailed physical measurements have triggered the development of new models which can be characterized by the conflation of findings from both the acoustic studies and cognitive-oriented abstract models, for example, Dependency Phonology (Anderson and Ewen 1987), Government Phonology (Kaye et al. 1985, 1990), and especially Element Theory (Harris 1990; Harris and Lindsey 1995; Backley 2011). In Element

Theory, only certain acoustic properties present in the speech signal are linguistically important. We have seen that along with the progression of the model, the representation of velars has changed. At the early phase of ET formation, labials and velars are represented by different elements. Labials, non-low back vowels, and the labial glide contain the element |U|, while velars are defined by the neutral element (Harris and Lindsey 1995), empty-headedness (Cyran 1997, 2010; Huber 2007b), or an additional element (Scheer 2004). Recently, however, all these proposals have been discarded in favor of a solution which establishes a direct relationship between the two categories (Backley 2011). Building on the idea put forth in Broadbent (1996), Backley claims that both velars and labials share the same element |U|. What differentiates both categories is the status of this resonance element, namely, it is headed in labials $|\underline{\mathrm{U}}|$, but non-headed in velars |U|. In this way, labials and velars are formally related, and at the same time, phonologically distinct.

The next chapter provides a considerable amount of cross-linguistic data which illustrate various phonological interactions velars and labials may enter into. The approach we adopt in Chapter Two is to crush the reader with hard evidence on the labial-dorsal close relationship while, at the same time, to stay as theoretically neutral as possible. This is simply because we want to avoid a situation in which fixed frames of a theoretical model influence data selection and, in this way, distort the facts.

Chapter Two

Labial-dorsal interactions cross-linguistically

1. Introduction

One of the elementary observations made in Chapter One was that dorsals interact with labials much more readily than with any other consonantal class. This is one of those indisputable facts which cannot be refuted or dismissed by sweeping it under the carpet. This is even more evident now as there exists strong, cross-linguistic evidence on the close relationship between labials and dorsals. It is hardly surprising then that any set of formal tools aspiring to be called a phonological theory must come up with some effective solutions able to capture this relatedness. Now, since Chapter One introduced and discussed the most valuable, though perhaps rather subjectively selected, previous attempts, this chapter should provide strong empirical evidence on the phonological patterning of labials and dorsals. To repeat the point made at the end of the previous chapter, the following discussion introduces only dry facts without an attempt to offer any explanation. Note that proposing a solution to a phonological problem is always burdened with the choice of a particular theory, which may lead, at the stage of data collection, to the distortion of facts. In other words, we want the chapter devoted to data presentation to be as theoretically unbiased as possible. This is not to say we will refrain from attempting to propose a solution, far from it. The analysis of the selected phonological phenomena, however, must be postponed until Chapter Three.

The major technical problem we faced in the preliminary phase was the organization of the material within the frame of the present chapter. The complexity of the issue and the fact that most of the phonological processes are closely intertwined with other processes make it difficult to unambiguously assign them to the appropriate sections. This simply means that certain processes could be easily assigned not to one but to several sections at the same time. This is the case of, for example, palatalization, which can be subsumed under at least four different labels here. Very briefly, secondary articulation is often formed as a result of phonetic co-articulation which involves some kind of compression of two segments into one. In the case of palatalization, a front vowel leaves a trace on a neighboring consonant and, if the vowel disappears, a segment with a secondary articulation is born. This situation creates a dilemma about whether we should locate the process under the label of secondary articulation, palatalization, consonant-vowel interactions, or perhaps still a different section devoted to shifts between the major consonantal places of articulation. Therefore, it should not surprise anyone to find here examples of processes which match several sections. Since it is just a matter of terminology, we do not try to break this impasse.

This chapter is organized in the following way. Sections 2 through 2.2 provide evidence on labial-dorsal interactions in languages both from the Indo-European language family, with special emphasis on the Germanic and Italic branches (Section 2.1), and from non-Indo-European languages (Section 2.2). Additionally, Section 2.1 is further divided according to the direction of the shift, so that Subsection 2.1.1 deals with the velar > labial shifts, while 2.1.2 deals with the opposite change, that is, labial > velar. Sections 3 through 3.2 concentrate on the phonological patterning of labials and dorsals with other major classes. Thus, while Section 3 deals with the interactions of labials and dorsals with coronals, the succeeding ones describe the patterning of vowels with dorsals (Section 3.1) and labials (Section 3.2). Next, Sections 4 through 4.3 describe various processes in which labials and dorsals readily participate. They include palatalization (Section 4.1), gliding (Section 4.2), and vocalization (Section 4.3). Finally, Sections 5 through 5.2 discuss the class of segments called labio-velars. Section 5 deals with complex segments (double articulation), Section 5.1 describes the phonological behavior of segments with secondary articulation (labialization), and finally Section 5.2 looks at the phonological activity of the labio-velar glide [w]. Section 6 recapitulates the main issues raised in Chapter Two.

2. Labial-dorsal mutual interactions: a cross-linguistic perspective

In order to provide a comprehensive view on mutual interaction and intrasegmental structure of labials and dorsals, the present section brings out a large body of relevant data. A considerable part of the data contains various historical developments which can be found in a number of (mostly Indo-European) languages. Moreover, this section discusses, though to a much lesser extent, examples of contemporary processes, including dialectal variation, observed in languages outside the Indo-European (IE) language family. The first part of the section is devoted to the presentation of the relevant facts from Germanic and other IE languages. In the second part, we turn to more exotic languages. It needs to be clarified right at the beginning of this chapter that what is meant here by a relevant fact is a phonological process which can unveil the internal structure of segments. It means that although the literature abounds in evidence of the intimate relationship between labials and dorsals, only some of the interchanges can inform us directly about their intrasegmental structure. The other changes, no less importantly, draw attention to the fact that labials and dorsals pattern together phonologically and so must share certain characteristics. For example, in English the co-occurrence restrictions on syllable initial consonant clusters ban homorganic sequences like [tl], [dl], [pw], and [bw]. Similar constraints allow for only a small subset of two-plosive sequences in the word-final position. Thus, while both [kt] and [pt] are grammatical word-final clusters in English, there are no clusters of the labial-velar or velar-labial plosives (Backley 2011). Similarly, Rice (2011), while discussing some cross-class consonant interactions, points out that there is some convincing evidence (both diachronic and synchronic) for grouping labials and velars together. The examples she provides, however, are based on the negative conclusion, that is, just because coronals do not behave like both velars and labials, the latter two must constitute a separate group. This can be illustrated by Korean, where in some speech forms the coronal stop and nasal assimilate in place to a following adjacent consonant (be it labial or velar). The labial stop and nasal assimilate to a following velar while the velar plus stop do not assimilate. Rice (2011: 535) concludes that since coronals assimilate to both labials and velars, the latter two groups form a separate class. In yet another example, both labial and velar stops are realized as labial and velar nasals when followed by, respectively, another labial and velar stop between word sequences in Pohnepian, for instance, *e kalap̲ p̲aan soupisek* > *e kala*[m p]*aan soupisek* 'he'll always be busy' and *e saik̲ k̲eŋwini* > *e sai*[ŋ k]*eŋwini* 'he hasn't yet taken medicine.' However, in a sequence of coronals, the first one does not become a nasal, as illustrated by *e meit̲ t̲aŋaaŋa* > **e mei*[n t]*aŋaaŋa* 'aren't you lazy!' It is suggested then that simply because coronals behave differently than labials and velars, the latter two must be recognized as a single class (Rice 2011: 536). The list of such less self-evident cases could be prolonged endlessly. For example, in Baule, a language of the Ivory Coast, the lateral /l/ is pronounced as the flap following an alveolar or palatal consonant, but as the lateral [l] after a labial or velar consonant, for instance, [tɾa] 'catch,' [sɾɛ] 'ask,' [cɾolo] 'funnel,' [ɟɾa] 'lion' but [blɔ] 'bush,' [mla] 'law,' [flɛ] 'call,' [kle] 'hat,' [glɔglɔ] 'insect' (Vago 1976: 674). Another example is Yakut (a Turkic language), in which the plural possessive suffix alternates between a bilabial oral and nasal stop, as in *tünnük* 'window' > *tünnük-püt* 'our window,' *ohoq* 'stove' > *ohoq-put* 'our stove,' and *tiiŋ* 'squirrel' > *tiiŋ-mit* 'our squirrel.' However, the behavior of the suffix after [l] varies in that in certain forms the initial consonant of the suffix is realized as [l], for example, *kül-le* 'ashes, part.' but in other forms the initial consonant remains an obstruent (a velar stop), as in *uol-ga* 'son, dat.' (van de Weijer 1996: 80). The immediate question that arises is why it is that the velar stop occurs in such forms.

To repeat a point made earlier, although valuable to a general discussion, such changes do not say much about the exact structure of the segments involved. To put it differently, they are less self-evident and so must be treated as subsidiary evidence. This does not prevent us from addressing some of them in Chapter Three, though. Furthermore, the following developments are also poorly informative for the intrasegmental structure of labials and dorsals, though for a slightly different reason. Note that even though at first sight diachronic changes responsible for cross-linguistically common fricative > glottal shifts, such as Latin [f] > Spanish and Gascon [h], Irish [f] > [h] > ø or Germanic [x] > Old English [h] (Hickey 1984b: 345), look like possible candidates for processes revealing the internal structure of labials and dorsals (as in a way they do reveal it), they do only apparently so. Note that labials and dorsals are reduced here to a glottal fricative [h], which is a pre-final stage on the lenition trajectory leading to zero (segment deletion). As such, this process must be recognized as the loss of place-definer primes, which simply means that it does not inform us of the labial-dorsal place interaction per se. This is evidenced by the fact that other fricatives (not necessarily labials or dorsals) may meet a similar fate, for instance, southern Spanish [s] > [h]. In ET terms, this is an example of segment decomposition, that is, [f] > [h] is interpreted as the loss of resonants |$\underline{\text{U}}$ A H| > |$\underline{\text{U}}$ A H|. With these circumstances in mind, we can proceed with collection of relevant data.

2.1 Germanic and other Indo-European languages

2.1.1 Velar > labial shifts

This section starts with a number of intuitive or downright natural cases of historical velar > labial developments. As the discussion unfolds, however, it turns to less evident instances. It is a well-documented fact that IE velars with the secondary labial articulation (labialized velars or labio-velars), that is, /k^w g^w/, have the plain labial /p b/ reflexes in a number of languages, such as Irish, Romanian, and Osco-Umbrian, among many others. Broadly speaking, the IE labio-velar consonant /k^w/ turns into either a plain velar or labial, for example, IE *e*k*^{w}o- 'horse' > Ogam Irish e*ch* /ex/, Welsh /ebol/, Latin *equu-* /k^w/, Old English *eoh* /x/, and Ancient Greek *hippo-* /pp/ (Huber 2007a). Moreover, on the basis of examples like Latin *se*[ks], *de*[k]*em* > Ancient Greek *he*[ks]*a*, *de*[k]*a*, 'six, ten,' respectively, it has been suggested that it is predominantly labio-velars, to the exclusion of plain stops, that can undergo the shift.[1] The regular alternation

[1] In her laboratory study of stop place confusions, Plauché (2001: 37) provides examples of some particular shifts from velars to labials, for example, Latin *lacte* >

between /k^w/ and /p/ can be illustrated on the example of Celtic (Huber 2007a, b). It is assumed that IE **k^w* turned into /p/ in the so-called *P*-Celtic languages, such as Welsh, Breton, and Lepontic (Gaulish), while it remained a labio-velar in *Q*-Celtic languages such as Ogam (Old) Irish and Archaic Gaulish, with a later simplification to the plain velar stop /k/ in Modern Irish and Scottish Gaelic. This bidirectional development divides Celtic languages into two groups as represented in (16) below.

(16) Development of the labialized velar in Celtic (Huber 2007a)

**k^w* > /k^w/ (> [kw])	Celtiberian, Ogam Irish, Archaic Gaulish
> /k/	Goidelic: Modern Irish, Scottish Gaelic
> /p/	Brythonic: Welsh, Breton; Lepontic (Gaulish)

Such developments are natural in that they seem to operate irrespective of the context in which the labialized velar happens to occur. In other words, the change to /p/ is not the result of any kind of feature spreading (place assimilation) from neighboring positions. Instead, it must be the labial glide [w], part of the labialized velar, which is responsible for the change. It is recognized, then, as some form of reconfiguration within a complex segment, which is a very common pattern found cross-linguistically. To quote Martinet (1975: 170; after Huber 2007b: 240), 'the passage of /k^w g^w/ to /p b/, that is, the transfer of occlusion from the velum to the lips, is a well-attested and perfectly normal evolution.' Like in Celtic, the development can be observed in the Italic branch. In this family group, Latin is the only language which retained the labio-velars. In the neighboring Osco-Umbrian varieties, the labio-velars wound up without exception as plain labial reflexes. Thus, the correspondences between Latin /k^w/ and Osco-Umbrian /p/ are quite regular, for instance, Latin *quis* > Oscan *pis* and Umbrian *pisi* 'who?' It means that the Italic branch follows exactly the same kind of dichotomy as the Celtic branch, in that some languages retain labio-velars (Latin) while others turn them into plain labials (Osco-Umbrian). Note, by way of digression, that the Germanic branch preserved the IE labialized velars, which show later effects of Grimm's Law, for example, IE **k^w* > OE /x^w/, as in OE *hwa, hwat* 'who, what,' and IE **g^w* > OE /k^w/, as in IE **g^{w}ena* > OE *cwena* 'woman' (> MoE *queen*), Southern Dutch (Flemish) *kween* 'old woman' and OE *cwicu* 'alive' (> MoE *quick*), Dutch *kwi(e)k* 'quick, alive'.

Similar developments of labio-velars can be observed in Romanian, in which the Latin /k^w/ evolved into a plain labial /p/ (Hickey 1984b). However, the Roma-

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Romanian *lapte* 'milk,' and more general patterns, like /k^w g^w/ > /p b/ illustrated by the developments from IE to Greek, Latin to Romanian, or Proto-Mixe-Zoquean to Mixe Tapchultec. She concludes that it is usually labialized velars which evolve into labials predominantly in the pre-consonantal position.

nian case is interesting in that it additionally contains changes of plain velars into plain labials, that is, Latin /k/ > Romanian /p/. Both patterns are illustrated under (17).

(17) The velar > labial shift in Romanian (Hickey 1984b: 347; Huber 2007a: 148)

a. *Latin /kʷgʷ/*	*Romanian /p b/*	*gloss*
ada**qu**are	adă**p**ă	*to take to water*
quattro	**p**atru	*four*
a**cq**ua	a**p**ă	*water*
qui	**p**e	*that, conj.*
e**qu**a	ia**p**ă	*mare*
lin**gu**a	lim**b**ă	*language*
b. *Latin /k ŋ/*	*Romanian /p m/*	*gloss*
co[kt]um	co[pt]	*cooked*
nox, no[kt]is	nea[pt]e	*night*
la[kt]em	la[pt]e	*milk*
lu[kt]a-	lu[pt]ă	*fight*
pe[kt]us	pie[pt]	*chest*
o[kt]o	o[pt]	*eight*
co[ks]a	coa[ps]ă	*hip*
co[ŋn]atus	cu[mn]at	*male relative*
pu[ŋn]u-	pu[mn]	*fist*
si[ŋn]u-	se[mn]	*sign*

First of all, it must be noted that the examples in (17a) duplicate the instances of /kʷ/ > /p/ shifts in Celtic and Osco-Umbrian discussed earlier. This seems to be a regular pattern found generally in Romance languages, as confirmed by Sardinian. The only difference between Romanian and Sardinian in this regard is that in the latter the Latin labio-velar /kʷ/ evolved into the voiced labial stop /b/, as in Latin *quattro*, *quinque*, *acqua* > Sardinian *battoro*, *kimbe*, *abba* 'four, five, water.' However, this regular and neat pattern is violated by a number of cases in which the plain labials in Romanian directly relate to Latin plain velars rather than to labio-velars (17b). Crucially, it is not a mere accident as the list in (17b) could be further extended to cover Latin developments in Dalmatian or some Latin correspondences in Albanian, such as Latin *o*[kt]*u*, *co*[ŋn]*atu* > Dalmatian *gua*[pt]*o*, *co*[mn]*ut* 'eight, male relative' or Latin *lu*[kt]*a* > Albanian *lu*[ft]*ë* 'fight.'

There are a number of available explanations for the velar > labial shifts in (17), but most of them are rejected by Hickey (1984b). For example, the explanation based on lenition is refuted on the grounds that both /k/ and /p/ are stops and neither is phonologically weaker than the other. A different view according to which the forms in (17) represent a conditioned shift (see Leonard 1980) is similarly problematic. Here the Romanian /p/ is assumed to derive from Latin /kʷ/, which makes it a conditioned shift, that is, a labialized stop shifts its plosive stage to its labial release, which results in /p/ as in Latin *acqua* > Romanian *apă* 'water.' This regular pattern is further confirmed by the cases of unshifted /k/ in Romanian, as in Latin *cantare* > Romanian *cînta* 'to sing.' In other words, since Latin /kʷ gʷ/ regularly evolve into Romanian /p/ and, furthermore, since Latin /g/ and /k/ are normally retained in Romanian, it has been suggested that the Latin [kt] clusters in (17b) are in fact regular sequences containing the labio-velar /kʷ/, hence Latin [kʷt] > Romanian [pt]. Thus, despite the fact that it requires the postulation of labialized velars in forms under (17b), this solution was applied to the developments represented by Latin *o*[kt]*o* > Romanian *o*[pt] 'eight' (Leonard 1980). Hickey (1984b) discusses yet another explanation based on the /v/ > /b/ shift illustrated by Latin *servire* > Romanian *serbi* 'serve.' It has been proposed that the developments in (17) proceeded along the following path k[ʷ] > [ᵘ] > [v] > [b] with some later adjustments, like devoicing of [b], deletion of the velar plosive, and nasal assimilation to the following obstruent (if applicable), as in Latin *acqua*, *lingua* > Romanian *apă*, *limbă* 'water, language.' Along with the fact that it again requires the postulation of labialized velars in forms under (17b), it is additionally complicated by the existence of forms like Latin *coxa* > Romanian *coapsa* 'hip.' In the latter example, the assumption that the sequence [ks] contained the labialized velar would be awkward. Note that the explanation of the [ks] > [ps] shift which is based on the following pathway reconstruction [kt] > [xt] > [ft] > [ps] must also be dismissed on the grounds that such reflexes and intermediate stages are not recorded in any of the four main Romanian dialects (Hickey 1984b). In the end, Hickey (1984b) inclines towards the spontaneous shift solution and points to the auditory-acoustic similarity of labials and velars. When faced with the same problematic cases of Romanian /p/ < Latin plain /k/, Huber (2007b) considers an option according to which the shift could originally have been restricted to positions following a back (labial) vowel but, with time, the application of the rule was extended to other contexts in Romanian, as evidenced by (17b).

Although the velar fricative /x/ was completely lost from the English consonantal system (Standard Pronunciation), it left behind many traces throughout the history of English. One such linguistic mark is velar labialization. To give a preliminary idea of the change, consider the IE verb stem **klak-* 'laugh,' which contains a final velar plosive /k/. This plosive has been lenited to the velar spirant /x/ in modern German, and during the development of English it has been reinterpreted as the labial /f/, hence German *lachen* [laxən] ~ English *laugh* [laf] 'laugh' (< IE **klak-*). Note that so far we have discussed the velar > labial shifts within the class of oral plosives; such developments, however, are not absent from the class of fricatives. Quite the opposite, fricatives are affected equally frequently. This is attested abundantly in West Germanic languages and Middle

English in particular. As already mentioned, in the latter period, the velar fricative /x/ in a large number of Old English words has been shifted to /f/ (labialization), for example, OE *hlahhan* /laxan/, *rūh* /ru:x/ > ME *laugh*, *rough* (with the *gh* spelling representing [f]). Since Chapter Three will subject the history of /x/ to close scrutiny, we confine ourselves here to providing only some examples illustrating velar labialization.

(18) Labialization of /x/ in ME (Wełna 1978: 202)

clough > clough	*clough*	sloghe > slough	*slough*
coughe > coff	*cough*	laughen > laugh, laffe	*laugh*
trouʒ > trough, troffe	*trough*	rough > rouf, ruff	*rough*
ynough > enoff	*enough*	tough > tuf, tuff	*tough*

The unstable spelling of some of the forms in (18) captures the /x/ > /f/ shift in progress. Interestingly, a similar change can be found in some southern dialects of contemporary Polish. Thus, apart from a common shift of the word final /x/ > /k/ in the dialects of Lesser Poland (south-eastern Poland) (Urbańczyk 1968; Dejna 1981), there are some /x/ > /f/ developments further to the south in the Spiš area (Polish-Slovakian border). The shifts in question, that is, /x/ > /k/ or /f/, occur predominantly in two contexts: word-finally (19a) and in some consonant clusters (19b). Consider first some examples illustrating these developments (19).[2]

(19) Dialectal developments of the velar fricative in Polish (Dejna 1981)

	Lesser Poland	*South*	*Standard Polish*	*gloss*
a.	[x] > [k]	[x] > [f]	[x]	
	da[k]	da[f]	da[x]	*roof*
	du[k]	du[f]	du[x]	*ghost*
	gro[k]	gro[f]	gro[x]	*pea*
	me[k]	me[f]	me[x]	*moss*
	stra[k]	stra[f]	stra[x]	*fear*
	nie[k]	nie[f]	nie[x]	*let*
	na noga[k]	na noga[f]	na noga[x]	*on foot*
	ty[k] stary[k]	ty[f] stary[f]	ty[x] stary[x]	*these old*
b.	[k]wała	------	[x]wała	*glory*
	[k]wila	------	[x]wila	*moment*
	[k]ciał	------	[x]ciał	*he wanted*

[2] In (19), only the sounds relevant to the present discussion have been transcribed. Bear in mind, however, that the dialectal forms are often quite different in many respects from the standard pronunciation (for details, see Dejna (1981), who uses non-IPA transcription, however).

zu[k]wały	------	zu[x]wały	*cocky*
[k]wast	------	[x]wast	*weed*
[k]wytać	------	[x]wytać	*grab*
spi[k]lerz	------	spi[x]lerz	*granary*
p[k]ła	------	p[x]ła	*flea*
t[k]órze	t[f]órze	t[x]órze	*coward, pl.*
------	[f]tóry	[k]tóry	*which*
------	[f]to	[k]to	*who*

In (19a), the velar fricative in the Standard variety is shifted to [k] or [f] word-finally in some dialects of Lesser Poland. Similar developments can be observed in (19b), with the difference that here the shift takes place in consonant clusters. Note further that the last two examples in (19b), that is, *kto*, *który*, are directly related to the metathesized forms in those dialects in which [x] was weak and prone to loss, for instance, *kto* – *tko* 'who,' *który* – *tkóry* 'which,' *nikt* – *nitko* 'nobody.' Moreover, in the same group of dialects (Lesser Poland), some forms are claimed to be derived by analogy, that is, the shift is motivated by the presence of the shift or lack of it in related forms. For example, in some dialects, a noun in gen.pl. may receive the ending -[ux], e.g. *syn*[ux], St. Pol. *syn*[uf] 'son, gen.pl.,' which agrees with the form of the determiner and adjective, as in *ty*[x] *dobry*[x] 'these good, gen.pl.' In other dialects, however, we can observe the opposite direction of the development in that the forms *ty*[x] *dobry*[x] 'these good, gen. pl.' are realized phonetically with the final labial fricative *ty*[f] *dobry*[f], which in turn are assumed to be modeled on *syn*[uf] 'son, gen.pl.' In the latter dialects, these endings are claimed to have influenced the phonetic realization of nouns in loc.pl. in that they terminate with [f], for example, St. Pol. *na pola*[x] – dial. *na pola*[f] 'in the fields,' St. Pol. *w ręka*[x] – dial. [v rentsaf] 'in the hands.'

While describing some developments of the bilabial [w] in the dialects of Lesser Poland and Mazovia, Dejna (1981: 23) reports on one characteristic pattern which consists in cluster simplification. The pattern is schematized as [xw] > [xv] > [xf] > [f], with the final stage containing the labial fricative [f]. It has survived in some place names and proper nouns, for instance, *Bogu*[f]*ał* < *Bogu*[xf]*ał*, [f]*alęta* < [xf]*alęta*, [f]*alimir* < [xf]*alimir*, [f]*alenica* < [xf]*alenica* but also in *fała* < [xf]*ała* 'glory,' [f^j]*ila* < [xf^j]*ila* 'moment.' Note that the latter developments resemble cluster simplification in the Kurp and Northern Mazovian dialects [fɕ]*ołek* ~ [ɕ]*ołek* 'violet,' [vʑ]*adro* ~ [ʑ]*adro* 'bucket,' [kfɕ]*at* ~ [kɕ]*at* 'flower,' [gvʑ]*azdy* ~ [gʑ]*azdy* 'stars,' [mɲ]*asto* ~ [ɲ]*asto* 'city.' In such forms, the second element of the soft labial, that is, [f^j v^j m^j], is first strengthened to [ɕ] or [ç] and then simplified by the deletion of the preceding fricative (or nasal).[3]

3 The analysis of the Kurp and Northern Mazovian soft labials has been proposed in, for example, Czaplicki (1998) and Kijak (2008). See also Chapter Three.

Finally, Hickey (1984b: 351) briefly reports on some dialectal alternations between /h/ and /f/ in modern Irish, for example, *toghta* /tʌhə/ ~ /tʌfə/ 'excellent,' *lútha-gháir* /lu:ha:r/ ~ /lu:fa:r/ 'joy,' and *cruth* /kruh/ ~ /kruf/ 'shape.' He does not discuss the exact phonetic realization of /h/ in such forms, and all we can learn from these examples is that the intervocalic or word-final /h/ evolves into a labial fricative /f/.

Let us return for a moment to the development of dorsals in the history of English and provide some more examples of dorsal related processes. The diachronic study of English is a fruitful source of information about dorsals, and, in what follows, we look at some of the most important processes affecting them. Apart from the cases where the velar is lost without a trace, as in, for example, word-initial consonant cluster simplification /xl/, /xw/, /xr/, /xn/, /kn/, /gn/ > /l/, /w/, /r/, /n/, as in *hlaf* /xla:f/ > /la:f/ > /ləʊf/ 'loaf,' there are also instances in which the presence of the original velar fricative, although indirectly, is still felt, as in compensatory lengthening, for instance, *meaht* /meaxt/ > /mɪxt > /mi:t/ > /maɪt/ 'might.' Finally, there are also processes where various effects of the velar loss are directly accessible in the form of various vocalizations, gliding, and diphthongizations. We start the presentation of the relevant data with the less obvious cases, turning to more clear examples as the discussion unfolds.

Huber (2006) provides a basis for dorsal-related processes in the history of English, OE in particular. Although his analysis is not intended to be exhaustive and certain changes, such as *i*-mutation, are deliberately disregarded, it is still a valuable source of information. Huber (2006) divides dorsal-related phenomena into two groups. The first group contains processes in which velars are a target of various modifications, for example, a deletion of the intervocalic velar fricative /x/, velar fricative voicing, various palatalizations, and the above-mentioned cluster simplifications. The second group includes processes in which a velar obstruent is a trigger of a change, for instance, breaking of front vowels in the context of velars. In his analysis, Huber (2006) tries to understand why it is the velar fricative that predominantly initiates or is first to undergo various developments, including nasal deletion, vowel breaking, and cluster simplifications. More specifically, his study concentrates on determining the reasons behind the loss of nasals before the Germanic voiceless fricatives. As for these, the Primitive Germanic contained a number of clusters of the nasal plus voiceless fricative type, sucha as [mf], [nθ], [ns], and [ŋx]. However, it is emphasized that the loss of the nasal in such clusters was initiated by the [ŋx] sequence, and only later was the process extended to cover the rest of the clusters. It short, in Primitive Germanic, the nasal disappears before the velar fricative, triggering some other modifications, like compensatory lengthening and vowel nasalization (Campbell 1959: 44). It follows that the original sequences containing a short vowel followed by a homorganic nasal plus the velar fricative *-[iŋx], -[uŋx], and -[aŋx] became nasalized long vowels followed by the velar fricative, that is, *-[ĩ:x], -[ũ:x] and -[ã:x], respectively. This development is illustrated in (20) below by the examples adopted from (Campbell 1959: 44; after Huber 2006a: 3).

(20) The loss of the nasal before the velar fricative in Primitive Germanic

Prim.Gmc	*OE*	*other Germanic*	*gloss*
-iŋx	*þīhan > þēon	*OS* thīhan	*to thrive*
-uŋx	fūht	*Du* vocht	*moisture*
-uŋx	ūhte	*Du* ocht(end)	*dawn*
-aŋx	ōht	*Du* acht, *OHG* āhta	*persecution*
-aŋx	þōhte	*Du* dachte, *OS* thāhta	*he thought*
-aŋx	*faŋxan > fōn		*to take, inf.*

In (20), the OE forms are additionally compared to the related forms in other Germanic languages, like Old Saxon (OS), Old High German (OHG), and Modern Dutch (Du). Interestingly, the loss of the velar nasal before [x] is often accompanied by vowel rounding as exemplified by some OE forms, such as, *ōht* and *þōhte.* As already noted, the same course of events later affected other nasal plus voiceless fricative clusters in the West Germanic languages, except OHG. Although instances of nasal loss before the voiceless velar fricative and before other voiceless fricatives occur in different periods of time and so are usually discussed separately in the literature, Huber (2006) treats them in the same way. He argues that the later developments, that is, nasal loss before other non-velar fricatives, are the continuation of the process started by nasal deletion before the velar fricative, which, with time, broadens its application scope. Be that as it may, we can see that the velar fricative triggers the loss of the preceding homorganic nasal, which often brings about vowel rounding.

As noted above, the disappearance of the velar fricative from English was triggered by a sequence of processes dating back to OE (Hogg 1992). In (21), we provide some examples adopted from Wełna (1978: 51) illustrating the vowel/glide development before the velar fricative. This change may be considered as a first step towards the loss of the velar fricative in later forms.

(21) Development of glide (vowel) before [x] in OE

furh	>	furuh	*furrow*
burh	>	buruh	*borough*
þurh	>	þuruh	*thorough*
holh	>	holuh	*hollow*
mearh	>	mearuh	*marrow*

In (21), the forms on the left contain liquid + velar fricative consonant clusters which get broken by the *u*-glide. It is worth mentioning here that the ME spelling of some of these forms is unstable, for example, *furgh*, *forough*, *forwe* 'furrow,' *burgh*, *burw* 'borough,' and *thorugh*, *thorowe* 'thorough.' The immediate conclusion is that the phonetic realization of the velar fricative fluctuated for some time between [u], [w], [x], and/or [ɣ], which suggests that it may have already been lost from the English consonant system. Furthermore, in ME the same forms, that is, those in (21), develop a vowel before the glide [w] which originally comes from the spirant /x/, [w] < /x/. The vowel is predominantly spelled <o>, as in OE *furh* > ME *furowe* 'furrow,' OE *burh* > ME *borowe* 'burrow,' OE *sorh* > ME *sorowe* 'sorrow.' The source of this vowel must be the following glide [w] < [ɣ]. It brings to mind the operation of the well-known Verner's Law, which is responsible for the appearance of an intervocalic voiced velar fricative accompanied with lip rounding (labialization), [ɣw] (Hickey 1985: 278). For instance, even though the intervocalic /x/ in the verb *seen* 'to see' was lost relatively early, it survived in the preterite form, that is, in the context where it was voiced by Verner's Law. It is pointed out that this voiced intervocalic segment can have two attested forms with alternative realizations, namely, *sæ*[ɣ]*on* and *sā*[w]*on* 'saw.'

The major source of new diphthongs in ME was the vocalization of [j w ɣ] and the breaking of certain vowels, namely, [e a o], before [x] (Kwon 2012). The latter type is sometimes called ME breaking to underline the similarity to OE breaking (see Chapter Three, Section 7.2). The ME breaking is responsible for the appearance of the [eɪ aʊ ɔʊ] diphthongs, which then undergo further development in Early Modern English (EModE), for instance, labialization and loss of ME [x]. The examples in (22), adopted from Kwon (2012), illustrate the impact of the velar fricative development in ME.

(22) ME diphthongization before the velar fricative (Kwon 2012: 36)

a. Diphthongization and subsequent labialization of [x]

Vowel	*EME (11 c.)*	*ME (13 c.)*	*EModE (16-18 c.)*	*gloss*
long	rūh	rough [ɔʊx]	rough, ruff [ɔf]	*rough*
	slōh	slough [ɔʊx]	slough, sluff [ɔf]	*slough, n.*
	genōh	enough [u:x]	enough, enuff [uf]	*enough*
short	troh	trough [ɔʊx]	trough [ɔf]	*trough*
	coh	cough [ɔʊx]	cough [ɔf]	*cough*
	lahhe	laugh [aʊx]	laugh, lauf, laf [af]	*laugh*

b. Diphthongization and subsequent deletion of [x]

Vowel	*EME (11 c.)*	*ME (13 c.)*	*EModE (16-18 c.)*	*gloss*
long	āhte	aught [aʊx]	aught [ɔ:]	*aught*
	þōht	thought [ɔʊx]	thought [ɔ:]	*thought*
short	faht	faught [aʊx]	faught [ɔ:]	*fought*
	slahter	slaught [aʊx]	slaught [ɔ:]	*slaughter*
	dohtor	doughter [ɔʊx]	doughter, douter [ɔ:]	*daughter*

c. Diphthongization and subsequent deletion of [ç]

Vowel	*EME (11 c.)*	*ME (13 c.)*	*EModE (16-18 c.)*	*gloss*
long	hēh	heigh [eɪç]	high [e:] ([i:] > [aɪ])	*high*
	þēh	theigh	thigh	*thigh*
short	fehtan	feight [eɪç]	fight [e:] ([i:] > [aɪ])	*fight*
	ehta	eight	eight [eɪ]	*eight*
	niht	night [ɪç]	night, nyte [i:] (> [aɪ])	*night*

As depicted in (22), the source of new diphthongs in ME was the diphthongization of front and back vowels (both short and long) before the velar fricative [x] (22a–b). For example, the vowel [ʊ] in *aught* is assumed to be a transitional glide which springs up between the back vowel [a] and the velar fricative [x]. Similarly, in (22c) the vowel [ɪ] in, for example, ME *heigh* is assumed to be a transitional glide between the front vowel [e] and the palatal variant of /x/, which is [ç]. Following Jordan (1974), Kwon (2012) notes that the deletion of [x ç] and the labialization of [x] to [f] depicted in (22a–c) began as early as the 14th century and encompassed most of England except the northern area including Scotland. This is why the velar fricative is still present in the Scottish consonant system. Furthermore, it is pointed out that there is some historical evidence, for instance, rhyming in EModE, to indicate that most of the forms in which [x] was deleted (22b) possessed competing variant forms with the labial [f], as in EModE literature: *oft – nought*, *daughter – after* (Shakespeare), *wrought – soft* (Chapman) (Kwon 2012). To sum up, ME breaking before [x] has triggered various further modifications, like labialization [x] > [f] accompanied by shortening of the preceding vowel (22a), deletion before [t] accompanied by lengthening of the preceding vowel (22b), and, finally, the pre-consonantal and word-final deletion of the palatal variant [ç] which never experienced labialization. These divergent developments may be schematized as in (23).

(23) Various effects of the velar fricative loss from ME to EModE (Kwon 2012: 38)

a. Labialization: [aux] > [af], [ɔux] > [ɔf], [u:x] > [uf]
b. Deletion: [aʊxt], [ɔʊxt] > [ɔ:t]
c. Deletion: [eɪç](t) > [e:](t), [eɪt] and [iç](t) > [i:](t)

On the basis of the data in (22), Kwon (2012) concludes that apart from a slight deviation, English basically observes the pattern of gradual obstruent lenition generally assumed in historical phonology studies (Vennemann 1972; Lass and Anderson 1975; Howell 1991, among others). More specifically, English departs from the established lenition trajectory of the velar plosive [k] > [x] > [h] > Ø in that in certain cases, instead of being dropped, the velar fricative is shifted to the labial [f], as represented in (24).

(24) Development of IE /k/ (Lass 1999: 117)

	Onset	Coda
Indo-European	/k/-	-/k/
Early Germanic	/x/-	-/x/
OE, ME	[h]-	-[x] or contextual palatalized variant -[ç]
EModE	[h]-	-[f] or Ø

The development of the IE velar plosive in English proceeds along the lenition trajectory to a certain point only; the common pattern [k] > [x] > [h] > Ø gets bifurcated in that the syllable-final [x] is either lost or shifted to a labial fricative [f]. Labialization is just one of several effects triggered by the loss of the velar fricative in OE and ME. Other modifications include the already mentioned diphthongization, vowel rounding, and gliding. This set can be further expanded by, for instance, the vocalization of the English lateral. Apart from some general co-occurrence restrictions according to which the velarized variant of the lateral (dark *l*) chooses to be preceded by velars rather than coronals in some varieties of English, for example, Jamaican English *little* [lɪkɫ], *handle* [hæŋgɫ] (Backley 2011: 179), there are also some processes illustrating the phonological development of [ɫ]. Thus, besides the diphthongization processes before velar fricatives discussed above, ME witnessed another change leading to the appearance of new diphthongs. This process boils down to the development of a transitional glide [u] between a back vowel and the velarized lateral [ɫ]. This is represented in (25) below.

(25) ME diphthongization before [ɫ] (Wełna 1978: 192ff)

a. ME [a] + [ɫ] > LME [au] + [ɫ]				b. ME [o u] + [ɫ] > LME [ɔu] + [ɫ]			
alter	>	aulter	*altar*	colte	>	coult	*colt*
malt	>	mault	*malt*	gold	>	gowlde	*gold*
falle	>	faul	*fall*	shuldre	>	shoulder	*shoulder*
walke	>	w[aulk]	*walk*	yolke	>	y[oulk]e	*yolk*

As illustrated under (25a–b), the change consists in the appearance of the transitional vowel/glide [u] before the lateral. It results in various (later) modifications, such as vowel raising and lengthening via the intermediate diphthongization stages: [a] > [au] > [ɒu] > [ɔː] (25a) and diphthongization or lowering and diphthongization: [o] > [ɔu] > [əʊ] and [u] > [ɔu] > [əʊ] (25b). What is important, however, is that the appearing vowel is specified as back and rounded.

Finally, Hickey (1984b: 351) briefly reports on the velar > labial shift in the history of Russian (see Bräuer 1961). In this language, there are instances of the /g/ > /v/ shift in the pronominal genitive ending '*-ogo.*' On the basis of some correspondences in Ukrainian and White Russian, Hickey argues for the intermediate stage in the development of /g/, that is, [ɣ], which is then shifted to the labial [v]. The cause of the change is sought in the environment in that the velar plosive occurs in the close vicinity of the central-back vowel, as in *ego* /jivo/ 'his,' *russkogo* /ruskəvə/ 'Russian, gen.' (Hickey 1984b: 351).

To sum up, we have seen that apart from some evident dorsal > labial shifts, there are also those in which the interaction between both classes is less obvious, for instance, diphthongization and vocalization. As will be argued in Chapter Three, however, both types of processes contribute to an understanding of the internal structure of labials and dorsals and their mutual interaction.

2.1.2 Labial > velar shifts

In a series of studies on the phonological patterning of labials and velars, Hickey (1984a, 1984b, 1985) provides a great number of cross-linguistic examples of their interaction. His discussion, however, is not confined to changes in one direction only, that is, the velar > labial shifts discussed in the previous section. Some space is also devoted to the development in the opposite direction, namely, labial > velar shifts. This type can be illustrated by the /p/ > /x/ shift from Latin to Old Irish (OI), as in Latin *se*[pt]*em* > OI *secht* se[xt] 'seven.' Two developmental paths are proposed to explain this /p/ > /x/ change. While the first assumes the /p/ > /k/ > /x/ pattern, the second maintains that in the first step, the labial stop is shifted to the labial fricative and only then to the velar spirant, hence /p/ > /f/ > /x/. It is argued that what makes the latter solution, that is, /p/ > /f/ > /x/, credible is the restriction on a sequence of plosives, which must have already been in operation in the OI period. The second factor which weighs in favor of /p/ > /f/ > /x/ development is a similar pattern found in Germanic, for instance, Old High German *nift* > Modern High German *Nichte* 'niece' < Latin *neptis* 'granddaughter.' In short, while in pre-historic Irish /p/ was usually deleted, as in Latin *pater* > OI *aithir* 'father,' in certain cases, it was shifted to [f]. In other words, /p/ lenities to /f/, and in the position before /t/, it gives the cluster /ft/, which is then shifted to /xt/. However, it is also possible for /p/ to be shifted to the velar plosive /k/. Hickey (1984b: 350) notes that the latter shift affects only loan words from Latin as, it will be recalled, Irish eliminated all instances of inherited /p/, mostly by deletion. Thus in OI there exists a group of old loan words from Latin which represents regular /p/ ~ /k/ correspondences (26).

(26) The labial > velar shift in Old Irish (Hickey 1984b: 350)

Latin	*OI*	*gloss*
pascha	cásc	*Easter*
purpura	corcar	*purple*
planta	cland	*plant*

It is pointed out that in such cases, the shift from labial to velar was not conditioned by the environment (Hickey 1984b). It would not be possible to postulate any intermediate stage, either, as has been done in some Romanian developments of the Latin /k/ discussed in the previous section.

While discussing epenthesis, Huber (2007b: 73) points out that it is not only coronals that are cross-linguistically common epenthetic consonants; velars can also serve this function. Velar epenthesis can be illustrated on the example of the well-documented and frequent appearance of [g] before the glide plus vowel sequences, as attested in Romance languages, for instance, Spanish, Galician, Italian, and French (Huber 2007b). More specifically, in Spanish, a voiced velar stop [g] is inserted in a situation when a Germanic loan word starts with the sequence of a labio-velar glide [w] followed by a vowel. This process is broadly known in the literature as velar fortition of glides or *w-reforzada*.[4] The subsequent development consists in the loss of lip rounding before a predominantly front vowel, which results in [g] + vowel sequences that are evident in Spanish. The development is schematized as [w] > [g^w] (> [g] + V), illustrated by the Old Germanic words starting with #we-, #wi-, #wa-, which evolve into the sequences [ge-], [gi-], [g^wa-] in Spanish (27).

(27) Velar fortition in Spanish (Ferreiro 1999; after Huber 2007: 73ff)

	Spanish		*Germanic*	*gloss*	*compare*
[ge]-	guerra	<	*werra	*war*	
[gi]-	guisa	<	wisa	*wise, manner*	
	guindar	<	windan	*to wind up, to heave*	
[g^wa]-	guadañar	<	*waidanian	*to scythe*	
	guardar	<	wardon	*to guard*	Eng. *warden*
	gualda	<	walda	*dyers's greenweed*	Eng. *weld*
	guarecer	<	warjan	*to provide shelter*	OE *werian*
	guarnecer	<	warnjan	*to equip*	Eng. *warn*
	guante			*glove*	Du. *want*

The velar epenthesis is also observed in Galician, with the difference that the Spanish [g^wa]- corresponds to Galician [ga]-, as in Sp. *guadanar* ~ Gal. *gadanar* 'to scythe,' Sp. *guardar* ~ Gal. *gardar* 'to guard.' Additionally, in Spanish, the epenthetic velar may trigger place assimilation of the dental [n] in the masculine indefinite article *un-*, for example, *u*[ŋ g^w]*evo* or *u*[n w]*evo* 'an egg' (Huber 2007b: 74). This occurs in a group of Spanish words which were derived by the diph-

[4] Huber (2007b: 186) notes that although in the majority of Latin words the glide [w] evolved into [β] in French, there are some cases with [g] reflexes, for example, French *gué* < Latin *vadum* (Spanish *vado*) 'ford' and French *guéret* < Latin *vervactum* (Spanish *barbecho*) 'fallow land'.

thongization of the stressed short open [ɔ] in Latin forms, for instance, Lat. *hortus* > Sp. *huerto* ‘orchard,’ Lat. *ovum* > Sp. *huevo* ‘egg,’ Lat. *orphanus* > Sp. *huérfano* ‘orphan’ (in Spanish, the orthographic <h> is silent). Although such forms lack the development to [g^w] + V, in certain dialects they may develop the epenthetic velar [g] which follows the indefinite article *un-*, as in the above mentioned *un huevo* [uŋ g^weβo] ‘an egg.’

Since it is a common process in Romance languages, the velar epenthesis [w] > [g^w] occurs not only in Western Romance but also in Eastern Romance, for instance, Dalmatian, where there were no Germanic words to accommodate in the system. For example, the result of the diphthongization of Latin /o/ is the sequence containing the epenthetic velar plosive, as in Latin *octo* > Dalmatian *guapto* ‘eight’ (Huber 2007b: 187). Huber (2007b) argues that since the sequences [g^w] + V are not found among the word-initial clusters in Latin (including Vulgar Latin), it cannot be maintained that the epenthesis (fortition) took place in order to assimilate these new words into the existing system. Finally, note that it is not only Germanic common nouns which were affected by the velar epenthesis but also loan words from Arabic, including proper nouns (of both Germanic and Arabic origin) (28).

(28) Velar epenthesis in proper nouns (Huber 2007b: 83)

Guillen/Guillermo	<	William
Gales	<	Wales
Guasington	<	Washington
Guimara/Guimarez	<	Wimara (Germanic)
Guadalquivir	<	Wad al-Kebir (Arabic) ‘the Great River’

Moreover, the process is still active, as evidenced by some more recent borrowings from Aztecan, Quechua, and English (29).

(29) Velar epenthesis in more recent loans (Huber 2007b: 83)

Spanish			*Aztecan, Quechua and English*
huacal/guacal	*type of basket*	<	Azt. uacalli (1571)
huaca/guaca	*Indian tomb*	<	Que. uaca (1551)
huasca/guasca	*whip, lash*	<	Que. uaskha (1599)
guacho	*orphan*	<	Que. uajcha (1668)
guanaco/huanaco	*wild llama*	<	Que. uanacu (1554)
guano	*guano*	<	Que. uanu (1590)
huachiman/guachiman	*watchman*	<	Eng. watchman
guelfar	*welfare*	<	Eng. welfare
guinche, guinche	*winch*	<	Eng. winch

In (29), just as in the forms discussed earlier, the pre-vocalic glide [w] evolves into a sequence composed of the velar stop [g] and the glide [w], that is, [g^w] + V in Spanish loanwords.[5] Although in a different language family, a similar process occurs also in Swedish.[6] Very briefly, in the Lappfjärd dialect, the coronal [t] is interpreted as velar [k] in the context of a following labial [v], as in St. Swedish *tvättas* ~ dial. *kvättas* 'be washed' (Backley and Nasukawa 2009).

There is no doubt that the analysis of dialectal forms is as rewarding an effort as the study of the historical development of a language. We have already seen it in the foregoing discussion, and we will have the chance to confirm it several times in the following pages. To make it more tangible, consider some modifications affecting the labial plosive /p/ in several varieties of spoken Spanish. For instance, it has been reported that in Caribbean dialects, there is some variation in the realizations of word-medial, syllable-final consonants, for instance, assimilation, segment loss, etc. (Brown 2006). Interestingly, there is a widespread sound change that does not conform to any regular development patterns found in these dialects, namely, the labial > velar shift in the pre-consonantal position. More specifically, in a number of Spanish dialects, word-medial, labial stops are articulated as velar stops, as in *pepsi* > *pe*[k]*si*, *séptimo* > *sé*[k]*timo* (Brown 2006). The somewhat surprising change from the labial to velar plosive is quite common, as this pronunciation has been reported in the casual speech style of Venezuela, Colombia, and Central America and is also found in the Caribbean islands and other areas of the Spanish speaking world. Consider some examples from Caribbean Spanish in (30).

(30) Labial > velar shift in Caribbean Spanish (Brown 2006: 49)

concepto	>	conce[k]to	*concept*
séptimo	>	sé[k]timo	*seventh*
opción	>	o[k]ción	*option*
receptor	>	rece[k]tor	*receptor*
pepsi	>	pe[k]si	*Pepsi*
captando	>	ca[k]tando	*grasping*

In (30), the labial plosive [p] in the pre-consonantal position (predominantly a coronal obstruent) is changed to the velar plosive [k]. Note that the shift occurs after a non-high vowel, front and back alike. Furthermore, the change is in

[5] Huber's (2007b) analysis includes also instances of consonant epenthesis in English, discussion of which is postponed to Chapter Three (Section 5.1).

[6] Since it is not a case of epenthesis proper, the discussed example is similar only to a certain extent to the Spanish development. The similarity lies in the fact that the labial consonant is responsible for the appearance of the preceding velar, be it an epenthetic stop or a shifted coronal.

operation even at the cost of producing ambiguity in the form of homophones, for instance, *apto* 'apt' > a[k]to, *cp. acto* 'act,' *aptitud* 'aptitude' > a[k]titud, *cp. actitud* 'attitude,' etc. Although much less frequently, the process can also proceed in the reverse direction, as exemplified by Venezuelan (31).

(31) Labial >< velar shifts in Mérida, Venezuela (Brown 2006: 50)

Syllable final	*% velar*	*% labial*	*other*
/k/ (N = 874)	99	< 1	< 1
/g/ (N = 466)	99	< 1	< 1
/p/ (N = 439)	53	46	1
/b/ (N = 410)	37	48	15

The results of the quantitative analysis show that the velar realization of the labial plosive is the most common pattern (53%). It is even more common than the model realization of the labial (46%). Velars, on the other hand, are realized as labials extremely rarely (less than 1%). On the basis of the data in (31) and due to both the high token and type frequency of syllable-final [k] and very low token and type frequency of syllable-final [p], Brown (2006) suggests that the pattern with the syllable-final [k], as the stronger and more productive one, promotes the [p] > [k] shift. However, there is no explanation whatsoever of why [p] is not shifted to any other high-frequency consonant.

The quantitative analysis of the Spanish [p] > [k] shift briefly discussed above brings to mind the results of the stop place confusions in laboratory studies we have already described in Chapter One (see Section 4.3). It was noted there that the consonants which get easily confused in laboratory studies are subject to parallel shifts in diachrony. It has been pointed out that just as in laboratory studies, alveolars are rarely subject to historical shifts in place and that historical shifts are often asymmetric (Plauché 2001). These observations find reflection in Brown's (2006) study, especially the asymmetry between [p] > [k] and [k] > [p] shifts evident in (31) above. Plauché (2001) provides some examples illustrating a few of the cross-linguistic historical sound changes that mirror the stop place confusions discussed in her laboratory study.[7] She notes that labials often shift historically to velars (sometimes palatalized or labialized) in all environments, including the pre-vocalic position, for example, [p] > [k^w] in Latin and Proto-Siouan-Iroquoian to Seneca, [p] > [k] in Proto-Algonkian to Atsina, Yurok, and [p] > [k^j]/[b] > [g^j] in Romanian. Unfortunately, she does not provide any examples illustrating these changes but instead limits herself to

[7] In this section, we discuss Plauché's (2001) examples of labial > velar shifts only. She also provides some instances of velar > coronal changes, which will be discussed later on in Section 3.

a laconic statement that these shifts parallel laboratory confusions of bilabials that precede a rounded vowel, such as [u], which are most often mistaken for velars. Plauché (2001) concludes that since both historical and laboratory labial > velar shifts (but also velar > labial) are common in the world's languages, they might constitute a separate class which is based on their similar acoustics. In her discussion, Plauché (2001) refers also to Bonebrake's (1979) study of labial > velar shifts in Dutch fricatives, the diachronic changes to which we turn now.

Dutch shows a diachronic change in which a labial fricative turns into a plain velar in the preconsonantal position. This is the mirror image of the process found in English (see the previous section) in that the shift in Dutch proceeds in the reverse direction, that is, labial changes into velar. Note, however, that the change in question is of an earlier date than the shift in English described above. Simply put, it operates in a different period and on a different set of forms. This becomes evident when we look at the data in (32) below, which provide some cognate forms of Dutch, German, and English. More specifically, the labial fricative /f/ in Proto-Germanic **luftuz-* 'air' is reinterpreted as the corresponding velar /x/ in the modern Dutch form *lucht* [lʊxt], hence German *Luft* [lʊft] ~ Dutch *lucht* [lʊxt] 'air' (< PGmc **luftuz-*) (Hickey 1984b; Huber 2007a).

(32) The development of [x] in Dutch (Huber 2007a: 153)

German	*English*	*Dutch*	*gloss*
Luft	loft	lucht	*air*
Kraft	craft	kracht	*strength*
sanft	soft	zacht	*soft*
kaufen	cheap	kopen	*to buy*
		kocht	*bought 3sg.*
klaffen	cleave	klucht	*farce*
graben 'to dig'	grave	gracht	*type of channel*
——	after	achter	*behind*
Stiftung	——	stichting	*fund*

In (32), we can see direct correspondences between a labial obstruent in German and English and the velar fricative in Dutch. Crucially, this seems to be an unconditioned shift as it occurs between any vowel (front and back) and the following coronal /t/.[8]

[8] Note, by way of digression, that Old Norse (ON) belongs together with English in that it has a labial obstruent, for example, ON *lopti* in *ā lopti* (~ Eng. *aloft*). As for German, there are two variants: while Old High German is grouped togerther with English and Old Norse, Low German (LG) behaves like Dutch in that it has /x/, for instance, LG *achter* ~ OE *æfter* (Huber 2007a).

As for the labial > velar shift within the history of Dutch, it is assumed to have taken place in Middle Dutch (MDu). The change affects the labial fricative /f/, which shifts into a velar and, in the majority of cases, ends up as /x/. Consider some examples in (33a–c), which have been adopted from Bonebrake (1979: 66).

(33) MDu /f/ > /x/ shift

a. labial > velar changes

OLF after	>	MDu achter	*after*
OLF hafta	>	MDu hachte	*capture/captivity*
OLF craft	>	MDu cracht	*power*
OLF gestiftoda	>	MDu stechten	*found*
OLF senifte	>	MDu zachte	*soft*

b. dialectal variation

OLF heliftron	>	MDu halfter	*halter*
		halchter (Limburg)	
		halter (South Limburg)	
		halser (Southwest Limburg)	
		halder (Zeeland)	
		halfter > halter > hauter (West Flemish)	

c. place names

Alftre	–	Alechtre	*Alfter (Cologne)*
Suftele	–	Suchtele	*Süchteln (Düsseldorf)*
Crufte	–	Crocht	*Kruft (Cologne)*
Uifta	–	Uechta	*Vichte (Kortrijk)*

First, note that for manifold reasons the Dutch evidence is far more scanty than that for the /x/ > /f/ change in English (Bonebrake 1979: 65). Moreover, the fact that the above table captures a general tendency rather than an exhaustive picture does not affect the conclusion that the shift in Dutch proceeds in the opposite direction to the change found in English. This becomes evident when we look at the examples under (33a). Additionally, (33b) illustrates some modifications found in various dialects. The forms in (33b) show that the general pattern is sometimes reversed or violated, as in the labial > spirant /s/ change in some dialects of Dutch, for example, MDu *nooddurft* > West Flemish *nooddorst* 'indigence.' Additionally, (33c) depicts the shift in some place names, which is a regular pattern found in the historical development of Dutch (see 33a), namely, the labial changes into velar. Finally, it must be noted that the Dutch facts are much more complex than we have adumbrated here, in that there are many exceptions to the change, which is sometimes blocked by the homonymy creation.

Moreover, various lexical items may develop in an unpredictable way and shift back to the labial fricative /f/.[9]

A similar change is reported to operate in Russian. While analyzing various reflexes of the Common Slavonic (CS) labio-velar **w*, Cyran and Nilsson (1998: 90) provide some examples from closely related languages in which **w* develops into the fricatives [f v x]. For instance, while (CS) **w* survives as such in the syllable-final position in Standard Ukrainian and Slovak, it develops into [v] or [f] in Czech and Polish, as in Slovak [slɔw], [la:wka] ~ Czech [slɔf], [la:fka] ~ Polish [swuf], [wafka], 'word, gen.pl.' and 'bench, nom.sg.' Interestingly, the reflex of the (CS) **w* in Northern Russian is the voiceless velar fricative [x], for instance, N.Russ. [słɔx], [łaxkə], 'word, gen.pl.,' 'bench, nom.sg.' That is, in Northern Russian, a labial shifts to velar in the syllable-final position (pre-consonantally and word-finally). Note that this change does not occur in the syllable-initial position where we find instead the labial reflex [v], as in N. Russ. [vʌda] ~ Polish/Czech/Slovak [vɔda] ~ East Ukrainian [wɔda] 'water, nom.sg.' What calls then for explanation in Northern Russian is, on the one hand, the development of the velar [x] and, on the other, the patterning of the labial fricative [v] with the velar fricative [x] in that the former occurs in syllable onset while the latter syllable finally.

Summing up, this section has provided some examples of the mutual interactions between labials and velars (labial >< velar) in the Indo-European languages. We have seen that labials and velars can develop within the same manner class, that is, a labial stop [p] becomes the velar stop [k] (Old Irish and Caribbean Spanish) and the other way round (Romanian) or a labial fricative [f] shifts to the velar [x] (Middle Dutch and Northern Russian) and the other way round (Middle English and southern dialects of Polish). It has become evident that labials and velars can bring in some other cross-manner interactions, such as diphthongization before a velar consonant (Middle English), velar epenthesis before a labial glide (Spanish), or vowel rounding before the velar nasal (Old English). In the immediately following section we look at some more evidence of the labial >< velar interactions, this time in the non-IE languages.

2.2 Non-Indo-European languages

The literature on the interactions between labials and dorsals in non-IE languages is huge, for example, Ladefoged (1972), Hyman (1973), Campbell (1974),

[9] For a detailed analysis and a thorough discussion of the development in Dutch, see Bonebrake (1979).

Vago (1976), Ohala and Lorentz (1977), Odden (1978), van de Weijer (1996), and Huber (2007b), among many others. For this reason, the discussion in this section is confined to just a few instances of non-IE languages characterized by the presence of the phonological patterning of labials and dorsals.

Backley (2011: 79) notes that there are many languages in which the effects of once active labial-dorsal interactions are now reflected in various co-occurrence restrictions. He provides the example of 15th century Korean [ɨ], which was rounded to [u] before labials and velars [m p pʰ k kʰ]. Backley (2011) argues that this is a process of assimilation where [ɨ] rounds to [u] when followed by a labial or velar. Due to the operation of this process, forms like [ətɨp] 'dark' and [təɨk] 'more' were changed to respectively [ətup] and [təuk] (Backley 2011: 80). The same vowel, that is, [ɨ], occurring in front of a coronal or palatal consonant was left intact. In short, this change is assumed to be fossilized evidence of a once active process of assimilation. Another example of the labial-velar interaction discussed by Backley (2011: 83) comes from Skikun, an Atayalic dialect of Formosan. This labial > velar shift is important in so far as it captures the change in progress. Since it is a phonologically active process, the shift is more characteristic of the younger generation of language users. Consider the following examples, which have been adopted from Backley (2011: 83).

(34) Labial > velar shift in Skikun (Backley 2011: 83)

older speakers	*younger speakers*	*gloss*
talap	talak	*eaves*
mgop	mgok	*share one cup*
kmiyap	kmiyak	*catch*
tmalam	tmalaŋ	*taste*
cmom	cmoŋ	*wipe*
qinam	qinaŋ	*peach*

The forms under (34) show that in Skikun, a word-final labial [p m] is shifted to a corresponding velar [k ŋ] in the speech of the younger generation.

Northern Saami, a language which belongs to Uralic family, is characterized by the presence of a synchronically active consonant gradation. In one of the gradation sub-patterns (Group 9), the velar plosive [k] is lenited to [w] before voiceless coronals. More specifically, this group contains words with consonant clusters starting with [k] in the strong grade. However, in the weak grade, the velar [k] alternates with the labial glide [w], while the last consonant is geminated. This alternation is depicted in (35) below, with the examples obtained thanks to Ove Lorentz (p.c.).

(35) Velar ~ labial alternations in Northern Saami

alternation	*strong grade*		*weak grade*	*gloss*
kc ~ vcc	gakcut	–	gavccui	*to climb*
kč ~ včč	čiekčat	–	čievččai	*to kick*
ks ~ vss	raksa	–	ravssat	*diaper*
kst ~ vstt	teaksta	–	teavsttat	*text*
kš ~ všš	dikšut	–	divššui	*to nurture*
kt ~ vtt	mokta	–	movtta	*enthusiasm*

This is an extremely common pattern, as evidenced by the alternation in recent loan words, for instance, *teaksta* 'text' – *teavsttat* 'text, pl.' A similar development is found in Finnish, another language characterized by Grade Alternation. In this language, the velar [k] alternates with the labial approximant [ʋ] as represented in (36).

(36) Velar ~ labial alternations in Finnish (Karlsson 1999: 37)

k ~ v	suku *family*	–	suvussa *in the family*
	puku *dress*	–	puvut *dresses*
	luku *number*	–	luvun *of a number*

The lenition pattern illustrated in (36) arises from the original change [k] ~ [ɣ], where the latter consonant becomes labio-velar and is eventually replaced by the labial approximant [ʋ]. Note that while in Finnish the alternation is certainly motivated by the labial context, this is not the case in Northern Saami. In the latter language, the alternation between velar and labial occurs before a coronal consonant and after any vowel, front and back alike.

Finally, consider some examples of historical labial-velar interactions in African languages. In one such alternation found in Bantu languages, the velar plosive in a Proto-Bantu form evolves into a labial in West Teke, for example, Proto-Bantu **kumu* > West Teke *pfuma* 'chief' (Backley and Nasukawa 2009). Another example concerns a historical sound development from Middle Kanuri (represented by the attested loanwords in Bade/Ngizim) to Modern Kanuri with a special reference to the Manga dialect. The languages belong to the West African languages and are spoken in northeastern Nigeria. The change in question is represented by direct correspondences between Ngizim and Kanuri in that what is a labial or velar plosive in the former language is shifted to the glide [w] in the latter. Apart from the instances of spirantization, that is, [t] > [ð], coronals are generally excluded from the development in question in the Manga dialect. Finally, note that Ngizim can be recognized as an earlier form of Kanuri (Middle Kanuri). The data in (37), adapted from Schuh (2005), illustrate the development in Kanuri.

(37) Development of labial/velar to the glide [w] in Kanuri (Schuh 2005)

	Ngizim (Middle Kanuri)	*Kanuri*	*gloss*
[b] > [w]	dàbi	dàwi	*hoe*
	bərbà	bərwà	*wealthy person*
[g] > [w]	māgì/māgù	māwù	*week*
	dugùl	dowòl	*morsel of meat*
[k] > [w]	d͡ʒākuwa	d͡ʒāwuwa	*cap*
	bərkù	bərwù	*complaint*

The data under (37) show that while the shift [b] > [w] occurs in the intervocalic position or between the rhotic and a vowel, [g k] are reduced to [w] in the environment of round vowels. Note further that in Kanuri the same velars can evolve into a palatal glide [j] but only in the context of a front vowel, for instance, *arzə̀kin* > *arsìyi* 'wealth,' *də̀ge* > *dìye* 'indeed.' Some more instances of interactions between front vowels and velars will be provided in Section 4.1 below.

To recapitulate, there exists a considerable amount of cross-linguistic data revealing the labial-velar interactions. As in IE languages discussed in the previous section, we can find numerous attestations of intimate relationship between labials and velars in the non-IE language family. The following sections, though, slightly change the perspective from which the labial-velar interactions have been looked at so far. Instead of describing particular cases in particular languages, they discuss the interactions of labials and velars with other segments, consonants and vowels alike. This step is taken to reveal even more details of the internal structure of the segments under investigation. It should be borne in mind, however, that the data we have discussed so far could be categorized according to one of the criteria used in the remainder of this chapter. This is especially the case of those instances where labials and/or velars interact with neighboring vowels in various phenomena, like palatalization, gliding, or vocalization. The immediately following section is important because it demonstrates some cases of labial/velar > coronal shifts. This is even more significant because it is frequently pointed out that since velars interact with labials as readily as with coronals, there is nothing special in the labial-velar interactions. The discussion in the following section is intended to disprove this claim.

3. Interactions of labials and dorsals with coronals: cross-class perspective

Labials and velars are reported to interact with coronals in a number of languages. The interaction often assumes the form of the shift where a labial or a velar consonant changes into a coronal one. What needs to be emphasized here is that in the vast majority of cases, the shift occurs before front vowels (glides) and is unidirectional, that is, a velar consonant can change into coronal, but the reverse shift is extremely rare. For instance, in the already mentioned dissertation devoted to the role of acoustic signal properties in the perception of place in English stop consonants [p t k], Plauché (2001) reports on the asymmetries in the direction of stop place confusions, namely, [ki] is often confused for [ti], but the opposite direction is very rare. She enumerates three main categories of errors, which include the place of the oral stop, the following vowel, and the direction of confusion. The general conclusion emerging from her analysis points to an asymmetric relation between velars and coronals in that the former are often confused for the latter in the context of the following front vowel. Plauché's (2001) conclusion brings to mind the process of palatalization, which often embraces velars and labials. Although palatalization will be examined separately in Section 4.1 below, some preliminary discussion is in order here as palatalization seems to be the key factor behind the change of velars and labials into coronals. It simply means that labials and velars may be shifted to coronals in the process of palatalization. For instance, in a typical palatalization change, a velar stop in the context of the following front vowel undergoes coronalization, that is, it changes into a coronal, as in [k] > [ts] > [tʃ]. There are numerous instances of this type of palatalization. For example, in Ionic and Attic, which are the dialects of Ancient Greek, the labialized velars *k^w* and *k^{wh}* became /t/ and /t^h/ before the front vowels /i e/. Furthermore, *g^w* became /d/ before /e/, and *k^wj* became /t/ in the syllable initial position or the geminate /tt/ intervocalically.[10] This means that apart from the regular alternations between labio-velars and plain labials discussed above (Section 2.1.1), there are common cases of changes from a labio-velar to a coronal exemplified by Ancient Greek (38).

(38) Labio-velar > coronal shifts in Ancient Greek (Huber 2007a: 149)

*k^w > t	*k^we	>	/t/e	*and*
	*$k^w$is	>	/t/is	*who*
	*k^wet^{w}ores	>	/t/ettares (/t/essares)	*four*
	*penk^{w}e	>	pen/t/e	*five*
*g^w > d	*n̥-g^wen	>	a-/d/en-(os)	
*g^{wh} > t^h	*g^{wh}en-je/jo-	>	*/t^h/en-jó	*thematic impf. of kill*

The regular pattern of the labio-velar > plain labial shift exemplified by IE > Latin > Greek development is violated by common cases where the labio-velar evolves into a coronal. As depicted in (38), however, the latter scenario is pos-

[10] In non-Attic varieties, the IE labio-velar developed into a plain velar, for instance, IE **penk^{w}e* > *penke* 'five.'

sible only in the context of the following front vowel. To sum up, in Ancient Greek, the IE labio-velar evolves bidirectionally; it becomes a plain labial before back vowels, while before front vowels, it changes into a coronal. While concentrating on the former pattern, Huber (2007a: 150) seems to underestimate the latter, saying that the details of this surprising change are not relevant to his discussion. Furthermore, even though the plain /k/ was not affected, as in Latin *dekem*, *kentu-* > Ancient Greek *deka*, *(he)kato-* 'ten,' and 'one hundred,' there are other languages in which /k/ does change into a coronal. For instance, in most of the Greek dialects of Lesbos, /k/ is changed into /ts/ before front vowels. In Spanish /k/ becomes /s/ via /ts/ again before front vowels (van de Weijer 1996: 46).

Finally, note that the coronalization affects not only velars but also labials, which may shift into coronals under the influence of front vowels. For instance, the traditional dialects spoken toward the end of the 19th century in the area of northeastern Bohemia (Litomyšl) are reported to have had the apico-alveolar consonants /t d n/ in the place of the Proto-Slavic bilabial **p *b* and **m* (Andersen 1973: 765). The regular correspondences can be observed between Bohemian dialects and Standard Czech in a number of very common words, for example, *koutit ~ koupit* 'buy,' *tekňe ~ pěkně* 'nicely,' *dežet ~ běžet* 'run,' and *nesto ~ město* 'town.' Since the change occurs in the context of the following front vowel, it has been argued that it is an instance of palatalization which replaces the original primary place of articulation, that is, labial, with the full-blooded coronal. A similar example can be found in Sino-Vietnamese where the labial stops /p/ and /pɦ/ of Late Middle Chinese are sometimes represented by dental /t/. The trigger of the shift is a following high front glide /j/, for instance, *ti* 'low' < Late Middle Chinese *pji*.

The above discussion, brief as it is, shows that the common interactions of labials and velars with coronals are possible in a rigidly defined context, namely, in the presence of the following front vowel. Since it is recognized as a type of palatalization, more instances of such interactions are discussed in the section devoted to palatalization (Section 4.1).

3.1 Dorsals and back rounded vowels

The instances of interactions between dorsals and back vowels are well-documented in the literature (e.g., van de Weijer 1996; Scheer 1999; Huber 2007b and the references therein). Recall from Chapter One (Section 4.3) that a typical context for labial-velar confusions was the following back rounded vowel [u], as confirmed by numerous laboratory studies (Plauché 2001). Finnish is another example of a language in which dorsals interact with back vowels. In this language, the velar fricative [ɣ] is interpreted as its labial counterpart [v] when it occurs between high rounded vowels, that is, the back vowel [u] but also the front rounded [y] (Backley and Nasukawa 2009). Similarly, in certain dialects of Finnish, velars may impose backness on following vowels, interrupting the vowel harmony pattern. This situation is illustrated in (39) by the examples adopted from van de Weijer (1996: 48).

(39) Interaction of velars with back vowels in Finnish (van de Weijer 1996: 48)

a.	itikka	*mosquito*			
	etikka	*vinegar*			
	tiirikka	*lock pick*			
b.	nimi	*name*	–	nimikko	*namesake*
	neljä	*four*	–	nelikko	*a quarter*
	heinä	*hay*	–	heinikko	*hay field*

In (39a), the velar plosive forces a back vowel to surface in what is a front-harmonic word. Similarly, in (39b), the velar plosive, which is a part of the suffix this time, is followed by a back vowel even if the suffix is attached to a front-vowel word.[11]

As already mentioned in Section 2.1.1, velar nasals may impose roundness on the preceding vowels. This is also the case in OE, where we can observe a lengthening process which turned [aŋg] into [a:ŋg] (Wełna 1978: 40). Crucially, in Late OE, this vowel undergoes rounding to [ɔ:], which results in [ɔ:ŋg]. Furthermore, in ME, the long vowel [ɔ:] is affected in the same context by shortening to [o] and finally it is realized as [ɒ] in Standard Modern English. This developmental pattern is depicted in (40) below.

(40) Vowel rounding in ME (Wełna 1978: 40)

Early OE		*Late OE*		*Early ME*	
(be)langian	>	(be)lāngian	>	belōng	*belong*
sang	>	sāng	>	sōng	*song*
strang	>	strāng	>	strōng	*strong*
tang	>	tāng	>	tōnge	*tong(s)*
*wrang (<OScandinavian)	>	wrāng	>	wrōng	*wrong*

Note that in (40), vowel lengthening and the subsequent rounding occur before the velar nasal.[12] Moreover, the rounding of LOE [a:] to EME [ɔ:] is a far more

[11] Note that it is also possible for velars to occur in fully front-harmonic words, as in, for example, Helsinki dialect (van de Weijer 1996).

[12] The high vowels [i ü u] are not lengthened before the same clusters (Wełna 1978: 41).

general and complex phenomenon as it also affected the vowel [a:] in other contexts, for example, *wāmb* > *wōmb* 'womb,' *āk* > *ōk* 'oak,' *dāh* > *dōh* 'dough,' *bāld* > *bōld* 'bold,' *twā* > *twō* 'two,' *clāfre* > *clōvre* 'clover,' and *hlāf* > *lōf* 'loaf.' Assuming that the pre-consonantal [l] was velarized, it could be claimed that vowel rounding took place in the labial/velar environment. However, there exist a considerable number of words which prove to the contrary, for instance, *nān* > *nōn* 'none,' *stān* > *stōne* 'stone,' and *rārian* > *rōre* 'roar.' Despite these, in the majority of cases, vowel rounding occurred in the close vicinity of labial/velar consonants (Wełna 1978: 100). Furthermore, in the Middle English standard variety, [u] was unrounded to [ʌ] in most contexts, but was generally preserved after labial consonants and sometimes before the velar [k]. It follows that the unrounding affected the following forms: *cut*, *sun*, *us*, *gum*, *husband* and *hug*, but it failed to apply in the vicinity of a labial, for example, *wool*, *push*, *book*, *full*, etc., and before [k], as in *cook*, *look*, *shook*, *rook*, etc. (van de Weijer 1996: 41).

Scheer (2004: 48) provides some evidence for the relatedness of velars and round vowels in Czech. In this language, the vocative formation consists in adding one of the three allomorphs, that is, -[i], -[u], and -[ɛ], depending on the last consonant of the root. This is represented in (41).

(41) Vocative formation in Czech (Scheer 2004: 48)

	Nominative	*Vocative*	*gloss*
a.	muž	muži	*man*
	lhář	lháři	*liar*
	Tomáš	Tomáši	*Thomas*
b.	doktor	doktore	*doctor*
	holub	holube	*pigeon*
	hrad	hrade	*castle*
c.	hoch	hochu	*boy*
	pták	ptáku	*bird*
	gong	gongu	*gong*

As we can see, palatals choose the front vowel [i] (41a), [ɛ] is taken by dentals and labials (41b), while velars are followed by [u] (41c). It is argued that the allomorph [u] adopts the velar quality from the preceding velar consonant (Scheer 2004: 49).

Further evidence for the relatedness of dorsals and back rounded vowels can be found in certain exceptions to ablaut in Palestinian Arabic. It is pointed out that due to the presence of velar, uvular, or 'emphatic' consonants in roots, the regular ablaut vowel is replaced by [u] in the imperfective (van de Weijer 1996: 48).

The final piece of evidence comes from the history of French and concerns the deletion of velars and labials in certain contexts. More specifically, both labials and velars are deleted in the environment of a back rounded vowel, which becomes evident by comparing some French and Latin forms (42).

(42) Deletion of labials and velars in French (van de Weijer 1996: 50)

Latin	*French*	*gloss*
securu-	sûr	*sure*
ruga	rue	*street*
tabula	tôle	*steelplate*
pavore	peur	*fear*

The data in (42) not only provide some evidence for the relatedness of [u] and velars, but also suggest the existence of an intimate relationship between labials and round vowels, which is discussed in the immediately following section.

3.2 Labials and round vowels

Since convincing a specialist of the close relationship between labials and round vowels is usually little more than preaching to the converted, the discussion in this section is confined to just a few cases illustrating the link between both classes of segments. In the Savo dialects of Finnish, for example, we can find a historical rule which rounded a stem-final front vowel /e/ in the third person singular present indicative (van de Weijer 1996: 32). This can be exemplified by the verb stems *teke* 'to do' and *käske* 'to command' followed by the historical suffix representing the third person singular present *-vi*. The result of this concatenation is a sequence of the stem-final /e/ followed by the labial consonant of the suffix. In this environment, the front vowel is labialized to *ö*, hence *tekevi* > *tekövi* (> *tekköö*) and *käskevi* > *käskövi* (> *käsköö*). In both cases, the unstressed vowel /e/ is rounded in the environment of the labial consonant /v/.

Hickey (1984b: 352) reports on an interesting case of labial fricative epenthesis in the Prague variety of Czech. In this variety, an epenthetic labial fricative [v] develops before the mid back vowel [o], as in *okno* > *vokno* 'window,' *otec* > *votec* 'father,' *on* > *von* 'he.' A similar case of pre-labialization is found in some dialects of Polish. In an area stretching up from the south-eastern Poland via central (Poznań) to the north (Gdańsk), the mid back vowels developed an onglide, that is, an epenthetic labio-velar glide [w], as depicted under (43).

(43) Development of the labio-velar glide in Polish dialects (Dejna 1981)[13]

Standard Polish	*dialectal forms*	*gloss*
okno [ɔknɔ]	[ʷɔknɔ]	*window*
ojciec [ɔjɕɛt͡s]	[ʷɔɕɛt͡s]	*father*
on [ɔn]	[ʷɔn]	*he*
oko [ɔkɔ]	[ʷɔkɔ]	*eye*

There are dialects in which the pre-labialization is so strong that it occurs both word-initially and word-internally, for example, [ʷɔknʷɔ] 'window,' *most* [mʷɔst] 'bridge,' *kot* [kʷɔt] 'cat,' *oko* [ʷɔkʷɔ] 'eye,' and *koza* [kʷɔza] 'goat.' Furthermore, Dejna (1981: map 8) speaks about certain areas in which the word-initial sequences [vɔ]-, [wɔ]- mingle with [u̯ɔ]-, while the word-initial [ɔ]- develops into the sequence [vɔ]- or [u̯ɔ]-, as in [vɔda] ~ [u̯ɔ]da 'water,' [vɔjna] ~ [u̯ɔ]jna 'war,' [wɔpata] ~ [u̯ɔ]pata 'shovel,' [ɔft͡sa] ~ [u̯ɔ]wca 'sheep,' [ɔknɔ] ~ [vɔ]kno 'window,' and [ɔvʲɛs] ~ [vɔ]wies 'oat.' Similarly, in Greater Poland (Kashubian dialects), the pre-labialization is reported in the gen.sg. forms of demonstratives and adjectives, that is, -*e*[gɔ] ~ -*e*[gu̯ɔ] ~ -*e*[gwɔ], with a possible simplification to -*e*[u̯ɔ] or -*e*[wɔ], as in *te*[gɔ] *dobre*[gɔ] ~ [tɛwᵘ̯ɔ] [dᵘ̯ɔbrɛwᵘ̯ɔ] 'this good, gen.sg.' Finally, in certain dialects of Greater Poland, the labial [u̯] < [w] can impose retracting and lowering on the preceding tautosyllabic [ɛ] along the following pattern: [ɛw] ~ [ɛu̯] > [ɔu̯] > [ɒu̯].[14] This situation can be illustrated by the comparison of the standard forms with the dialectal ones, for instance, *p*[ɛw]*ne* ~ *p*[ɒu̯]*ne* 'full,' *pud*[ɛw]*ko* ~ *pud*[ɒu̯]*ko* 'box,' *w*[ɛw]*na* ~ *w*[ɒu̯]*na* 'wool,' *kuki*[ɛw]*ka* ~ *kuki*[ɒu̯]*ka* 'puppet,' and *m*[ɛw] ~ *m*[ɒu̯] 'he milled.'

Apart from the clear examples of the mutual interactions between labials and round vowels, that is, developments in which vowels are rounded in the environment of a labial consonant and consonants are labialized under the influence of a round vowel, there are less evident cases which assume the form of dissimilation. For instance, the short vowel */o/ in Scots became unrounded in

[13] Dejna (1981: map 57) differentiates between a strong and weak labialization, which depends on the region. The weak variety is transcribed as [ᵘ̯], while the strong one is claimed to be a pure diphthongization with an independent segment [u̯], for instance, [ᵘ̯ɔkᵘ̯ɔ] and [u̯ɔku̯ɔ] 'eye,' respectively. Moreover, Dejna (1981) differentiates between bilabial [w] and labialized [u̯]. These are minor phonetic differences which are ignored here; what is crucial to the present discussion is the fact that round vowels can trigger the development of a labial glide.

[14] Dejna (1981: map 56) uses in this place a different symbol to represent the low vowel *o*. In his transcription, we find a non-IPA symbol [å], which must stand for either a mid-low [ɔ] or a fully lowered [ɒ]. Unfortunately, he does not provide any detailed description of the exact phonetic properties of [å]. In any case, the vowel in question is both lowered and rounded.

the 16th century when it was adjacent to a labial consonant, hence RP English [tɒp], [pɒt] and Scots [tɑp], [pɑt] 'top' and 'pot.' The explanation of this change can be sought in the Obligatory Contour Principle (OCP), a constraint according to which two segments that are too much alike are not permitted to occur together. Note further that while English does not generally exclude the combinations of rounded vowels and labial consonants in the syllable-final position, it does preclude labial consonants from occurring after the closing diphthong [aʊ] (Pulleyblank 1989). A similar situation is reported in some varieties of Chinese. For example, while in Cantonese rounded vowels cannot occur after labial consonants, in Mandarin Chinese rounded glides are never found after labial initials. By the same token, rounded vowels cannot follow labial consonants in Ayutla Mixtec, an Otomanguean language indigenous to Mexico (van de Weijer 1996: 32ff).

Summing up, this section has provided a brief discussion of the interactions of labials and dorsals with coronals, on the one hand, and the unquestionable relationship between dorsals/labials and back round vowels, on the other hand. In what follows, we change the approach to the question of what unites labials and velars by assuming a process-oriented perspective. We start by returning briefly to one particular example of the cross-class relationship, namely, a dorsal-coronal interaction, which in the vast majority of cases takes the form of palatalization.

4. Interactions of dorsals with vowels: cross-process perspective

4.1 Palatalization[15]

It has been pointed out (van de Weijer 2011: 697) that the term palatalization is used in the literature with at least two meanings. It can describe a historical process in which predominantly coronal or velar consonants shift to a palatal or palato-alveolar place of articulation under the influence of non-low front vowels, [k] > [tʃ]. It can also denote a synchronic or diachronic process in which consonants acquire a secondary palatal articulation due to co-articulation, for example, [k] > [kʲ]. This section presents a number of examples of the former type.[16]

[15] Palatalization is a broad topic, exhaustively studied by a large number of researchers working in various theoretical models, for example, Rubach (1984, 1993, 2011), Calabrese (1993), Szpyra (1995), Ladefoged and Maddieson (1996), and Ćawar and Hamann (2003), and from different perspectives, including perceptual studies (Guion 1998; Chang et al. 2001, among many others).

[16] For a discussion and analysis of the secondary palatal articulation, see, for example, van de Weijer (2011).

It has been noted that the most common historical shift between a velar and alveolar place in voiceless stop consonants is a shift from a velar stop consonant to an alveolar stop. More specifically, a high front vowel and/or a palatal glide often trigger the palatalization of the velar stop, which as a result changes into a palato-alveolar fricative or affricate (Plauché 2001). This phenomenon, broadly known as velar palatalization, is a common type of palatalization and a relatively common sound change cross-linguistically. Plauché (2001), after Guion (1998), provides numerous examples of velar palatalization from various languages, illustrated under (44) below.

(44) Velar palatalization (Plauché 2001: 33)

Language	Change	Environment
Slavic (1st palatalization)	/k/ > /tʃ/ /g/ > /ʒ/ /x/ > /ʃ/	/j ĭ i ɛ ē/
Slavic (2nd palatalization)	/k/ > /tʃ/ /g/ > /dʒ/ /x/ > /s/	/i ɛ/
Indo-Iranian	/k/ > /tʃ/ /g/ > /dʒ/ /gʰ/> /dʒʰ/	/i e/
Bantu	/k/ > /ts/ /g/ > /dʒ/	[j] + /i e/
Old to Middle Chinese	/k/ > /tɕ/ /kʰ/ > /tɕʰ/ /g/ > /dʑ/ /x/ > /ɕ/	[j] + /i e/

In all the languages mentioned in (44), a front vowel or glide triggers the palatalization of a velar consonant, which shifts into an alveolar/palato-alveolar fricative or affricate. Moreover, Plauché (2001) observes that stop place shifts in the opposite direction, that is, from alveolar to velar place, in the same pre-vocalic position, are unattested. Although there are some cases of shifts from coronal to velar stops in the word-final position, the regularity of the velar > coronal shifts in the pre-vocalic (front vowel) position is unshakeable. She concludes that this asymmetry in historical sound changes mirrors the asymmetry of listener confusions in laboratory studies in identical context. Interestingly, Plauché (2001: 34) also reports on some (less common) historical bilabial > coronal shifts in the context of the preceding high front vowel, for instance, /p/ > /pʲ/ > /tʃ/ before /j/ from Latin to Italian and /p/ > /t/ and /m/ > /n/ in Classical Greek. Ohala (1979: 358) also points to the possibility of (palatalized) labials [pʲ bʲ mʲ] shifting to coronals [t ts tʃ d dz dʒ n ɲ]. This is illustrated by the alternation we have already touched upon in Section 3, namely, the labial > coronal shift exemplified by the correspondences between Standard Czech and Bohemian dialects. Recall that in these dialects, the labials before front vowels are palatalized and changed into coronals, as in *město* [mjɛstɔ] > [nɛstɔ] 'town,' *pět* [p^{j}ɛt] > [tɛt] 'five,' *pivo* [p^{j}i:vɔ] > [ti:vɔ] 'beer,' and *pěkně* [p^{j}ɛkn^{j}ɛ] > [tɛkn^{j}ɛ] 'nicely.' A similar change occurs in some dialects of Italian (Roman dialect and Genoese with some neighboring dialects), for example, [pjeno] > [tʃena] 'full,' [pjanta] > [tʃanta] 'to plant,' and [bjaŋko] > [dʒaŋku] 'white.' Interestingly, in some dialects of Polish (Kurp region), the so-called soft labials, which are sequences of a labial plus the front glide [j], that is, [p^j b^j f^j v^j m^j], develop according to a different scenario. Instead of being shifted to a coronal, the glide gets strengthened to a fricative, which, in consequence, leads to the appearance of new clusters. Compare Standard Polish and two dialectal forms in (45).

(45) Developments of soft labials in Polish dialects (Furdal 1955 and Zduńska 1965)

Standard Polish	*Kurp*	*Northern Mazovian*	*gloss*
[p^j]asek	[pɕ]asek	[pç]asek	*sand*
[b^j]ały	[bʑ]ały	[bʝ]ały	*white*
[f^j]ołek	[fɕ]ołek	[fç]ołek	*violet*
[v^j]oska	[vʑ]oska	[vʝ]oska	*village*
[m^j]ód	[mɲ]ód	[mɲ]ód	*honey*

In both the Kurp and Northern Mazovian dialects, the front glide strengthens to a fricative or a nasal depending on the preceding context. While in the Kurp dialect the result is an alveolo-palatal fricative, in Northern Mazovian the glide is shifted further back and realized as a palatal fricative. In both dialects, the glide after the bilabial nasal is realized as a palatal nasal [ɲ] (see also Section 2.1.1). Finally, note that the mirror image historical shifts, that is, coronal > labial, do not occur in the pre-vocalic context, though a change of this type is reported in Latin prefixes before the labial glide [w]; compare Latin [dwi-] > [bi-].

In a different study, Huber (2007b: 267) compares the ability of velars and coronals to undergo palatalization only to find out that velars are much more susceptible to this process. It is pointed out that even in a language in which both velars and coronals palatalize, coronals do so in a significantly limited environment. For instance, both velars and coronals became eventually palatalized in the development from Latin to Italian (46). However, while velars palatalize with no restrictions, coronal palatalization is blocked in certain cases. Thus in Italian sequences like /ke- ki-/ were palatalized to /tʃe- tʃi-/ regardless of the phonological environment, that is, word-initially (46a–b), intervocalically (46c–d), and after sonorants (46e–f) or obstruents (46g).

(46) Italian palatalization of Latin /ke ki/ (Huber 2007b: 267)

	Latin /k/	>	*Italian* /tʃ/	*gloss*
a.	/k/ircum	>	/tʃ/irco	*circus*
b.	/k/entum	>	/tʃ/ento	*hundred*
c.	pa/k/em	>	pa/tʃ/e	*peace*
d.	de/k/idere	>	de/tʃ/idere	*to decide*
e.	vin/k/ere	>	vin/tʃ/ere	*to win*
f.	fal/k/em	>	fal/tʃ/e	*scythe*
g.	s/k/ientia	>	/ʃ/enza	*science*

When compared to velars, Italian coronals behave quite differently. One of the differences is that word-initial coronals are not affected by palatalization in a situation when they are followed by a sequence of a vowel + consonant. This is a more general constraint holding in Western Romance languages, for example, Latin /t/*erra* > Italian /t/*erra*, Spanish /t/*ierra*, etc, 'land.' The ban on coronal palatalization in this context becomes evident when the latter forms are compared to forms containing the velar stop in an identical context, for instance, Latin /k/*entu* > Italian /tʃ/*ento*, Spanish /θ/*iento*, etc. 'hundred.'

Hickey (1984b, 1985) provides some further examples of velar palatalization in the history of various IE languages, including Old English, Old Irish, Albanian, and some Romance languages. While in the latter study (Hickey 1985) he compares the palatalization of velars in OE and OI, in the former he describes the situation in Albanian. In this language, the Latin *ct* cluster can have two reflexes, the palatal one /it/ and the labial /ft/. Furthermore, these reflexes are found in various Romance languages. While the former reflex can be found in the western part of the East Romance area (Dalmatia), the latter occurs in the East proper, that is, Romania (Hickey 1984b: 351). In Albanian, the /it/ reflex occurs before front vowels and some cases of /a/, for instance, Lat. *directus* ~ Alb. *dreitë* 'direct,' Lat. *tractare* ~ Alb. *traitoj* 'prepare, cook.' Hickey (1984b) argues that the velar is palatalized by the following front vowel along the following pattern: /k/ > /k'/ > /j/ > /i/. However, in other contexts, the velar is not affected by palatalization but instead shifted to the labial [f], as in Lat. *laxa* ~ Alb. *lafshë* 'battle' and Lat. *coxa* ~ Alb. *kofshë* 'hip' (Hickey 1984b: 351).

In a study devoted to the major places of articulation and their interactions, Rice (2011: 540) mentions that in many Slavic languages velars can undergo a shift in place of articulation, resulting in coronals. To illustrate the shift, she provides one example of palatalization found in Serbian (47).

(47) Palatalization in Serbian (Radišić 2009; after Rice 2011: 540)

a. *Serbian: First palatalization*

ru/k/a + itsa	ru[tʃ]itsa	*hand*
pra/x/ + iti	pra[ʃ]iti	*dust*

b. *Serbian: Second palatalization*

ɔra/x/ + i	ɔra[s]i	*nut*
pɛ/k/ + i	pɛ[ts]i	*to bake*

In (47), in the context of the following front vowel, a velar stop and a velar fricative is shifted to a coronal affricate and fricative respectively.

It is well-known that Russian palatalization is of great complexity, putatively comparable only to Polish palatalization.[17] As such, it is highly interesting and deserving of separate study. For obvious reasons, the following presentation is confined to just some general facts; it should be borne in mind, however, that the discussion here barely scrapes the tip of the iceberg.

Russian contains two pairs of consonants: palatalized and velarized. They are contrastive in that palatalized and non-palatalized consonants can occur in an identical context, that is, pre-consonantally, word-finally, and before a back vowel, as in *polka* 'shelf' vs. *polʲka* 'polka,' *nos* 'nose' vs. *nʲos* 'he carried,' *krof* 'shelter' vs. *krofʲ* 'blood' (Trubetzkoy 1939; Fant 1960; Evans-Romaine 1998). Without going into unnecessary detail, the distribution of Russian vowels [i] and [ɨ] depends strictly on the preceding consonant. Palatalized consonants go with the front variant [i], while the velarized ones are followed by the retracted variant [ɨ], as in [bʲit] 'beaten' vs. [bɨt] 'way of life,' [xodʲi] 'walk!' vs. [xodɨ] 'gaits.' Now, since the front vowel [i] can also occur independently of the preceding consonant, for example, [igratʲ] 'to play,' it seems that the [ɨ] variant is consistently linked with a velarized consonant. In Modern Russian, the situation is complicated by the fact that velar consonants are assumed to be just of the plain kind and so velar palatalization is allophonic, that is, it depends on the context. Thus, before the front vowels [i] and [e], the velar stop undergoes palatalization, as in [kʲipa] 'pile,' [gʲerp] '(coat of) arms,' while the same velar is realized as plain in the context of a back vowel, in the pre-consonantal and word-final position, as in [koʃka] 'cat,' [xudo] 'harm, evil,' [gdʲe] 'where,' [ix] 'them.'[18] What is peculiar about velars is that the plain variant cannot be followed by the vowel [ɨ]. It is surprising inasmuch as this vowel is strictly connected with the velarized consonants. Thus, in Russian, sequences such as *[kɨ] or *[xɨ] are banned, and can be found only in a broader context, that is, between words, for instance, [ivan] 'Ivan' vs. [k ɨvanu] 'to Ivan.' In other words, morpheme-internally, the only option for velars is to be followed by the front vowel [i], which triggers

[17] Polish palatalization has been thoroughly discussed and analyzed in various theoretical models, with some recent contributions including Szpyra (1995), Rubach (2003, 2011), and Gussmann (2007), among many others.

[18] Note that it is possible for a palatalized velar to be followed by a back vowel, as in [lʲikʲor] 'liqueur,' [tkʲoʃ] 'you weave,' or [pʲekʲoʃ] 'you bake.' Such forms, however, are either loans or dialectal/exceptional realizations, for details see Flier (1982).

velar palatalization. In short, the front vowel [i] is realized as [ɨ] after velarized consonants, and since velars are assumed to be just of a single plain kind, it is not possible to get *[kɨ], but instead we find the palatalized variant after the front vowel [i], that is, [kʲi]. It is assumed that the responsibility for this state of affairs falls on a sound change known as post-velar fronting which affected East Slavic between roughly the twelfth and fourteenth centuries. Note that before this change, velars did not occur before front vowels at all, while they did occur before [ɨ]. In other words, the distribution of velars was completely different in that sequences like [kɨ], [gɨ], and [xɨ] were well-formed in contrast to [kʲi], [gʲi], and [xʲi], which were banned. In short, post-velar fronting affected sequences like [kɨ] and changed them into [kʲi] as shown in (48).

(48) Post-velar fronting (Padgett 2003: 45)

a.	[kɨjev]	>	[kʲijev]	*Kiev*
	[rukɨ]	>	[rukʲi]	*hands, acc.pl.*
b.	[gɨbʲelʲ]	>	[gʲibʲelʲ]	*ruin/death*
	[drugɨ]	>	[drugʲi]	*friends, acc.pl.*
c.	[xɨtrɨj]	>	[xʲitrɨj]	*clever*
	[pastuxɨ]	>	[pastuxʲi]	*shepherds, acc.pl.*

Leaving aside for now the question of what triggered the post-velar fronting, the data in (48) show that before the change, velars occurred together with [ɨ], which may indicate that velars were velarized like other consonants in Modern Russian. After the change, however, velars lost their velarization, and so now they must be followed by the front variant [i], which is their palatalization trigger, that is, [kʲi]. To complicate the picture even further, note that it has been suggested that the responsibility for this situation falls on a still earlier change which affected velars and turned them into palato-alveolars (mutation) [kʲ] > [tʃʲ]. For instance, Jakobson (1962) argues that since the earlier development changed palatalized velars into palato-alveolars, an inventory gap occurred, filled by the post-velar fronting [kɨ] > [kʲi] (cf. Padgett 2003; Dresher 2009). Be that as it may, velars lost their velarization and as such function as plain velars in contemporary Russian, which is confirmed by their distribution. Russian facts bring home at least two important lessons: velars are consonants that are easily affected by palatalization, and they can bear secondary velarization. In Russian, velars lost their velarization and became plain, which means they are no longer able to retract the following [i] into [ɨ]. This explains the lack of *[kɨ] sequences and the fact that before the front [i], the plain velar undergoes palatalization to [kʲi].

The conclusion that emerges from the brief discussion in this section is that even though both labials and coronals can undergo palatalization, it is velars which are most susceptible to it. Moreover, while it is true that velars can interact with coronals (velar > coronal shift), this interaction is restricted to a rigidly defined context, namely, to a position before a front vowel or glide in the process called palatalization.

4.2 Gliding

A word of explanation is in order right at the outset of this section. Note first that numerous phenomena and processes we have discussed so far could be introduced in this section. Thus, for example, a number of changes which occurred in the history of English can be subsumed under gliding, such as velar labialization, diphthongization before velars and velarized lateral, or vowel development before the velar fricative (Section 2.1.1). Similarly, the development of labials/velars into the glide [w] in Kanuri (Section 2.2) or pre-labialization in certain dialects of Polish (Section 3.2) could be brought under the label of gliding. Secondly, in the literature, gliding is very often equated with vocalization because in both cases a consonant, usually in a weak position, develops a glide (an on-glide or off-glide), which in turn may lead to the appearance of a vowel or a second part of a diphthong accompanied by the loss of the original consonant. In short, even though in this study gliding and vocalization (next section) are discussed separately, they could as well be combined into a single section.

As mentioned above, in the history of English there are quite a number of instances of gliding. Recall the case of vowel/glide development before the velar fricative in OE represented under (21) above. These forms illustrate the situation in which liquid + velar fricative sequences get broken by the *u*-glide, for instance, *furh* > *furuh* 'furrow' and *burh* > *buruh* 'borough,' etc. The conclusion that the phonetic realization of the velar fricative fluctuated between [u], [w], [x], and/or [ɣ] is further confirmed by the unstable spelling of these forms in ME, for example, *furgh*, *forough*, *forwe* 'furrow,' *burgh*, *burw* 'borough,' etc. Note further that ME velar labialization (18) and ME diphthongization (22) are related by the fact that the former change is preceded by the development of a glide which is responsible for the ME diphthongization. Although only some of these diphthongs have survived into modern times, there is robust evidence that they arose due to gliding before the following velar fricative. While discussing the relationship between vowels and consonants, van de Weijer (1996: 38) follows the same line of thought. He argues that the development of the glide from the velar consonant is later the trigger of velar labialization in Late ME (van de Weijer 1996: 38). He provides numerous examples which are represented under (49).

(49) The loss of velar fricative with accompanying modifications (van de Weijer 1996: 38)

a.	OE trog	/trɔx/	>	trough	/trɔf/
	ME coghe	/kɔxə/	>	cough	/kɔf/
b.	OE rūh	/ru:x/	>	rough	/rʌf/
	LG[19] sluwe	/slu:x/	>	slough	/slʌf/
	OE swōgan	/swo:x/	>	sough	/sʌf/
	OE genōg	/jeno:x/	>	enough	/ɪnʌf/
c.	OE dohtor	/dɔxtɔr/	>	daughter	/dɔ:tə/
	ME slather	/slɑxtər/	>	slaughter	/slɔ:tə/
	OE dohtig	/duxti/	>	doughty	/daʊtɪ/
	OE thurh	/θrux/ (</θurx/)	>	through	/θru:/
d.	OE thōht	/θo:xt/	>	thought	/θɔ:t/
	OE bōg	/bo:x/	>	bough	/bau/
	OE āhte	/a:xtə/	>	ought	/ɔ:t/
	OE swōgan	/swo:ɣan/	>	sough	/saʊ/
	OE thēah	/θe:ax/	>	though	/ðəʊ/
	OE dāg	/da:x/	>	dough	/dəʊ/
	OE plōh	/plo:x/	>	plough	/plaʊ/
	OE slōh	/slo:x/	>	slough	/slaʊ/

The data in (49) are divided into two groups. In (49a–b), the syllable final /x/ corresponds to /f/ in modern forms, while in (49c–d), the velar fricative /x/ is lost, which in turn results in the appearance of a long vowel or a diphthong with a rounded second element. Similarly, Gussenhoven and van de Weijer (1990: 323) distinguish the consonantal development (49a–b) and the vocalic one (49c–d). Furthermore, it is pointed out that while a short vowel appears in the consonantal development, a long vowel (or a diphthong) results in the vocalic one. For some words, there exists variation between the vocalic and the consonantal development up to the present day, for example, *slough* [slʌf] 'the skin of a snake' and *slough* [slau] 'swamp, bog' (see also Chapter Three, Section 7.4.2). To cut a long story short, the key to the explanation of both changes, Gussenhoven and van de Weijer (1990) argue, is the labial glide which developed between the back vowel and the velar fricative [x]. This becomes evident when we look at the ME spelling of some of the forms in (49), such as EME *rūh* > ME *rough* [ɔʊx] > EModE *rough, ruff* [ɔf] 'rough,' EME *troh* > ME *trough* [ɔʊx] > EModE *trough* [ɔf] 'trough,' EME *þōht* > ME *thought* [ɔʊx] > EModE *thought* [ɔ:] 'thought,' and EME *dohtor* > ME *doughter* [ɔʊx] > EModE *doughter, douter* [ɔ:] 'daughter,' etc. For the consonan-

[19] LG is Low German.

tal development (49a–b), they propose an explanation according to which the labial glide [w] < [x] filled the vacated slot, moving out of the nucleus and thus shortening it. In other words, the labial glide links to a consonantal slot and receives a consonantal interpretation. In the vocalic development (49c–d), they argue further, the vacated slot is not filled; hence, the nucleus remains long. In this scenario, the labial glide is interpreted as the second part of a diphthong or is combined with the preceding vowel to form a long monophthong.

Let us stay within the scope of diphthongization in the history of English a moment longer. Huber (2007b: 167) discusses the development of OE [ɣ], which is the source of two glides, [j] and [w], depending on the context. Consider first some data under (50), illustrating the correspondences between OE on the one hand, and Dutch and German on the other.

(50) Development of OE [ɣ] (Huber 2007b: 167)

	English	*Dutch*	*German*
a)	da**y**	da**g**	Ta**g**
	e**y**e	oo**g**	Au**g**e
	ha**i**l	ha**g**el	Ha**g**el
	na**i**l	na**g**el	Na**g**el
	pla**y**	ple**g**en *care for*	pfle**g**en *ident.*
	ra**i**n	re**g**en	Re**g**en
	sa**i**l	ze**g**el	Se**g**el
	sa**y**	ze**gg**en	sa**g**en
	wa**y**	we**g**	We**g**
	fi**gh**t	ve**ch**ten	fe**ch**ten
	li**gh**t	li**ch**t	li**ch**t
	mi**gh**t *power*	ma**ch**t *power*	Ma**ch**t *ident.*
	si**gh**t	zi**ch**t	Si**ch**t
b)	**y**awn	**g**eeuwen	**g**ahnen
	yearn	**g**aarn(e)	**g**ern
	yellow	**g**eel	**g**elb
	yester(day)	**g**isteren	**g**estern
	yield	**g**elden *to be valid*	**g**elten *ident.*
c)	bo**w** ‘arch’	boo**g**	Bo**g**en
	dra**w**	dra**g**en	tra**g**en
	follo**w**	vol**g**en	fol**g**en
	furro**w**	vur**g** (*dial*)	Fur**ch**e
	ma**w** (*of a bird*)	ma**g**en *stomach*	Ma**g**e *ident.*
	(to)morro**w**	mor**g**en	mor**g**en
	sa**w** (*of to see*)	za**g**	(sah)

sorro**w**	zor**g**	Sor**g**e
so**w** *female pig*	zeu**g**	(Sau)
swallo**w** (*verb*)	zwel**g**en	schwel**g**en *to wallow in*
willo**w**	wil**g**	Wil**g**e
plo**ugh**	ploe**g**	Pflu**g**

In (50a–b), the voiced velar fricative [ɣ] evolves into the palatal glide [j] in the context of a neighboring front vowel. In (50c), on the other hand, the velar fricative develops into the labial (back) glide [w] in the context of a back vowel. As can be seen from the comparison of forms in three closely related languages (50), the velar fricative gliding affected the forms in English. Word-initially and following a front vowel, the velar fricative became a palatal glide [j], while after a back vowel it became eventually a labial (labio-velar) glide [w], both of which came to form part of a diphthong in Middle English.[20]

Huber (2007b) notes that the formation of diphthongs illustrated in (49) and (50) was one of the most prominent changes in ME. It is assumed that these modifications had their beginning in Late OE. The process started with the gliding of the voiced velar fricative after front vowels (51a) and was later extended to the context of back vowels (51b). Although the result of gliding was, respectively, the palatal glide [j] and the labial [w], in both cases it contributed to the appearance of diphthongs and the loss of [ɣ] in ME.

(51) Gliding and diphthongization of English [ɣ] (Huber 2007b: 179)

	Old English		*Middle English*	
a.	læg	>	lai	*lay*
	sægde	>	saide	*said*
	legde	>	leide	*laid*
	wegan	>	weien	*move, weigh anchor*
b.	dagas	>	dawes	*days*
	boga	>	bowe	*bow*
	fugol	>	fowel, foul	*fowl*

Recall (Section 2.1.1 and the data under (49)) that it was in ME that the voiceless velar fricative [x] suffered a similar fate. In effect, it led to various modifications, like diphthongization with subsequent labialization and, finally, the loss of [x].

Interestingly, Huber (2007b) reports on some dialectal developments which are apparently the reverse of gliding in that the palatal glide [j] is strengthened to the velar [k]. Such alternations can be found in, for example, the Bergüner dialect of Räto-Romantsch, as represented under (52).

[20] See also the developments under (22c) (Section 2.1.1).

(52) Dialectal [k] > [j] development (Huber 2007b: 281)

/krey + r/	>	kre**k**r̩	*believe*
/krey + a/	>	kre**y**a	*he believes*
/rey + r/	>	re**k**r̩	*laugh*
/rey + a/	>	re**y**a	*he laughs*
/deyt/	>	de**k**t	*(dialectal deyt) finger*
/feyl/	>	fe**k**l̩	*thread*
/veyr/	>	ve**k**r̩	*(dialectal veyr) true*
/lay/	>	la**y**/*lak	*lake*
/dzey/	>	dze**y**/*dzek	*juice*

As can be seen in (52) the palatal glide, which is a member of a falling diphthong, evolves into the velar [k] in the context of the following consonant. In a situation when the glide is word-final or followed by a vowel, the strengthening does not take place. Furthermore, when the glide is followed by a sonorant the alternation in question is accompanied with the formation of the syllabic consonant, for example, [feyl] > [fe**k**l̩] 'thread.' It is pointed out that the alternation illustrated in (52) is not an isolated case; just the opposite, it is quite a regular pattern found in numerous dialects. Thus, besides the above-mentioned Räto-Romantsch, similar modifications are reported in High Provençal, Channel Island and Picardy French as well as certain German, Flemish, and Danish dialects. In nearly all these dialects, the voiceless or voiced velar stop (depending on the context) replaces the original glide, either the palatal [j] or the labial [w] (Andersen 1988).

To sum up, as we have seen in this section, velar consonants are often reduced to glides. The character of the resulting glide depends on the context, that is, the palatal glide [j] evolves in the vicinity of front vowels, while the labial (back) glide [w] occurs next to back vowels. In most of the cases, gliding ends up with vocalization, to which we turn in the next section.

4.3 Vocalization

As already alluded to in the previous section, gliding and vocalization are closely related processes. They are related insofar as they change consonants into glides and vowels. On the other hand, they are recognized as two separate mechanisms in that gliding is often just an intermediate stage leading to full vocalization (the final stage). And just as vocalization can skip the intermediate gliding stage, gliding does not have to reach the final stage, that is, vocalization.

A good example of vocalization is the development of the back rounded vowel [u] between a back vowel and the velarized lateral [ɫ] in Middle English.

Recall from Section 2.1.1 (examples under (25)) that the operation of this process first leads to the appearance of the transitional vowel [u] before the lateral and then to various modifications, such as vowel raising and lengthening via the intermediate diphthongization stages. There are two general patterns along which the transitional vowel develops. They can be schematized as [a] + [ɫ] > [au] > [ɒu] > [ɔː] and [o]/[u] + [ɫ] > [ɔu] > [əʊ] and exemplified by *alter* > *aulter* 'altar' and *colte* > *coult* 'colt,' respectively.[21] Moreover, the velarized lateral can either survive to modern times, as in *malt* > *mault* > [mɔːɫt] 'malt,' or be lost altogether, as in *walke* > [waulk] > [wɔːk] 'walk.' In this context, Hickey (1985: 275) notes that Modern English forms like *ball* [bɔːl] and *talk* [tɔːk] evolved according to the pattern mentioned above, that is, [a] + [ɫ] > [au] > [ɒu] > [ɔː]. More specifically, he argues that it was not a direct shift from [a] to [ɔː] but that it was preceded by a diphthongization of the low vowel to [au]. This diphthong was the result of [ɫ] vocalization in Late Middle English. Subsequently, it was affected by monophthongization which, as part of the wider change of the Great Vowel Shift, led to ModE [ɔː]. Moreover, Hickey observes that the velarized lateral [ɫ], which is responsible for the development of the [u] on-glide, disappears when followed by a labial or velar consonant, for example, *walke* > [waulk] > [wɔːk] 'walk,' but survives in the word-final position and (in most of the cases) before a coronal, for instance, *ball* [bɔːl] and *malt* > *mault* > [mɔːɫt] (p. 275). Finally, note that due to hypercorrection and the influence of spelling, [l] was reintroduced into some words, such as *fault* < French *faute* and *almost* (for earlier *a'most*).

Interestingly, another liquid of English, [ɹ], suffered a nearly identical fate. It was vocalized and lost in the post-vocalic context (see Chapter Three, Section 2.1.2). What is even more interesting is that the vocalization of the lateral can be observed in various dialects of contemporary English. In Foulkes and Docherty (1999), the following dialects are identified as having lateral vocalization: London (Tollfree 1999; Harris 1994), Reading (Williams and Kerswill 1999), Derby (Foulkes and Docherty 1999; Foulkes and Docherty 2000), and Birmingham (Mathisen 1999). Other dialects that have been observed to have [l] vocalization are Estuary English (Przedlacka 2001; Britain 2005) and Australian English (Borowsky and Horvath 1997). In all these dialects, the lateral emerges as a vowel or glide, that is, [o u w]. For instance, in London English we get alternations such as [fiːɫ] ~ [fiːu] 'feel,' while in Liberian English vocalization produces forms such as [pipɔ] 'people,' [litɔ] 'little,' and [kiɔ] 'kill.' Note further that the reverse process, namely, the glide formation from neighboring vowels,

[21] Operstein (2010), following Jespersen (1922), argues that in one of the intermediate stages, the velarized lateral was prevocalized, that is, it developed the back on-glide [w]; hence, the pattern she proposes is /al/ > [awl] > /ɔːl/ > /ɔː/ exemplified by the development of *chalk*. Note that since prevocalization is just a different term for gliding, this is a welcome observation.

is equally common. Thus, English liquids [l ɹ], like glides [j w], can function as a hiatus-breaker in glide formation processes[22] (linking and intrusive *l* in the dialects of Pennsylvania in the USA and Bristol in the UK). As with intrusive [ɹ], the context for intrusive [l] is a preceding non-high vowel, typically a back one, as in *law is* [lɔːlɪz].[23] Backley (2011: 180) points to one interesting fact related to the process of [l] intrusion. In English, when the 'nationality' suffix *-ese* [iːz] is attached to a proper noun with a consonant at the end, no phonological modification occurs except for a shift in stress, for example, *Taiwan-ese*, *Nepal-ese*, etc. But when the proper noun ends in a vowel, the result of the suffix attachment is a sequence of two vowels, a situation which is typically avoided in English. In this situation, there are two repair strategies: either the first of the two vowels is dropped, for instance, *Malt(a)-ese* and *Burm(a)-ese*, or if the first of these vowels is [oʊ]/[əʊ] and [oː], the lateral [l] gets inserted, as in *Congo*-[l]*ese* and *Togo*-[l]*ese*. This means that the vowels [oʊ]/[əʊ] and [oː] act as the trigger for [l] insertion. It is pointed out that the solution cannot be sought in the historical development of this suffix simply because [l] is not present historically in *-ese*; this suffix derives from French *-ais(e)* and ultimately from Latin *-ensis*, neither of which contains [l].

Like English, Dutch shows dialectal variation between a clear and dark lateral [l] ~ [ɫ]. The latter variant is produced with a lower and further retracted tongue position than its clear counterpart, and it occurs in the pre-consonantal and final position, for instance, *pil* [pɪɫ] 'pill,' *kool* [kɔːɫ] 'cabbage,' *help* [hɛɫp] 'help,' and *wolk* [ʋɔɫk] 'cloud' (van der Torre 2003: 172). What is crucial for the discussion here is that the dark variant can be vocalized, that is, reduced to some vocalic reflexes. This phenomenon can be observed in both the history and recent developments of Dutch. It is pointed out (van der Torre 2003) that at a certain stage of Dutch development, lateral liquids in the pre-consonantal position and after a low back vowel changed into back round vowels. This development is illustrated under (53), where both the altered Dutch forms and the unchanged German cognates are provided.

(53) Lateral vocalization in Dutch (van der Torre 2003: 173)

Dutch		*German*		*gloss*
woud	[ʋɔut]	Walt	[ʋɑlt]	*forest*
oud	[ɔut]	alt	[ɑlt]	*old*
goud	[xɔut]	Gold	[gɔlt]	*gold*
mout	[mɔut]	malt	[mɑlt]	*malt*
hout	[hɔut]	Holz	[hɔlts]	*wood*

[22] This is one of the reasons why Backley (2011) subsumes them into one class, namely, English glides.

[23] For a detailed analysis of intrusive liquids in English, see Kijak (2010).

In contemporary spoken Dutch, a similar process is taking place, that is, the vocalization of non-pretonic liquids. This change can be observed especially in the speech of the young generation, and it leads to a situation in which the vocalized liquids [l] and [r] are easily confused with the Dutch glides [ʋ] and [j] respectively (van de Weijer 1999; Botma and van der Torre 2000). For these speakers, the contrast between a post-vocalic [l] and a post-vocalic [ʋ] has disappeared completely, and the words like *meeuw* [mi:ʋ] 'gull,' *mail* [mi:l] 'mail,' and *meel* [mi:l] 'flower' are all produced as [mi:w].

Similar processes are scattered all around various languages, which is evidenced in their historical development and captured as active, synchronic changes. Thus, the process of [l] vocalization takes place in Slovenian, Serbo-Croatian, Brazilian Portuguese (Backley 2011: 179), Medieval French, and Rhaeto-Romance (Operstein 2010: 165ff). For instance, in Serbo-Croatian, the participle is formed by the suffixation of [l] (Arsenijević 2002). The vowel final thematic verb forms in (54a) and (54b) show that the suffix is realized as the lateral [l] in the neuter and feminine forms respectively, while in the corresponding masculine forms, the suffix is word-final and lenities to a vocalic reflex (54c).

(54) Vocalization of the lateral in Serbo-Croatian adopted from van der Torre (2003: 174)

a.	pliva-l-a	[plivala]	*swum, fem.*
	hoda-l-a	[hodala]	*walked, fem.*
	pada-l-a	[padala]	*fell, fem.*
	presta-l-a	[prɛstala]	*stopped, fem.*
b.	pliva-l-o	[plivalo]	*swum, neut.*
	hoda-l-o	[hodalo]	*walked, neut.*
	pada-l-o	[padalo]	*fell, neut.*
	presta-l-o	[prɛstalo]	*stopped, neut.*
c.	pliva-l	[plivao]	*swum, masc.*
	hoda-l	[hodao]	*walked, masc.*
	pada-l	[padao]	*fell, masc.*
	presta-l	[prɛstao]	*stopped, masc.*

The only difference between the vocalization of [l] in Serbo-Croatian and in Dutch is the context in which it operates. While in Serbo-Croatian it is vocalized word-finally (54c), in Dutch it affects the lateral in the pre-consonantal position (53), but in contemporary Dutch vocalization is also reported to occur in the word-final position (see above). Another example comes from the Belear dialect of Catalan in which the laterals are reported to have the tendency to vocalize in weak positions. The lateral [l] in the standard dialect is reinterpreted as [u] in Belearic, for instance, St. Cat. [alba] ~ Bel. [auba], 'sunrise.' Finally, in Mehri, the vocalization of [l] is a synchronic process responsible for the alternation [l] ~ [w]. In forms derived from the root *łlθ* 'third,' the lateral [l] appears in the onset of a full CV syllable, as in [ɬo:ləθ] 'third, masc.,' while the glide [w] occurs in all other positions, hence [ɬəwθe:t] 'third, fem.' (Backley 2011: 179).

Van der Torre (2003: 174) brings up the case of Polish *ł* for discussion on vocalization. Without going into details, which are much more complex than this brief note may suggest, in most dialects of Polish, *ł* is pronounced as [w], but there are still some other varieties in which it surfaces as the lateral liquid [l] (see also Bethin 1992). Additionally, there is some evidence from the paradigmatic alternations, which suggests that [w] and [l] are two allophones of *ł*, with [l] surfacing before front vowels and [w] elsewhere (55).

(55) [w] ~ [l] alternation in Polish (van der Torre 2003: 174)

	nom. sg.	*loc. sg.*	*gloss*
szkło	[ʃkwɔ]	[ʃklɛ]	*glass*
mgła	[mgwa]	[mglɛ]	*mist*
stół	[stuw]	[stɔlɛ]	*table*
czoło	[tʃɔwɔ]	[tʃɔlɛ]	*forehead*

As illustrated under (55), the glide [w] in the nom.sg. corresponds to the lateral of loc.sg. However, as mentioned above, the situation in Polish is much more complex because there are numerous exceptions to the above pattern, for instance, *mgła* [mgwa] – *mgłę* [mgwɛ] 'mist, nom.sg-acc.sg.' or *stół* [stuw] – *stołek* [stɔwɛk] 'table – stool.' Note that in the latter forms, the [w] ~ [l] alternation does not take place even though the consonant occurs in the identical context to the one in (55). Exceptions and details aside, the alternation between the lateral [l] and the glide [w] in Polish may suggest that these segments have certain structural similarities.[24]

As a final example of vocalization consider the development of strong verbs from OE into Modern English represented in (56) below.

(56) Vocalization of [x] in English strong verbs (Huber 2007b: 169)

Old English			*Modern English*		
sē**c**an	sō**h**te	sō**h**t	seek	sought	sought
ten**c**an	to**h**te	to**h**t	think	thought	thought
by**cg**an	bo**h**te	bo**h**t	buy	bought	bought
wyr**c**an	wor**h**te	wor**h**t	work (regular paradigm of earlier wrought)		
bren**g**an	bro**h**te	bro**h**t	bring	brought	brought

[24] For the analysis of Polish [w], see, e.g., Kuryłowicz 1952, Gussmann 1981, Bethin 1992, and Cyran and Nilsson 1998.

In (56), apart from the alternations between a palatal affricate and the velar fricative [x] in OE, we can observe the effect of the velar fricative [x] vocalization recorded in the spelling of the ModE irregular verb forms. As already mentioned in the previous section (4.2), in ME the velar fricative, before it was dropped altogether, developed the back rounded vowel [u] (vocalization). This vowel is still present in ModE spelling. The effect of ME vocalization, that is, the back rounded vowel [u], later becomes mingled with the original vowel, which gives ModE [ɔ:] exemplified in (56) by the phonetic realization of the ModE past and past participle forms.

To recapitulate, vocalization is a common cross-linguistic process, often preceded by glide formation, during which a consonant evolves into a vowel. This section has provided some evidence which shows that in the vast majority of cases, the result of a velar consonant vocalization is a back rounded vowel. The existence of a reverse process – the development of a consonant (usually a liquid or glide) after back, non-high vowels – has also been attested, for instance, intrusive *l* in English. To find more evidence on labial-dorsal interactions, we look, in the following section, at the phonological activity of labial-velars, that is, segments with both double articulation (Section 5) and secondary articulation (Section 5.1).

5. Labial-velars (double articulation)

It is a well-known fact that only a stop articulation, whether oral or nasal, is robust enough to allow for execution at two different places at the same time. Moreover, among double articulations, labial-velar stops are the most common complex segments. Note that while labial-coronals have only been reported beyond doubt in Yeletnye, there is not a single language on record with segments that could be defined as coronal-velars (Ladefoged and Maddieson 1996: 345). It follows that the most typical examples of doubly articulated stops are the labial-velar stops [k͡p] and [g͡b], which are found mostly in West African and northern central African languages. They are also relatively common at the eastern end of New Guinea (Ladefoged and Maddieson 1996). Similarly, Clements and Rialland (2008) point out that labial-velars are almost unique to Africa, and Maddieson (1984) claims that only 6% of the languages sampled have labial-velars, including only one outside Africa. On the other hand, a more extensive database of specific languages containing labial-velars, which has been collected over several years (Cahill 2015), shows that labial-velars are not as unusual as previously thought, but occur in at least 840 (12%) of the world's languages, including at least 57 languages of the Pacific, and some cases elsewhere.

Cahill (2015) points to three main sources of labial-velars. Firstly, they can arise through spontaneous sound change in both recent and earlier stages of a language, often along the following path */ku/ > /kw/ > /k͡p/, for example, the Sawabantu languages (Cameroon) (Mutaka and Ebobissé 1996/97; Connell 1998/99). The second source is genetic, which simply means that labial-velars are descendants of complex segments found in parent languages. It has been argued that labial-velars are reconstructable in several African proto-families, for instance, Central Sudanic, Ijoid, Mande, and the large Volta-Congo family, including several of its specific subfamilies, such as Benue-Congo, Gur, and probably Kwa, Kru, and some others (Cahill 2015). The final source mentioned by Cahill (2015) is language contact. Note that labial-velars can spread even across major language family boundaries, as in Bantu languages, which as a group generally lack labial-velars (Grégoire 2003). The above sources have been proposed not only for African, but also for Pacific languages (Lynch 2002; Ross 1998; Blust 1981). Cahill (2015) concludes that in African languages the genetic inheritance source is by far the most common one, followed by sound change and language contact.

Summing up, labial-velar stops and nasals, such as [k͡p], [g͡b] and [ŋ͡m], are common only in certain languages, for instance, African and Melanesian languages; they are far more rare in Asian languages. For example, Hajek (2009) enumerates just a few examples of Asian languages containing labial-velars; among them there is Adu Yi, the Tibeto-Burman language spoken in Southern China, which contains five labial-velar stops [k͡p k͡pʰ g͡b ᵑg͡b ŋ͡m]. They occur only in the word or root-initial position and have their origin in the labialized velar and labial consonants, such as */kwu/ > /k͡pu/ 'fist' (Adu Yi). Similarly, Vietnamese, another Asian language, is reported to contain labial-velar stops and nasals (Hajek 2009). In the latter language, only velars /k/ and /ŋ/ are realized phonetically as labial-velars, that is, [k͡p] and [ŋ͡m]. Crucially, they are restricted to the word-final position and must be preceded by rounded vowels or vocalic nuclei with rounded off-glides (57).

(57) Distribution of complex segments in Vietnamese (Hajek 2009: 218)

khung [xuŋ͡m]	*frame*	hục [hʊk͡p˺]	*to turn into an addict*
không [xɤᵘŋ͡m]	*no, not*	hộc [hɤᵘk͡p˺]	*drawer*
khòng [xaᵘŋ͡m]	*bent over*	học [haᵘk͡p˺]	*to study*

As depicted in (57), the development of doubly articulated stops in Vietnamese results from lip-rounding of word-final velars after rounded nuclei, as in /huk/ [hʊkʷ˺] > [hʊk͡p˺]. Note that the labial /p/ and /m/ in the same context, that is, word-finally after rounded vowels, do not undergo this realization, for instance, /hup/ [hʊp˺] 'sink in water' and /ɲum/ [ɲʊm] 'a pinch of a substance.' Note further that there are at least two different views on the exact properties of vowels which precede the word-final labial-velars. According to one view, only the monophthongal mid-vowels [o ɔ] can appear before final labial-velars

(Kirby 2006). On the other hand, Thompson (1991) holds that before final /k ŋ/, only diphthongs are possible, which means that [hawk͡p] 'to study' is the phonetic realization of /hawk/ rather than /hɔk/. Be that as it may, this is always one of the back rounded vowels or a diphthong with the labial off-glide. Apart from the relatively well-documented examples of labial-velars in Vietnamese, there exist some records on the word-final labial-velars in other languages spoken in Northern Vietnam, such as Tay Nung (Tai-Kadai) and Dao or Iu Mien (Hmong-Mien). They follow the Vietnamese pattern in that [k͡p] and [ŋ͡m] appear word-finally after back rounded vowels, for instance, Tay Nung [p^{h}uŋ͡m] 'mend,' [k^{h}uk͡p] 'clogs,' and Dao [ŋɔŋ͡m] 'buffalo' (Hajek 2009: 219).

As mentioned at the beginning of this section, labial-velars are very common in African languages. This is the case in, for example, the Sawabantu languages, which are divided into two groups according to the presence or absence of complex segments, that is, labial-velars. In West Sawabantu (WS), we find [g͡b k͡p ŋ͡m/ŋ͡w ŋg͡b] which correspond to [ɓw kw mw ŋgw] in East Sawabantu (ES) (Connell 1998/99). It is assumed that the labialized consonants of ES are simply the more conservative forms, which are found in Proto Sawabantu (Connell 1998/99). Consider some direct correspondences between ES and WS represented in (58).

(58) Development of labial-velars in West Sawabantu (Connell 1998/99; Cahill 2015)

East Sawabantu	*West Sawabantu*	*gloss*
ɓw-èlé	gb-èlé	*tree*
kw-àmbà	kp-àmbà	*cassava*
mw-ànà	ŋm-ànà	*child*
kwédí	kpélí	*death*
è-ɓwéà	è-gbéà	*one hundred*
kúɓwako	kúgbako	*diarrhea*
kwátá	kpátá	*sword*

It has been proposed that the labial-velars of West Sawabantu are innovations (Mutaka and Ebobissé 1996/97). The authors argue that the developments represented under (58) involve desyllabification of a high back vowel in the context of a following vowel, the high back vowel then triggers labialization of the preceding consonant, which, in turn, undergoes hardening or fortition. This pattern can be schematized as follows: /ku/+V > /k^{w}/+V > /k͡p/+V, and similarly /pu/+V > /p^{w}/+V > /k͡p/+V, where 'V' stands for a vowel and /k͡p/ represents both a voiceless and voiced variant.

Finally, to repeat a point made earlier, other complex segments, such as labial-coronal stops, are quite rare, if not actually impossible. For example, although Ladefoged (1968: 11) reports on the presence of [p͡t] and [b͡d] in Gur languages such as Dagbani, these sounds are allophones of [k͡p] and [g͡b] which occur before front vowels. The existence of labial-coronals has been confirmed by Ladefoged and Maddieson (1996) in Yeletnye, spoken in Papua New Guinea (see also van de Weijer 2011: 704). However, as van de Weijer (1996: 202) notes, the existence of labial-coronals in most of the cases is at best controversial. For instance, in Margi, which is said to contain a range of labial-coronal stops, they show some characteristics of complex segments in the process of reduplication, while in Bura, a close relative of Margi, they are consonant clusters rather than complex segments. Sagey (1986) arrives at the same conclusion, pointing out that the Margi labial-coronals were derived historically from consonant clusters created by syncope.

To sum up, cross-linguistically the most common doubly-articulated stops are labial-velars. They are found mostly in African languages but also, on a much smaller scale, in Asian languages. Although incomparably rarer, labial-coronals are also reported in certain languages. Crucially, coronal-velars are totally absent from the language databases.

5.1 Labio-velars (secondary articulation)

It is a generally accepted view that secondary articulation, which includes labialization, velarization, palatalization, and pharyngealization, is in the majority of cases nothing more than historically fossilized evidence of co-articulation (van de Weijer 2011: 694). In other words, van de Weijer (2011) draws a clear distinction between secondary articulation and co-articulation in that the latter is typically the anticipatory shaping of the speech organs to accommodate the immediately following sounds. Thus, round vowels will impose rounding on neighboring consonants just as front vowels impose a palatal quality on such consonants. By the same token, velarization is imposed by back vowels and pharyngealization by low ones. Unlike co-articulation, secondary articulation can be phonemic, which means that it is often the effect of some historical processes which make a consonant with secondary articulation grow independent.

Since velarization, defined as secondary articulation, is far less common than labialization and since palatalization has already been discussed elsewhere (Section 4.1), this section deals with labialization. But it must be noted that the following discussion does not aim to be exhaustive. Indeed, numerous instances of processes closely related to labialization as secondary articulation have already been discussed in the body of Chapter Two, for example, the development of the IE labio-velars [k^w g^w] and the evolution of the labio-velars to plain labials from Latin to Romanian (Section 2.1.1), the appearance of the labio-velar [g^w] as the result of epenthesis in Spanish (Section 2.1.2), and the development of labio-velars into dentals before front vowels in Ancient Greek (Section 3).

The term labialization (both as co-articulation and secondary articulation) is used to refer to the addition of a lip rounding gesture to a segment with the accompanying elevation of the tongue back (Maddieson 1984; Ladefoged and Maddieson 1996; Stonham and Kim 2008). Additionally, Ladefoged and Maddieson (1996: 368) note that labialization is often used to describe a sequence of a consonant and the glide [w]. In short, labialization covers not only labialized consonants such as /k^w t^w/, etc. but also the consonant + *w* sequences. It has been observed that from the acoustic point of view, labial consonants show the effect of a lower second formant transition in adjacent vowels, while in labialized consonants the second formant of neighboring vowels is even lower (Ladefoged and Maddieson 1996: 357ff).

Articulatory and acoustic details put aside, Ohala and Lorentz (1977) bring into discussion Ruhlen's (1976) catalogue of 706 languages containing labialized obstruents. This database, represented in (59) below, clearly shows that labialization occurs predominantly on dorsal consonants (velar and uvular).

(59) Statistics of labialization in a language database (Ruhlen 1976)

Labial	Dental	Alveolar	Palatal	Velar	Uvular	Pharyngeal/glottal
48	26	16	43	318	107	26

Similarly, Ohala and Kawasaki-Fukumori (1997) show that among 40 languages with labialization that they surveyed, only three languages had labialized labials, while labialized alveolars and palatals occurred only in two languages. In the remaining 35 languages only labialized dorsals were found. The immediate conclusion is that labialization tends to target dorsals rather than coronals, and so [k^w] is far more common than [t^w]. This preference becomes evident when we consider figures from another study (Backley and Nasukawa 2009). It is pointed out there that the UPSID database records 60 languages with labialized velars but only 2 languages with labialized coronals. Finally, according to yet another language database including 628 segment inventories, there are 117 languages which have at least one labialized consonant. Crucially, in such inventories containing one or two labialized consonants, these are almost always velars (Mielke 2008).

Generally, languages exhibit a gap in the inventory of labio-velar segments, that is, they tend to avoid /C^wu/ sequences. If a language has labio-velar consonants and they are in the context of a following round vowel, then labialization on the consonant is typically dropped. This connection can be illustrated by Chehalis, a Salish language of the American Northwest, in which the labialized dorsals, that is, velars and uvulars, become plain before [o] and [u] (Ohala and

Kawasaki-Fukumori 1997). Similar effects can be observed in Nuuchahnulth, a Wakashan language spoken along the west coast of Vancouver Island in Canada. In this language, labialized consonants appear only before [a] and [i]. More specifically, the language contains a basic vocalic set with only three vowels: [i a u]. Now, while any non-labialized consonant can appear before any of these vowels, there are no cases of words where a labialized consonant precedes the back rounded vowel [u]. It follows that in a derived context, we should observe an alternation between a labialized and plain consonant, which is indeed the case, for instance, [hawik^w-uk] > [hawikuk], *[hawik^{w}uk] 'a big eater' and [ts'ax^w-uuł] > [ts'axuuł], *[ts'ax^{w}uuł] 'wrinkles.' Furthermore, in this language, labio-velars function as separate, contrastive segments (secondary articulation), which is illustrated in (60) below.

(60) Labio-velars in Nuuchahnulth (Kim 2003: 46)

/k^{w}a/	*moving backwards*	/ka/	*to pinch*
/k^{w}its/	*to scratch away dirt*	/kits/	*to dive under water*
/q^{w}aħ/	*red clay or red-colored paint*	/qaħ/	*to die*
/x^{w}akak/	*swollen*		
/ʃuχ^{w}ak/	*rusty*		

There are three immediate observations concerning labialization based on the data in (60): a) it is contrastive, b) it can be followed by the vowels [i a] but never by the back rounded [u], and c) it occurs only with dorsal consonants, that is, velars and uvulars [k q x χ].

Finally, note that more instances could easily be added to the list of labio-velar related phenomena which have been compiled so far (see Sections 2.1.1, 2.1.2 and 3). Thus, apart from numerous cases of the IE labio-velars changing into labials in Greek (cf. Section 3), Romanian, Osco Umbrian, Celtic (some dialects) and sporadically in Germanic, a similar development can be observed outside the IE language family, for instance, Proto-Zapotec, Songkhla, and Proto-Yuman, among many others (Ohala and Lorentz 1977: 589).

Summing up, just as the labial-velars are the most common double articulations (previous section), labialization as secondary articulation affects mostly velars (dorsals). To put it differently, it is labio-velars which constitute the largest group of segments with secondary labial articulation, which has been confirmed statistically by numerous databases. Historically, the labial part of a labio-velar segment can develop in one of the following ways: it can be absorbed by the velar changing it into a labial; it can develop into a stop forming a complex labial-velar consonant [k͡p]; it can disappear altogether, as in some cases in Germanic, for instance, IE **g^{w}ou-* > Germanic *cu* > English *cow* [kaʊ], German *Kuh* [ku:], Dutch *koe* [ku:]; or finally, it can change into the labio-velar glide [w]. And it is the labio-velar glide to which we turn in the following section.

5.2 The labio-velar glide [w]

The main reason why the labial glide [w] is discussed here separately is that it has always been the subject of much controversy. For instance, Ohala and Lorentz (1977: 577) point out that many phonologists are unwilling to classify labio-velars (including the glide [w]) as both labial and velar even though phonetically they contain both components. It follows that [w] is often placed in consonant charts either in the labial section or the velar one. This is the case in SPE, which defines labio-velars in general as either primarily velar with secondary labialization, or the other way round, as primarily labial with secondary velarization. In other words, in such studies the affiliation of labio-velars is based not on the phonetic evidence but on classificatory arguments (Kaisse 1975; Anderson 1976). For example, Ladefoged (1968) notes that labio-velars, which, we may recall, are quite common in various West African languages, are analyzed as labials or velars based on their overall pattern in a language. This simply means that if a language which contains labio-velars happens to lack one member of a voiced-voiceless pair of stops, be it /g/, the repair strategy is applied and a labio-velar is assigned to this empty slot and classified as velar. Note, however, that taxonomic arguments of this kind do not say much about segments themselves. More interesting conclusions are drawn from the phonological behavior of segments. This approach is taken by Anderson (1976), who points out that in Yoruba, labio-velar stops must be defined as velars since the preceding nasals assimilating to their place of articulation show up as [ŋ] and not [m]. Interestingly, in languages where labio-velars pattern with both labials and velars, which is the case of [w] in, for example, Fula, he proposes that there must be two glides: one labial and one velar. On the other hand, Ohala and Lorenz (1977), who are dissatisfied to the same degree with the taxonomic results, analyze labio-velars from the phonetic perspective. They argue that the taxonomic approach is useless because, among many other things, there are many (West African) languages which both contain labio-velars and display no gap in the plain velar stop inventory. Although Ohala and Lorenz (1977) refer to all labio-velars [u k͡p g͡b kw gw], in their analysis they put emphasis on just one class-representative, namely, the labio-velar glide [w], immediately pointing out that the solution they reach can be applied to all segments in this class. The analysis they propose is based on (excluding statistics) sound change, allophonic and morphophonemic variation. For instance, in Tswana (a Bantu language), a nasal becomes velar [ŋ] before both a typical labio-velar like [k͡p] or [g͡b] and the glide [w], as in *-roma* 'send' + *wa* > *roŋwa*. Interestingly, there are languages in which the labio-velar glide betrays its labial and velar characteristics. This is the case in, for example, Tenango Otomi. In this language, the fricative /h/ and the nasal /n/ before the labio-velar glide [w] are changed into, respectively, the labial fricative [ɸ] and the velar nasal [ŋ]. Similarly, in some dialects of Yoruba, [ã] merges with [ɔ̃] after the labial consonants /w k͡p g͡b b f m/. However, nasal consonants which assimilate to the place of articulation of the following /w/ appear as the velar [ŋ].[25] Finally, Vago (1976: 672ff) reports that in the aforementioned Baule (see Section 2), the labio-velar [w] is related to both labials and velars. In this language, [w] is pronounced as the front rounded glide [w̄] between an alveolar or a palatal consonant and a front vowel, as in [tw̄i] 'gun,' [lw̄i] 'fat,' and [ɟw̄e] 'fish.' With some minor exceptions,[26] /w/ is realized as a labio-velar glide in all other contexts. This means that /w/ remains a labio-velar glide between a labial or a velar consonant and a front vowel, for example, [bwi] 'back,' [bwe] 'nose,' [kwe] 'fetus,' and [kwɛkwɛ] 'comb.' If front vowels are assumed to be responsible for the fronting, why do they not trigger it in a situation when /w/ is preceded by a labial or velar?

To sum up briefly, Section 5 has demonstrated that labio-velars, as both complex segments (Section 5) and segments with secondary articulation (Section 5.1), are cross-linguistically the most common segments of this type. Moreover, together with the labio-velar glide (Section 5.2), they must be specified for both labiality and velarity as they readily interact with both labials and velars even within the same system.

6. Summary and conclusions

This chapter has been planned with the purpose of creating a considerable data repository for phonological phenomena related to labials and dorsals. It contains a large body of relevant facts from numerous mostly Indo-European languages, including both various historical developments and contemporary processes including dialectal variation. In order to portray the rich diversity of labial-dorsal related phenomena, the core of this chapter has been based on three different perspectives. The material in the first part has been organized according to the languages demonstrating labial-velar interactions. Additionally, the cross-linguistic data in this part have been divided into two groups based on the direction of the shift. We have seen that apart from some evident labial >< dorsal

[25] For more examples indicating that the labio-velar glide [w] is related to both velars and labials, see Ohala and Lorentz (1977) and the references therein.

[26] There are two exceptions to the pattern: word-initially before /i/ and in the context between /ɟ/ and /a/, /w/ is realized as a labio-velar glide [w].

shifts, there are also those in which the interaction between both classes is less obvious, like diphthongization, vocalization, and epenthesis.

In the second part of this chapter, the approach to data presentation has been broadened from the language-oriented one, which describes labial-dorsal mutual shifts, to an approach focusing on the interactions of labials and dorsals with other classes of segments. Thus, instead of describing particular cases in particular languages, this part has introduced the interactions of labials and velars with other major classes of segments, both consonantal and vocalic. It has been demonstrated that the common interactions of labials and velars with coronals are possible but only in a rigidly defined context, namely, in the presence of the following front vowel. Moreover, this part has documented the unquestionable relationship of labials and dorsals with back rounded vowels.

The third part has concentrated on the question of what unites labials and dorsals by assuming a process-oriented perspective. In other words, to reveal the internal structure of labials and dorsals, they have been looked at through the prism of common processes they participate in. It has been demonstrated that even though both labials and coronals can undergo palatalization, it is velars which are most susceptible to it. Moreover, we have seen that velars can shift to coronals only in a strictly defined context, that is, before front vowels. Furthermore, this part has provided some evidence to demonstrate that in the vast majority of cases, the result of velar vocalization and gliding is a back rounded vowel or the labial glide [w]. Moreover, the character of the resultative glide has been shown to depend on the context in that the palatal glide [j] evolves in the vicinity of front vowels, while the labial (back) glide [w] occurs next to back vowels. The existence of a reverse process, that is, a development of a consonant (usually a liquid or glide) after back, non-high vowels, has also been reported. Finally, we have seen that labio-velars, as both complex segments and segments with secondary articulation, are cross-linguistically the most common segments of this type. It has become evident that, together with the labio-velar glide, they must be specified for both labiality and velarity as they readily interact with both labials and velars even within the same system.

In Chapter Three, I will adopt the theoretical solution proposed in Element Theory with the purpose of applying it to selected processes and modifying it if necessary. Apart from the analysis of the labial-dorsal interactions introduced in Chapter Two, we will also address some instances of phonological phenomena which, at first sight, may look only loosely connected with the topic of this study. Additionally, Chapter Three will critically discuss earlier solutions proposed by some other researchers working within the Element Theory framework. The main objective in Chapter Three, however, is to propose a representation of labials and dorsals which is able to explain their mutual cross-linguistic interactions and account for the numerous phonological phenomena illustrated in Chapter Two.

Chapter Three

Love triangle, or phonological patterning of labials, dorsals, and back vowels

1. Introduction

The preceding chapter has provided raw data illustrating cross-linguistically the common phonological patterning of labials and dorsals. The approach adopted there has been deliberately theory-neutral. Thus, instead of offering explanations for various phonological phenomena, the discussion has concentrated on the presentation of numerous instances of the labial-dorsal interactions. In the present chapter, the perspective changes to a fundamentally analytic one. In other words, the primary objective of this chapter is to analyze a number of selected processes, both those already introduced and some new ones, with the purpose of refuting the broadly accepted view which holds that velars lack any resonance elements. This chapter adopts an alternative solution according to which both labials and dorsals are specified for the resonance element |U|. The choice of Element Theory for the analysis in this chapter is justified by the fact that this is the only model which has pushed the idea of vowel-consonant unity to its logical conclusion. And since the internal structure of segments (including dorsals) is very frequently manifested through the vowel-consonant interactions, this choice is even more firmly substantiated.

The chapter is organized as follows: Sections 2 through 2.3 deal with the representation of major places of articulation proposed in Element Theory. Thus, Subsections 2.1 and 2.1.1 discuss the representation of palatals, coronals, and front vowels. Additionally, Subsection 2.1.2 looks more closely at the internal structure of English coronals. The conclusive argument concerning the representation of English coronals is based on the analysis of linking and intrusive liquids and *r* vocalization in the history of English. The character of the place definer in labials and round vowels is illustrated on the example of vocalic developments in English and in some dialects of contemporary Polish and Czech (Subsection 2.2). Finally, Subection 2.3 discusses in detail the representation of dorsals which is adopted and developed in the present study. Section 3 disposes of the mainstream view according to which velars do not contain any place definers, that is, resonance elements. Additionally, it describes some advantages of the solution laid out in the previous section. Next, Section 4 tackles complex segments both as secondary articulation and double articulation segments in various languages. Sections 5 and 5.1 look at numerous instances of labial > velar interactions in Dutch (Section 5) and Spanish (Subsection 5.1). Section 6 deals with the common interactions of velars with front vowels in the palatalization processes (Italian, Russian and the Northern Mazovian dialect of Polish). Additionally, it provides an explanation for the infrequent shifts between velars and coronals on the example of Spanish. Section 7 analyzes numerous instances of velar > labial developments, the majority of which have been collected from the diachronic development of English. Thus, Subsection 7.1 looks at the vocalization of the velar fricative in OE. A new solution for Old English Breaking is proposed in Subsection 7.2. Other phonological phenomena analyzed in Section 7 include: vowel rounding before velars in OE and ME, supplemented by similar developments in modern Czech (Subsection 7.3), ME diphthongization before both the voiced velar fricative (Subsection 7.4.1) and voiceless velar fricative (Subsection 7.4.2), ME velar labialization backed by similar cases in some southern dialects of contemporary Polish (Subsection 7.4.2.1), and finally, diphthongization before the velarized lateral (Subsection 7.4.3). Section 8 briefly summarizes the main points.

2. Place definers

The analysis of selected phonological processes proposed in this chapter is couched in the Element Theory model. The rationale behind this choice is manifold and has already been provided in Chapter One (see Section 5). One of the most significant assumptions of this approach is that consonants and vowels are built out of the same set of elements. More specifically, the particular model I adopt here is the one proposed by Backley (2011). Recall from Chapter One (Subsection 5.6) that it makes use of just six elements |I U A ʔ H L| to represent both vocalic and consonantal systems. Since in this study a particular emphasis is put on the representation of dorsals and since the intrasegmental structure of the remaining major places of articulation is basically uncontroversial in ET circles, the discussion concerning the representation of coronals, palatals and labials is rather brief here. Finally, it is the representation of dorsals that challenges the mainstream ET solution, which is why a considerable amount of space is devoted to the presentation of the arguments for the solution advocated in this study.

2.1 Palatals and front vowels

In ET, the resonance elements |I U A| are primarily associated with vowel structure but they also function as place definers in consonants, that is, they can be rendered articulatorily as the major places of articulation. Basically, front vowels are represented by the element |I| (high front vowels), a combination of |I| and |A| (front mid and low vowels) or, in the case of the front rounded vowels, as |I| and |U|. In consonantal systems, on the other hand, the headed element |I̲| defines the natural class of palatals, and so it is present in both palatal and palatalized segments, for example, [ç ʃ kʲ ɲ], etc. Moreover, a single |I̲| in the consonantal slot is interpreted as the palatal glide [j], while the same element in the vocalic slot is phonetically realized as the the vowel [i]. Finally, this element is recognized to contribute palatal resonance to any consonant in which it appears. The latter situation is illustrated by the common palatalization [s] > [ʃ] in English, as in *miss you* [mɪʃju] in (61).

(61) Palatalization of [s] in English

O	N	O	N		O	N
m	ɪ	|A|		←	|I̲|	u
		|H̲|				
		[s]>[ʃ]			j	

In (61), the resonance element |A| of the alveolar fricative [s] is replaced by the element |I̲| of the following palatal glide [j]. In consequence, [s] is changed into a palato-alveolar fricative [ʃ] (palatalization). Note that in (61), the coronal [s] is represented by the |A| element, which means that English coronals are |A|-segments. This representation for English coronals receives further confirmation in Subsection 2.1.2 below.

2.1.1 Coronals

In Chapter One, it was pointed out that because of the size of the class of coronals (including dental, alveolar, postalveolar, palato-alveolar and retroflex), they are proposed to be represented either by a non-headed |I| or |A|. In short, there are two different kinds of coronals, namely, |I|-coronals and |A|-coronals, and the choice between these two in a particular system depends on their phonological behavior. Furthermore, it is assumed that two segments with phonetically identical places of articulation do not necessarily share the same phonological properties. It means that in the same system, we may find a group of |A|-coronals and, additionally, another group of coronals which, however, behave as |I|-segments. The only rational premise which allows us to determine how a segment is represented is its phonological behavior. Finally, note that since coronals are represented as non-headed |I| or |A| segments, they are prone to various processes (lenition) and modifications (e.g., palatalization) cross-linguistically.[1]

2.1.2 English coronals

It is uncontroversial to state that English coronals are represented by the non-headed resonance element |A|. The following discussion of a short episode from the historical development of English [ɹ] may further confirm this assumption.[2] Note first that the division of English into two major dialect groups, that is, rhotic and non-rhotic, is based on the distribution of *r*. In the non-rhotic pattern, which characterizes southern England, Australia, New Zealand, and also some parts of the eastern and southern United States, the contextual freedom of historical *r* is severely limited in that it occurs only in the pre-vocalic position. However, in both varieties, the set of vocalic contrasts before historical *r* is radically different from that found before other consonants. For instance, in the majority of rhotic dialects, excluding Scottish English, the vocalic inventory in the context of the following *r* is sharply reduced and the short-long vowel opposition is neutralized. In short, the influence exerted by the historical *r* on the preceding vowel is noticeable in the quality and quantity modification of the latter. The situation is basically the same in the non-rhotic dialects, with the difference that here *r* is phonetically suppressed in half of the contexts.

It is widely assumed that the phonetic realization of *r* started to change in Early New English in that the formerly trilled consonant became more open and finally dropped altogether. It took place in two contexts: word-finally and pre-consonantally. Crucially for us here, the process of *r* weakening affected the preceding vowels, both short and long, which in effect were lowered and ended up as more central. For instance, the high vowels [i u] and the mid vowel [e] when followed by *r* coalesced into [ɜː], as in *bird*, *first*, *burst*, *nurse*, *person*, and *certain*. In a situation when *r* was preceded by a long vowel, the scenario was slightly different in that the vowel was laxed and diphthongized, for instance, [iː/uː] + *r* > [ɪə/ʊə], as in *beer*, *cheer*, *deer* and *pour*, *poor*, *door*, etc.[3] Later on, the [ʊə]

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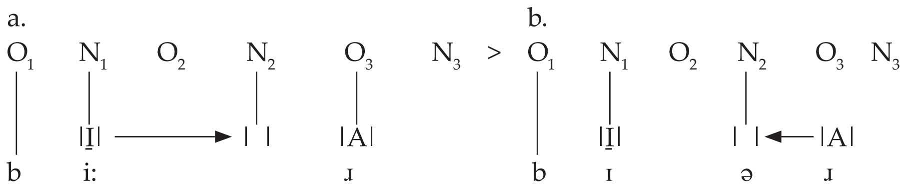
[1] This is in line with the findings of Paradis and Prunet (1991), according to which coronals are the most unmarked class of segments.

[2] The discussion in this section is based on Kijak (2009, 2010).

[3] It is pointed out that diphthongization as the initial stage also affected some short vowels in the pre-*r* context. For instance, the vowels in *far*, *art*, *arm*, *bark* and *cord*, *fork*, *north*, *short*, developed the transition glide, which was eventually dropped,

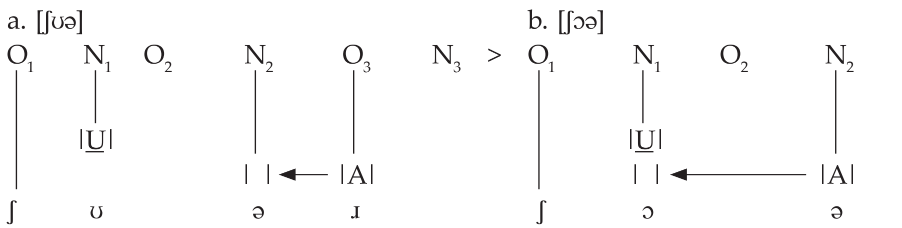
diphthong in the latter forms underwent further lowering, ending up as [ɔː] or [ɔə]. In this way, it merged with another pattern characteristic of this period, that is, [ɔː] + *r* > [ɔə] in forms like *lore, more,* and *boar*. The former lowering phenomenon can be observed in contemporary English where two competing forms exist side by side, as in *sure*, *pure* [ʃɔː], [pjɔː] and alternative [ʃʊə], [pjʊə]. Finally, like other long vowels, the front non-high vowels underwent diphthongization, for example, [ɛː/æː] + *r* > [ɛə], as in *pear, tear, bare*, *care*, etc. All these developments can be explained straightforwardly on the assumption that *r* is represented by the non-headed element |A|. This can be exemplified by the vocalic developments in *beer* (62) and *sure* (63).

(62) *beer* [biːɹ] > [bɪə]



In a weak position the coronal *r* gets delinked from the consonantal point O_3 and moves to the preceding nuclear point N_2 (62b). In consequence, the original vowel is laxed, [iː] > [ɪ], and diphthongized to [ɪə]. Recall from Chapter One that the element |A| receives the schwa interpretation when linked to the nuclear point. A similar explanation is provided for the vowel lowering effect produced by *r*, that is, by the leftward migration of the element |A| illustrated in (63).

(63) *sure* [ʃʊə] > [ʃɔə] > [ʃɔː]



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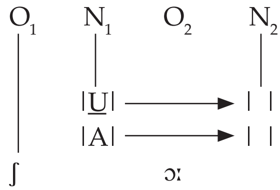
while the original vowel was lengthened, for instance, [faɹ] > [faᵊɹ] > [faə/faːɹ] > [fɑː] *far* and [koɹd] > [kɔᵊɹd] > [kɔəd/kɔːɹd] > [kɔːd] *cord*, respectively (Wełna 1978: 215; after Wright 1924, Kurath 1964, and Prins 1974). Note that the intermediate forms, that is, [faᵊɹ] and [kɔᵊɹd], are confirmed by some contemporary rhotic dialects in which, for example, *far* and *poor* are realized as [fɑəɹ] and [pɔəɹ], respectively (Harris 1994: 256).

c. [ʃɔː]



As in (62b), the element |A| is interpreted as the schwa under the nuclear slot N_2 in (63a). However, this is not the end of the road for this element, as it moves further left and, together with the element |U|, is interpreted as the round vowel [ɔ]. And finally, in (63c), the whole material is merged under N_1, giving rise to a complex structure interpreted under two nuclear slots as a long monophthong, that is, |U A| = [ɔː].[4] In short, forms like *sure* and *pure* traveled a long distance from [ʃʊə]/[pjʊə] via [ʃɔə]/[pjɔə] to [ʃɔː]/[pjɔː], and the alternative realizations of the standard [ʃɔː] can still be found in both rhotic and non-rhotic dialects.

To sum up the discussion so far, in Early New English the word-final and pre-consonantal *r* was weakened and subsequently lost around the 18th century. Before it disappeared, however, *r* left an audible trace in the form of the realization changes affecting the preceding vowels. Thus, in this context, both short and long vowels faced some qualitative and quantitative developments.

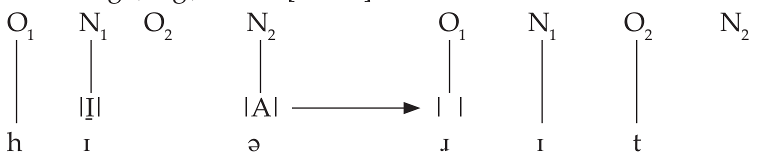
Interestingly, non-rhotic dialects are additionally characterized by the presence of the *r*-zero alternation, a typical sandhi phenomenon, where the alternating variants depend on whether a vowel or consonant follows, for example, *far above* [fɑːɹ əˈbʌv] and *far below* [fɑː bɪˈləʊ]. More specifically, the approximant *r* shows up pre-vocalically both across morpheme- and word-boundary, as in *hearing* [hɪəɹɪŋ] vs. *hears* [hɪəz] and *hear about* [hɪəɹ əˈbaʊt] vs. *hear to* [hɪə tu]. In other words, while some etymologically *r*-full words never contain consonantal *r*, for instance, *beard* [bɪəd], others, such as *hear* [hɪə], *hearing* [hɪəɹɪŋ], alternate between an *r*-less and *r*-full variant. The alternation in question is known as linking *r*, where the approximant variant shows up pre-vocalically, while the zero alternant appears before a consonant or the pause. This process has an extension in the form of the so-called intrusive *r*, which boils down to the realization of constricted *r* in etymologically *r*-less forms. This alternation is conditioned by the same trigger as is the linking *r*, that is, the presence or absence of a following vowel, and it arises at the morpheme-boundary, both word-internally and finally, for example, *drawing* [ˈdrɔːɹɪŋ] vs. *draws* [ˈdrɔːz] and *draw it* [ˈdrɔːɹ ɪt] vs. *draw*

[4] Note that the development of [ʊə] to [ɔː] additionally requires the shift in headedness in that the diphthong [ʊə] is headed by |U|, while the long monophthong by |A|.

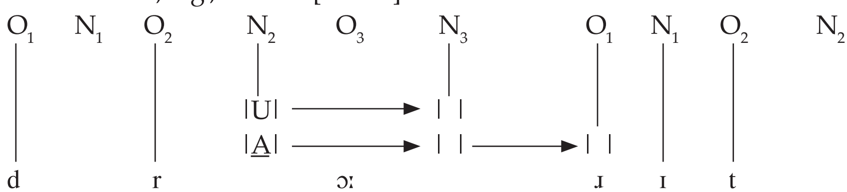
them ['drɔː ðəm]. Crucially, intrusive *r* is blocked in a situation when the morpheme final vowel is high or up-gliding, as in *see all* or *say again*, etc. It follows that the occurrence of intrusive *r* relies strictly on the quality of the preceding vowel in that it must be one of the non-high vowels. Recall that the sub-system of vowels before historical *r* is severely curtailed. Apart from long non-high vowels, such as *far* [fɑː], *more* [mɔː], and *work* [wɜːk], in this set we find centering diphthongs, for example, *dear* [dɪə], *dare* [deə], and *poor* [pʊə]. This is the result the historical *r* exerted on the preceding vowels, that is, lowering, centering, and loss of tension. It means that both linking and intrusive *r* operate in the same context, namely, after a non-high vowel or a centering diphthong, as only these vowels are specified by |A|. In other words, since both non-high vowels and centering diphthongs contain the element |A|, linking and intrusive *r* get the same explanation: interpretation of the element |A| under the following consonantal slot. This is illustrated in (64).

(64) Linking and intrusive *r*

a. linking *r*, e.g., *hear it* [hɪəɹ ɪt]



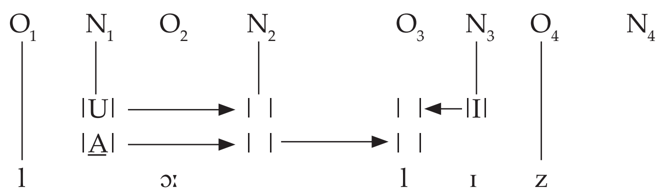
b. intrusive *r*, e.g., *draw it* ['drɔːɹ ɪt]



In (64a), the second part of the diphthong is the central weak vowel represented by the element |A|. The scope of the interpretation of this element extends to the following consonantal position O_1, which results in the appearance of linking *r*. Similarly, in (64b) the mid low vowel [ɔː] contains the element |A| which is interpreted in the following consonantal point O_1 as an intrusive *r*. In both processes, the following morpheme must begin with a vowel as only in this situation is the consonantal position empty and can it host the incoming element |A|. This explains the absence of the alternating [ɹ] in the pre-consonantal position, as in *hear to* [hɪə tu] and *draw them* ['drɔː ðəm]. Finally, note that the same solution may be successfully applied to the identical process of linking and intrusive [l] which has been reported in some dialects spoken in the Northeast of the United States (Gick 1999; Bermúdez-Otero 2005).

As with the linking and intrusive *r* described above, the alternating [l] occurs after non-high vowels, usually after [ɔː] in a situation when the following morpheme starts with a vowel, for example, *doll is* [dɔːl ɪz] vs. *dolls* [dɔːz] and *law is* [lɔːl ɪz] vs. *law book* [lɔː bʊk]. As has already been pointed out (Chapter One), the English lateral [l], being a coronal, is represented by the element |A|, additionally accompanied by |I| or |U| depending on the variant, that is, clear [l] or dark [ɫ], respectively. Bearing in mind that both alternating consonants are liquids [ɹ l] defined by the resonance element |A| and that the sandhi phenomena of linking and intrusion operate on the identical intervocalic context in which the first vowel belongs to the set of non-high vowels, the explanation becomes clear immediately. It is the same process that utilizes either [ɹ] or [l] depending on the dialect. The operation of intrusive [l] is represented in more detail under (65).

(65) Intrusive [l], e.g., *law is* [lɔːl ɪz]



As in the intrusive [ɹ] in (64b), here too the resonant |A|, which is part of the elemental make-up of the back vowel [ɔː], spreads to the following empty consonantal point O_3 and, together with the element |I| of the following vowel, is interpreted as the lateral [l].

Since the representation of coronals is not the primary objective of this study, I will not pursue it any further here but simply adopt the view that their representation may vary between |A| and |I| depending on the dialect and/or language. The short analysis of alternating liquids presented above justifies the assumption that coronals in English are specified by the element |A|.

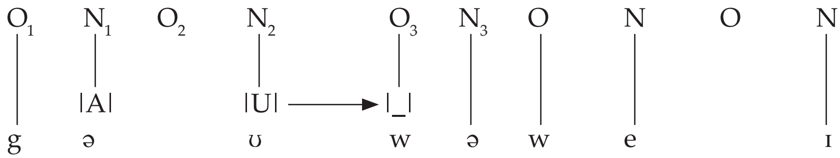
2.2 Labials and round vowels

It is assumed without much justification that headed |U̲| defines the natural class of labials and is present in labial and labialized consonants, such as [b f k^w m w].[5] Furthermore, it defines the set of rounded vowels, back and front alike,

[5] Recall from Chapter One that labio-dentals like [f ɱ] are assumed to be complex expressions in that they contain an additional non-headed |A|, hence |U̲ A| (Backley 2011).

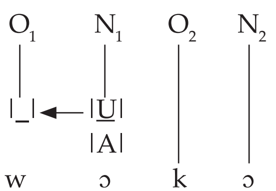
for example, [ɔ u y ø], etc., and when associated with the consonantal point, it gets the interpretation of the labial glide [w], as illustrated in (66) on the example of glide formation in English, as in *go* [w] *away*.

(66) The representation of the labial glide [w]



In (66), the element |U| promoted to the head position under the consonantal point O_3 is interpreted as the labial glide [w]. The presence of |U̲| in labials and round vowels is evidenced by their common cross-linguistic interactions. In Chapter Two (Section 3.2), the case of labial fricative epenthesis in Prague Czech was mentioned. Recall that in this variety, an epenthetic labial fricative [v] develops before the mid back vowel [o], as in *okno* > *vokno* 'window,' *otec* > *votec* 'father,' *on* > *von* 'he.' A similar development was observed in some dialects of Polish in which the mid back vowels developed an on-glide, that is, an epenthetic labio-velar glide [w], for instance, *okno* St. Pol. [ɔknɔ] ~ dial. [ʷɔknɔ] 'window,' *ojciec* St. Pol. [ɔjɕɛt͡s] ~ dial. [ʷɔɕɛt͡s] 'father,' and *oko* St. Pol. [ɔkɔ] ~ dial. [ʷɔkɔ] 'eye.' Since the back mid vowel [ɔ] is a complex expression represented by the combination of |A U|, the epenthetic phenomenon in both languages receives a straightforward explanation; namely, it is triggered by the element |U| extending its realizational scope to the initial empty consonantal point. This is illustrated in (67).

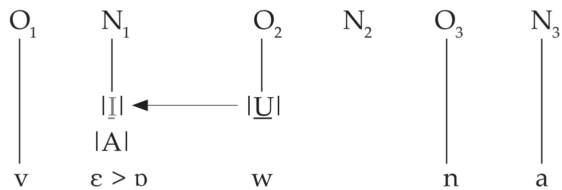
(67) Development of the epenthetic glide in Polish [ɔkɔ] ~ dial. [ʷɔkɔ] 'eye'



The same explanation applies to the remaining examples in both dialects, Polish and Prague Czech, with the difference that in the latter language the epenthetic segment is strengthened to the labio-dental fricative, which may suggest the spreading of both elements, that is, |A| and |U|.

It was also mentioned (Chapter Two) that in certain dialects of Greater Poland the labial [u̯] < [w] can impose retracting and lowering on the preceding tautosyllabic [ɛ] along the following pattern: [ɛw] ~ [ɛu̯] > [ɔu̯] > [ɒu̯], which is illustrated by the comparison of the standard and dialectal forms, for instance, *p*[ɛw]*ne* ~ *p*[ɒu̯]*ne* 'full,' *pud*[ɛw]*ko* ~ *pud*[ɒu̯]*ko* 'box,' *w*[ɛw]*na* ~ *w*[ɒu̯]*na* 'wool.' It is again the element |U̲| of the labial glide [w] which is responsible for the retracting effect on the preceding vowel as represented under (68).

(68) Polish dialectal development of *w*[ɛw]*na* ~ *w*[ɒu̯]*na* 'wool'



The labial glide [w] in (68) is responsible for the retracting of the preceding vowel by copying its element into the place of the original |I̲|. In effect, the combination of |U| and |A| is interpreted as the low back vowel [ɒ].[6]

Having swept aside all the uncontroversial representations, including palatals, coronals, and labials, we are now in a position to take a closer look at the internal structure of dorsals. Since it is the main topic of this study, in the remainder of this chapter we analyze the selected processes introduced in Chapter Two with the purpose of modifying and defending the anti-mainstream solution to the representation of dorsals, that is, the one sensed by Broadbent (1996) and fully developed by Backley and Nasukawa (2009) and Backley (2011).

2.3 Dorsals

It has been suggested (Backley 2011) that velars and labials contain the element |U|. Recall from Chapter One that this element is associated with the low-frequency energy pattern responsible for the falling spectral slope. This pattern can be found in round vowels, labial consonants and additionally in dorsals. This captures the acoustic similarity of the segments in question and confirms the presence of the resonant |U| in dorsals (velars and uvulars). Furthermore, the difference between labials and velars boils down to headedness in that headed |U̲| is interpreted as labial resonance and non-headed |U| as velar resonance. Uvulars and pharyngeals are represented by the headed element |A̲|. Additionally, uvulars are specified by |U| on the grounds that they often interact with

[6] The quality of the resultative vowel may suggest the switch in headedness, that is, [ɛ] |I̲ A| > [ɒ] |U A̲|.

velars, hence |$\underline{\text{A}}$ U|. The table representing the major places of articulation provided in Chapter One (Section 5.6) is reproduced in an abbreviated form as (69) for the reader's convenience.[7]

(69) The class of dorsals and palato-velars (place definers only) (Backley 2011)

palato-velar	[c ç]	|$\underline{\text{I}}$ U|
velar	[k x]	|U|
uvular	[q χ]	|U $\underline{\text{A}}$| or |U A|
pharyngeal	[ħ ʕ]	|$\underline{\text{A}}$|

As will be repeatedly emphasized in the following discussion, there are certain facts which suggest the necessity of representing English velars as complex non-headed expressions containing |U A|. This possibility is actually predicted by Backley (2011), who points to the fact that in some systems, uvulars may function as non-headed |A U| segments. Such uvulars, he adds, are assumed to be velar segments modified by the addition of |A|, which in articulatory terms means that they are more retracted than regular velars. It will be suggested that such retracted velars are found in English and, what is more, can coexist with regular velars within the bounds of the same system. There are some clear advantages to this solution. For instance, the complex structure of velars can account for the fact that they interact both with labials containing |U| and other dorsal segments containing |A|. Moreover, they are suitably endowed to interact with both round vowels |U| and low vowels |A|. Next, since they are complex (equipped with two resonance elements), they are the first to undergo lenition in prosodically weak positions. Finally, they are headless, which makes them even more prone to lenition processes and targets of various phonological phenomena, including palatalization and labialization. It must be emphasized here again, however, that the intrasegmental structure is not given once and for all, and phonetically identical segments may differ on language to language bases. The ultimate referee is always the phonological behavior of a segment in a particular system. Thus, it may be the case that in languages which contrast velars and uvulars, the difference between these segments is enhanced by representing the former segments by a single non-headed |U|, while the latter ones by |U $\underline{\text{A}}$|. For instance, Labrador Inuttut (Smith 1977) contains both velar and uvular stops [k] and [q], but the contrast between these two is neutralized in

[7] To repeat the point made earlier, in this study we deal with place definers only, that is, resonance elements. It simply means that the internal representation of segments that we provide in this study is devoid of other phonological material responsible for manner and laryngeal specification.

the final position. Crucially, the opposition is always neutralized in favor of the velar category, which may suggest that uvulars are more complex segments here, hence [q] |U $\underline{\text{A}}$| > [k] |U A|. Similarly, in Chemehuevi, a Shoshonean language, the velar [k] is realized as [q] in the context of the following back vowels [a o] (van de Weijer 1996: 123). It follows that the velar stop [k] |U| is realized as uvular [q] (U $\underline{\text{A}}$) in front of the vowels which are specified for |A|.[8] Finally, in Somali, the pharyngeal and the glottal fricatives have an opening effect on vowels (van de Weijer 1996: 110). No such effect is reported for velars. The explanation may lie in the fact that in this language pharyngeals contain the element |$\underline{\text{A}}$|, while velars are specified for |U| only. It follows that in Somali, pharyngeals, to the exclusion of velars, have a lowering effect on vowels. On the other hand, there are languages in which velars are represented by two resonance elements; for example, those which do not contrast velars and uvulars and/or pharyngeals. Crucially, the theory has the capacity to differentiate all three classes of dorsals even within a system in which velars are represented by |U A|. In such a system, uvulars may be represented as |U $\underline{\text{A}}$| and pharyngeals as |$\underline{\text{A}}$|.

To recapitulate, the susceptibility of velars to various phonological processes is explained by their complex structure. They are non-headed segments containing the resonant |U| which, in certain systems, may be accompanied by |A|. Since they are non-headed, they are susceptible to various processes in which neighboring segments exert some influence on them, for instance, palatalization. Being complex and non-headed, velars are prone to lenition and, finally, while the presence of |U| suggests common interactions with labials and round vowels, the element |A| predicts some interactions with other dorsal consonants and low vowels. However, before this assumption is verified by the data accumulated in Chapter Two, we should first critically evaluate the mainstream view according to which velars lack any resonance elements.

3. Polemic with the mainstream solution

As already mentioned (Chapter One, Section 5.5), the idea that velars lack any resonance elements dates back to Particle Phonology (Schane 1984) and Radical CV Phonology (van der Hulst 1989). In Element Theory, this view can be perceived as a logical consequence of the elimination of the neutral element (which earlier replaced the cold vowel) from the model. Shortly put, since velarity was

[8] Note that the same shift is predicted to occur before the front vowel [e], as it is also endowed with the element |A|. Unfortunately, since the vowel system of this language is /i ɨ u o a/, this assumption is unverifiable.

initially represented by the neutral element in the head function, the removal of the neutral element left velars empty-headed, with no resonance elements at all. This idea found ultimate expression in the works of Huber (2003, 2004, 2007a), especially in his book-length study (Huber 2007b). However, it must be emphasized here that even though in the following discussion we basically refer to Huber's (2007b) study, the critical analysis is thought to be more general, aiming at the broadly shared position in ET circles.

Huber's (2007b) argument is centered around three core assumptions enumerated in (70).

(70) Typology of labial-velar interactions (Huber 2007b: 235)

a. the labial > velar shift is always the consequence of reduction (lenition), that is, the suppression of the labial place definer |U| in a prosodically weak position. It results in a placeless velar, for instance, [p] > [k], [f] > [x] and [m] > [ŋ], etc., represented as |U| > |_|;
b. the reverse velar > labial shift is always a conditioned change, that is, it is possible only in the close vicinity of the labial, be it a vowel, glide, or obstruent;
c. only labio-velars in the pre-vocalic position are granted the right to change into plain labials and velars.

As will be argued below, none of the assumptions given in (70) hold true. Let us start by pinpointing more general problems and turn to more concrete examples as the discussion unfolds. The first constraint in (70) plays a double function; it explains cross-linguistically common labial > velar shifts and, at the same time, excludes the spontaneous shifts of labials to other major places of articulation, like, for example, coronals. It means that the following alternations: *[p] > [t], *[b] > [d], etc. are simply rejected by (70a). What the latter constraint does not explain, however, is the scarcity of the coronal > velar changes. Even worse, it actually predicts a situation in which a coronal consonant changes spontaneously into a velar one. Note that the suppression of coronality |A| should in principle be as natural as the suppression of labiality |U|. This is, however, not the case, and coronal > velar shifts *[t] > [k] are rather rare, as confirmed by laboratory experiments and historical studies (see Chapter Two). More generally, on the assumption that velars do not contain any resonance elements, it is envisaged that coronals (or any other consonantal class as the case may be) can be reduced to velars at least on a similar scale as labials, which is not the case at all. The same criticism applies to (70b). Note that if it were the case that a velar consonant must be supported by a neighboring labial vowel to change into a labial, we should easily find cases in which a low vowel, defined by the coronal element |A|, triggers the velar > coronal shift, that is, [k] > [t]. Since it fully relies on the neighboring vowel, the shift is predicted to be as common as the [k] > [p] change. However, changes of velars to coronals are basically restricted to palatalization processes (see Chapter Two). Moreover, according to (70b), the cases of vocalization, for example, [k] > [w] > [u], must be interpreted as a sequence of two (independent) events, namely, element reduction accompanied by the spreading of |U| from a neighboring labial segment, either a consonant or vowel. Finally, (70c) secures the right for velars to change into labials with the proviso that the former are, or used to be (historically), labio-velars. More generally, it is claimed that only historical labio-velars [k^w] and [g^w] may spontaneously undergo the change into plain labials (or velars) (Huber 2007b: 233). To put it differently, plain velars and plain labials are not predicted to spontaneously undergo any comparable change, hence *[k] > [p], *[x] > [f] and *[p] > [k], *[f] > [x] are not allowed pre-vocalically (Huber 2007b: 248). It can be seen that Huber's (2007b) fundamental claim is based on the observation that plain velars (lacking any resonance elements) cannot develop spontaneously into labials. This development is predicted only in two situations: (a) when a velar has the secondary labial articulation [k^w] or (b) when the velar occurs in the context of a labial vowel or glide. Although it is true that both labialized velars and velars in the labial context frequently change into labials, there are also numerous instances of spontaneous velar > labial changes which are discussed in the following sections.

To sum up the discussion so far, the constraints on the labial-velar interactions given in (70) allow labio-velars to undergo changes to plain labials or velars in a prevocalic position. In a prosodically weak position (pre-consonantally and word-finally), reductions of labials to velars are spontaneous (unconditioned) and the quality of the preceding vowel has nothing to do with it. Finally, the velar > labial changes can occur only after labial (rounded) vowels. Unfortunately, these constraints obviate any uniqueness of labial-velar interactions and so their undeniably close relationship remains as mysterious as before. One of the immediate consequences of this view is that any consonant, be it labial or coronal, is theoretically granted the right to shift to velar, which is not confirmed by cross-linguistic data. Huber (2007b: 232) is aware of this problem because he says "there is in reality a two-way communication between labials and velars, conspicuously 'skipping' coronals." Therefore, what we are dealing with here is an apparent contradiction, that is, in order to negate the intimate relationship between labials and velars, Huber (2007b) repeatedly refers to common interactions between them.

From the above discussion it follows that to invalidate the mainstream view, we simply need to find some cases in which plain velars change into labials in the labial-free context. Such cases do exist and they have already been provided (Chapter Two), for example, some instances of plain velar > labial developments in Romanian < Latin, the [x] > [f] shift in certain dialects of Polish, identical shifts (labialization) in Middle English, and velar > labial developments in Northern Saami, to name just a few. Furthermore, extremely inconvenient for Huber's (2007b) solution is the fact that both complex segments and segments with the secondary articulation are predominantly labio-velars (see Section 5 in Chapter Two), as is also the existence of phonological phenomena such as vowel rounding and labial glide formation, both of which occur before velars, cases of velar epenthesis before labials, and velar vocalization and diphthongization resulting in a rounded vowel, among others (see the discussion in the following sections). These processes must remain unaccounted for in a model which does not allow for resonance element(s) in velars.

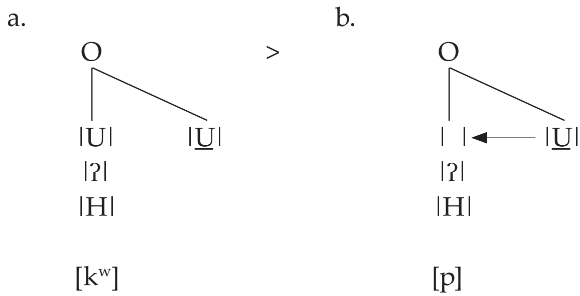
To be fair, it must be noted here that Huber (2007a) does look to some of the problematic changes enumerated above. He calls them atypical because they violate his constraints given in (70). The strategy Huber (2007a) adopts consists in making such cases look less atypical than they really are. For instance, it is claimed that the [x] > [f] shift (labialization) in Middle English, for instance, *clough*, *enough*, and *draught*, (see Section 2.1.1 in Chapter Two), is only apparently atypical because the shift occurred after back vowels, predominantly after [o], and never after front vowels (Huber 2007a: 154). Being rounded, this vowel [o] is responsible for the development of the glide [u] and, in consequence, the appearance of a new diphthong (ME diphthongization). Later on, the second part of the diphthong, that is, [u], triggered the labialization. Note that Huber needs the back vowel to explain the labialization [x] > [f] simply because velars lack any resonance elements and cannot spontaneously shift to labials. However, in order to account for the shift after the low vowel [a], which is not specified for |U|, Huber (2007a) is forced to admit that what was a contextual reason for the acquisition of labiality in the original setting was later extended to more environments (back vowels in general). What is left unsaid, though, is that the back vowels themselves, or more precisely, the back rounded [u], is itself the result of an earlier vocalization of the velar fricative, which later on triggered various developments including diphthongization and labialization (see the analysis in Section 7.4). Thus, what calls for explanation is not the labialization after the low vowel [a] but rather the development of the back rounded [u] before velars. If velars do not contain any resonance elements, their common vocalizations to the back rounded vowel must remain a puzzle. Huber (2007a) is forced to adopt the same explanation for numerous instances of the plain velar > labial shifts in Romanian < Latin (see Section 2.1.1 in Chapter Two). In short, previous explanations assume that the change was initiated by the labiality element of the preceding vowel, and with time it extended its applicational scope to all back vowels. In other words, an earlier minor regularity grew into a change which applied vacuously after back vowels. To conclude, the absence of resonance elements in velars makes the ME labialization and Romanian [k] > [p] shifts into sheer coincidences. Needless to say, the solution advocated by Huber (2007b) generates additional problems, like, for example, nasal place sharing with a following plosive. Very briefly, we would have to postulate two separate mechanisms here: one in which a nasal shares a place definer with the following plosive (labial, coronal/dental, or palatal), as in Polish *lampa* [lampa] 'lamp,' *banda* [banda] 'gang,' and *sądzić* [sɔɲdʑitɕ] 'think,' and another one in which a nasal discards a place definer in front of the following plosive (velar), as in *łąka* [wɔŋka] 'meadow.' However, instead of tracking the problems created by the representation of velars as empty segments, in the remainder of this chapter, we will focus on the advantages of the solution advocated in this study. For obvious reasons, the following discussion is confined to selected processes introduced in Chapter Two.

4. Complex segments

As with the mainstream solution, the representation advocated in this study assumes that velars are segments with no headed resonance elements. However, in opposition to the ET tradition, it is claimed here that velars contain a non-headed resonant, namely, a dependent |U|. One of the immediate advantages of this solution is that it makes the representation of velars equal to the representation of other major places of articulation. In other words, the exceptionality status is removed from velars in that, just like labials, palatals, and coronals, they are defined by resonance elements. What is more, the fact that velars contain a non-headed resonant |U|, or in certain systems |U A|, makes them similar to coronals, which, we recall, are non-headed |A| or |I| segments. This is a step forward as it may explain increased susceptibility of both coronals and velars to various processes, including palatalization and lenition, in opposition to segments with the headed resonants, like labials and palatals. At the same time, it explains the intimate relationship of velars with labials and labial vowels, on the one hand, and with other dorsals and low vowels, on the other.

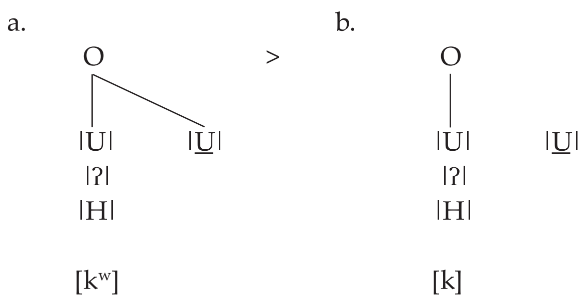
It follows that the development of IE labio-velars [k^w g^w] into plain labials and velars characteristic of a number of languages, for example, Irish and Romanian, receives a straighforward explanation. For instance, the regular alternation between IE [k^w] and [p] in the so-called *P*-Celtic languages, such as Welsh, Breton, and Gaulish (see Chapter Two), is analyzed here as a simple replacement operation, that is, the non-headed |U| of the velar [k] is replaced by headed |$\underline{\text{U}}$| of the following labial glide. The replacement operation is illustrated in (71) .

(71) [k^w] > [p] shift



The contour structure, that is, the labio-velar stop [k^w] in (71a), evolves into the plain labial stop [p] in (71b). Since the labial glide is represented by a single element $|\underline{U}|$, the development is a natural, one-step operation of replacement. A twin development into the plain velar [k] – IE [k^w] > [k], as in Irish and Scottish Gaelic – is even more basic, as it boils down to the suppression of the glide [w] (72).

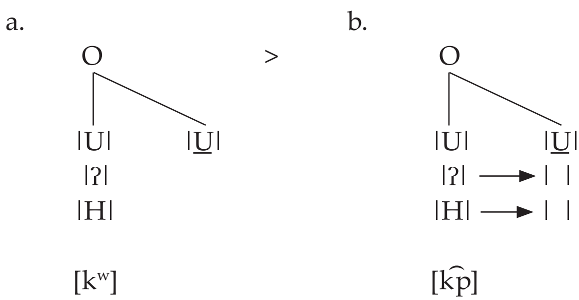
(72) [k^w] > [k] shift



In (72b), the element $|\underline{U}|$ representing the secondary labialization is delinked from the consonantal slot and, in consequence, a labialized velar becomes the plain velar stop. The developments in (71) and (72) must be recognized as a form of lenition as in both cases a complex segment is reduced to a plain stop. As noted in Chapter Two, this is a very common development found cross-linguistically, for example, Latin *quattro*, *acqua* > Romanian *patru*, *apă* 'four, water.' Other developments of the IE labio-velars, including those in Germanic, for instance, IE *k^w > OE [x^w], as in OE *hwat* 'what,' or IE *g^w > OE [k^w], as in IE *g^w*ena* > OE *cwena* 'woman' (> MoE *queen*), are instances of 'manner' elements suppression. Thus, while in [k^w] > [x^w] the occlusion element |ʔ| is suppressed, in [g^w] > [k^w] the laryngeal element |L| gets delinked.

In Chapter Two we have seen that labialization as secondary articulation affects mostly dorsals, and labio-velars constitute the largest group of segments with secondary labial articulation. This has been confirmed statistically by numerous databases (see Section 5.1 in Chapter Two). The propensity of velars to be labialized is explained by their intrasegmental structure. Just because velars are specified by non-headed |U|, they can either evolve into labio-velars spontaneously or arise due to the following labial vowel. On the other hand, coronals with secondary labialization are less common, especially in those systems which lack front rounded vowels and where coronals are represented by the element |I|. We recall that the elements |I| and |U| represent antagonistic resonance characteristics, and so languages often avoid their conflation. A similar explanation applies to palatals which are represented by the headed element |I̲|. Finally, labials are also less often labialized as they contain the headed |U̲|, and labialization in this case would result in a segment with two identical heads, that is, |U̲|. Furthermore, the labial part of a labio-velar segment can develop in one of the following ways: it can be absorbed by the velar changing it into a plain labial (71), it can disappear altogether (72), it can change into the labial glide [w], or finally, it can develop into a stop forming a complex labial-velar consonant [k͡p] (73).

(73) [k^w] > [k͡p] shift



In (73), the labio-velar stop [k^w] evolves into a complex labial-velar segment [k͡p]. The development is straightforward, as it comes down to the spreading of the manner elements from the velar to the following glide. Doubly articulated stops may also arise along the following path: *[ku] > [kw] > [k͡p]. In this scenario, a sequence of the velar stop followed by a labial vowel evolves into a labialized velar, which in turn develops into a labial-velar complex segment, for example, *[kwu] > [k͡pu] 'fist' in Adu Yi and *kwédí* > *kpélí* 'death' in West Sawabantu.[9] This developmental pattern is confirmed by the observation that, in the majority of cases, doubly-articulated stops appear in the vicinity of

[9] The West Sawabantu example, *kwédí* > *kpélí* 'death,' developed along the same pattern, that is, /ku/+V > /k^w/+V > /k͡p/+V (see the discussion in Section 5, Chapter Two).

rounded vowels, for instance, Tay Nung [pʰuŋ͡m] 'mend,' [kʰuk͡p] 'clogs,' Dao [ŋɔŋ͡m] 'buffalo,' and Vietnamese [xuŋ͡m] 'frame' (Hajek 2009). Note that the development of a labial-velar stop represented under (73) must be recognized as an example of strengthening. This is because a mono-elemental glide becomes more complex, and in ET complexity is related to segmental strength. The problem is that this form of strengthening, that is, a development of labial-velar stops, occurs not only word-initially (as predicted) but also word-finally, which is a typical lenition site. This is the case in Vietnamese, in which the development of doubly articulated stops is restricted to the word-final position after rounded nuclei. What is interesting, however, is that in this language only velars undergo the development, as in /huk/ [hʊkʷ˺] > [hʊk͡p˺]. The labial /p/ and /m/ in the same context, that is, word-finally after rounded vowels, are not affected, for example, /hup/ [hʊp˺] 'sink in water' and /ɲum/ [ɲʊm] 'a pinch of a substance.' It seems that in Vietnamese, a weak, non-headed segment in the prosodically weak position (word-finally) has to become linguistically more prominent in order to survive. Since heads generally contain more linguistic information than non-heads, labials in Vietnamese remain intact, while velars undergo the development to the labial-velar stop. Finally, the fact that among double articulations, labial-velar stops [k͡p] and [g͡b] are the most common complex segments receives an explanation identical to the one applied to segments with secondary labialization [kʷ] (see above). As for the labio-velar glide [w], it has been noted that there are languages in which [w] patterns both with labials and velars, for instance, Fula, Baule, Yoruba, and Tenango Otomi. Recall that in the last mentioned language, the fricative /h/ and the nasal /n/ before the labio-velar glide [w] are changed into, respectively, the labial fricative [ɸ] and the velar nasal [ŋ]. The immediate conclusion is that both labials and velars must contain the element |U| simply because the labio-velar glide [w] is certainly represented by |$\underline{\text{U}}$|.

5. Labial > velar shifts: the case of Dutch

The cross-linguistically common shifts of labials into velars get a straightforward explanation in a model which assumes the presence of |U| in the internal structure of labials and velars. We have seen (Chapter Two) that such developments occur in the diachronic evolution of a language, for example, Latin *planta* > Old Irish *cland* 'plant,' in dialectal alternations, as in Caribbean Spanish *séptimo* > *sé*[k]*timo* 'seventh,' and in contemporary languages, for instance, Skikun *talap* > *talak* 'eaves.' Since labials are represented by |$\underline{\text{U}}$| which functions as the head, and velars are non-headed |U| segments, it follows that the shift in question boils down to the switch in headedness, that is, a headed |$\underline{\text{U}}$| in a labial becomes a non-headed |U| in velars, as represented in (74).

(74) [p] > [k] shift

a.		b.
O	>	O
|		|
|$\underline{U}$|		|U|
|ʔ|		|ʔ|
|H|		|H|
[p]		[k]

In Old Irish, there is another, more common, pattern of the labial > velars shift, as in Latin *se*[pt]*em* > Old Irish *secht se*[xt] 'seven.' It is assumed that in the latter scenario, the first step consists of the shift from the labial stop to the labial fricative, and only then is the latter shifted to the velar spirant, hence /p/ > /f/ > /x/. Recall that this option is based on a similar pattern found in Germanic, for instance, Old High German *nift* > Modern High German *Nichte* 'niece' < Latin *neptis* 'grand-daughter.' This developmental path is represented in a way similar to the one in (74), with the difference that in the [p] > [x] shift, the switch in headedness is accompanied by the loss of the occlusion element, as represented in (75).

(75) [p] > [f] > [x] shift[10]

a.		b.		c.
O	>	O	>	O
|		|		|
|$\underline{U}$|		|$\underline{U}$|		|U|
|ʔ|		|ʔ|		|H|
|H|		|H|		
[p]		[f]		[x]

The labial stop in (75a) is lenited to the labial fricative [f] (the loss of |ʔ|) and then weakened by the switch in headedness to the velar fricative [x]. Note that the alternative path proposed by historians, namely, [p] > [k] > [x], can get an equally simple explanation: |$\underline{U}$ ʔ H| > |U ʔ H| > |U ʔ H|.

The representation of the shift under (74) applies to the same developments in other languages, for example, Caribbean Spanish and Skikun, discussed in

[10] Backley (2011) argues for the |$\underline{U}$ A| representation of the labial fricative [f], which means that the representation of the intermediate stage in (75b) requires a more detailed discussion.

Chapter Two. Since the shift boils down to the loss of headedness, it should be categorized as a lenition process. The weakening character of the shift is further confirmed by the context in which it occurs, that is, pre-consonantally (Caribbean Spanish) and word-finally (Skikun). These are prosodically weak positions universally recognized as lenition sites.

The same labial > velar shift is found in the history of Netherlandic[11] (Bonebrake 1979, see also Section 2.1.2 in Chapter Two).[12] However, the alternations in this language are of particular interest to this study, as they include not only labial > velar shifts but also the shifts in the opposite direction, that is, velar > labial in some coastal dialects to the north (West Flemish). Recall that it is the latter shift which is problematic for the generally held view that velars are devoid of any resonance elements. Note that in order to explain the velar > labial shift, the proponents of this solution must justify the appearance of the labial element |U| in the internal structure of velars. Therefore, Huber (2007b) argues that the shift in this direction is possible only in the context of a neighboring labial vowel. This claim will be challenged in the following sections. However, before we critically look at Huber's (2007b) statement, we should first carefully examine the instance of labial-velar alternations in Dutch and its dialects to find out whether the velar to labial pattern is conditioned by a neighboring labial vowel or occurs spontaneously in a labial-free context.

An immediate conclusion one may draw when looking at the Dutch data is that the shift in this language is opposite to the one found in English (see Chapter Two). In Dutch, the OLF labial fricative [f] changes into the MDu velar [x], for instance, OLF *after* > MDu *achter* 'after,' OLF *craft* > MDu *cracht* 'power,' and OLF *senifte* > MDu *zachte* 'soft.' One of the characteristic features of this change is that it usually occurs before the voiceless dental stop [t] which serves a variety of functions; for example, it may be a part of a morpheme or an initial element of a suffix. Apart from such evident cases of the labial > velar shift in MDu, there are also some earlier forms which show no sign of alternation whatsoever. Some examples are provided under (76).

(76) Non-alternating forms in pre-MDu (Old Low Franconian) (Bonebrake 1979: 66)

after	*after*	heliftron	*halter*
gedruft	*confused*	scefte/scepfti	*shaft*
getunft	*pact*	gesifte	*vision*
craft/crefh	*power*	sufte	*pestilence*

[11] The term Netherlandic covers Standard Dutch and its dialects.

[12] For the interactions between labials and velars in Scandinavian, see Bonebrake (1979).

However, as is pointed out by Bonebrake (1979), there are good reasons to assume that the orthographic <f> in the forms under (76) was realized phonetically as [x], for example, orthographic confusion of symbols or inverted spelling as in *craft/crefh* 'power,' *gesifte* < *gesig* 'vision, seen.' To recapitulate, apart from the regular [f] > [x] alternations in Middle Dutch, there is some evidence on the labial > velar shift in Old Low Franconian. However, the evidence is so scanty that Bonebrake (1979: 70) decides to refer to place names, for instance, *Anrufte* > *Anröchte*, *Scafthorpe* > *Schachtrup*, *Graf* > *Grath* > *Gracht* and *Crufte* > *Crocht* > *Kruft*, etc. Interestingly, the labial to velar change in MDu did not occur after the liquids [r l]. Instead, such clusters were simplified in one of several ways: by metathesis, as in MDu *nootdurft* > *nootdruft*, *nootdrucht* 'indigence'; by epenthesis, as in Du *helft* > dialectal *heleft* [heləft], occasionally *helecht* [haeləxt] 'half'; by consonant deletion, for example, MDu *halfter* > dialectal *halter* (South Limburg), accompanied with voicing, as in *halder* (Zeeland); and by sibilant formation with consonant deletion, for instance, *halser*, *helser* (Southwest Limburg) 'halter.' The cluster can also be modified by [f] > [s] shift, as in *halfter* > St. Du *halster* 'halter,' MDu *dorfte* > *dorste* 'dared' (St. Du *durfde*) MDu *nooddurft* ~ WFl *nooddorst*, *noodurst* 'indigence.' In *halser* < *halfter*, the |U̲| element of the labial fricative is replaced by the resonance element |A| of the following stop [t], which results in *halster* (St. Dutch); the coronal stop may be lost, and in this way the form *halser* (Southwest Limburg) appears. Interestingly, in West Flemish, the same form appears as *hauter* < *halter* < *halfter*. It follows that in West Flemish, we can additionally observe liquid vocalization, that is, [l] > [u]. Recall that this is a common development found in many languages, including English and Dutch, for example, English [fi:ɫ] ~ [fi:u] 'feel,' Du *goud* [xɔut] ~ Germ. *Gold* [gɔlt] 'gold' (see Section 4.3 in Chapter Two).

For reasons stated above, the velar > labial shift is far more informative for this study. Interestingly, this change (apart from English and other languages) is also found in some dialects of Dutch, for instance, West Flemish. It resembles the English case (ME labialization) not only because of the direction but also because some of the lexical items that have been affected are etymologically common to both languages, for example, Du. *genoeg*, WFl. *(g)enoef*, Eng. *enough*. It must be emphasized here, however, that the velar > labial changes in ME and Modern Dutch dialects occur in radically different periods and so they must be treated independently of each other.[13] It follows that apart from the relatively common labial > velar developments in MDu, some coastal modern dialects, like West Flemish, are characterized by the change in the opposite direction (77).

[13] Bonebrake (1979) reports also on some velar > labial changes in the pre-MDu period, for instance, *trechter* > *trefter* or *trifter* 'funnel.'

(77) [x] > [f] in Dutch dialects (Bonebrake 1979: 152)

Standard Dutch	*dialect*	*gloss*
dwerg	dwerf	*dwarf*
genoeg	genoef	*enough*
huig	hijf	*uvula*
joechelen	joef	*giggle/giggled*
loeg	loef/louf	*laughed*
oorlog	oorlof	*war*
ploeg	ploef	*plough*
bochel	poffel	*hump of a hunchback*
schraag	schraaf	*trestle*
vroeg	vroef/vrouf	*early*
vragen	vroef/vrouf	*ask/asked*

Basically, the shift in (77) occurs in two contexts: in the liquid environment, for example, Du *balg* > WFl *balf* 'bag,' and, more commonly, after a rounded vowel, as in *vroeg* > *vroef/vrouf* 'early.'

It must be noted here that the unrounded vowel in WFl *hijf* corresponds to the rounded vowel form *huig* 'uvula.' Crucially, this change occurs also after a liquid Du *balg* > WFl *balf* 'bag,' *dwerg* > *dwerf* 'dwarf,' and after a non-rounded vowel, for instance, Du *schraag* > WFl *schraaf* 'trestle.' While it is true that the shift predominantly occurs after a rounded vowel, the roundness itself is frequently the effect exerted by the following velar. Be that as it may, labialization also occurs spontaneously, as in *dwerg* > *dwerf* 'dwarf.' In the latter form, the non-headed |U| of the velar must be promoted to the headed |$\underline{\text{U}}$| in the labial [f]. A more detailed discussion of the velar > labial shift is postponed until Section 7, where we look at similar examples in Middle English and in some contemporary Polish dialects.[14]

Northern Russian is another language on record with the labial > velar shift. Recall from Chapter Two that in this language, the Common Slavonic **w* evolves into the voiceless velar fricative [x], for instance, N. Russ. [słɔx], [łaxkə], 'word, gen.pl.,' 'bench, nom.sg.' (see Chapter Two). In other words, in Northern Russian, the CS **w* shifts to velar in the syllable final position. On the other hand,

[14] The explanation given by Bonebrake (1979) is based on the acoustic similarity, that is, it is a perceptual phonetic confusion which initiates the alternations between labials and velars. In West Flemish, the velar > labial changes "are implemented by rounding the articulation of the velar, which in turn facilitates the auditory confusion of the modified velar with the existing labials in the language, until finally the modified velars are recognized as labials" (Bonebrake 1979: 210).

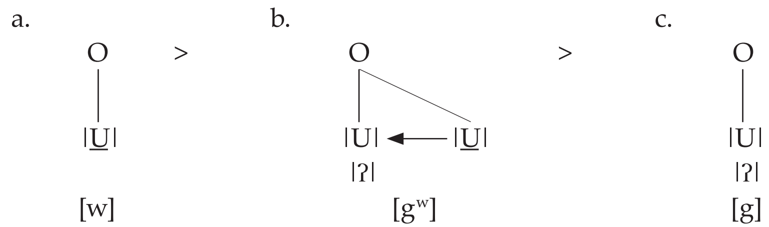
in the syllable-initial position, the CS *w develops into the labial reflex [v], for example, N. Russ. [vʌda] ~ Polish/Czech/Slovak [vɔda] ~ East Ukrainian [wɔda] 'water, nom.sg.' The [w] > [x] development is explained here as the case of switch in headedness, namely, the headed |U̲| in [w] becomes a non-headed |U| in the velar [x]. Since both [v] and [w] are labials, the explanation of the development in the syllable initial position, that is, [w] > [v], is quite simple. What calls for an explanation, however, is the strengthening of [w] to a fricative, which occurs in both a prosodically strong position (word-initially) and a prosodically weak position (syllable finally).[15] Finally, note that the fortition in Northern Russian could be compared to the case of velar epenthesis in Spanish (*w-reforzada*) in that it is triggered by the labio-velar glide [w].

5.1 Velar epenthesis in Spanish

Velar epenthesis in Spanish, which boils down to the appearance of [g] before the glide, is a common phonological phenomenon in Romance languages. Thus, apart from Spanish, it is also found in such languages as Galician, Italian, and French, among others (see Chapter Two). Recall that in Spanish, the voiced velar stop [g] is inserted in a situation when a word-initial labial glide [w] is followed by a vowel. In consequence, the labial glide is lost and what is left is a sequence of the velar stop followed by a vowel, for example, [ge] in *guerra* 'war,' [gi] in *guisa* 'wise/manner.' In a different scenario, the labial glide survives, which results in a sequence of [g^w] followed by a vowel, as in [g^wa] in *guardar* 'to guard.' This development is characteristic not only of common nouns of Germanic origin (the examples given above), but also of proper nouns of both Germanic and Arabic origin, for instance, *Gales* < *Wales*, *Guadalquivir* < *Wad al-Kebir* 'the Great River.' Interestingly, some relatively recent borrowings from Aztecan, Quechua, and English indicate that this is a still active process, as can be seen in *huacal/guacal* < Azt. *uacalli* (1571) 'type of basket,' *guacho* < Que. *uajcha* (1668) 'orphan,' and *guelfar* < Eng. *welfare* 'welfare.' In a model which assumes a similar structure for labials and velars, the epenthetic velar in the context of the labio-velar glide is barely surprising. This is a case of fortition (depicted in (78)), in which a monoelemental segment, that is, [w], becomes more complex, hence stronger, in a prosodically strong position.

[15] Since Element Theory assumes headed segments to be stonger than non-headed ones, the Northern Russian pattern appears less accidental. Note that the headed [v] occurs in a strong position and the non-headed [x] in the weak one (cf. Cyran and Nilsson 1998).

(78) Velar epenthesis: [w] > [g^{w}] > [g][16]



The labio-velar [w] in (78a) evolves into a complex segment in a prosodically strong position, that is, a labialized velar, by copying its resonance element as a non-headed |U|, which is strengthened by the occlusion element.[17] Finally, in (78c) the labialization is lost which results in the plain velar stop. Stop epenthesis is a common phenomenon found in various languages, including English. To describe it briefly, in English, the oral stops [p t k] pop up between a nasal stop and a fricative [s f θ] in a foot-internal position, as in *Am*$^{[p]}$*sterdam*, *trium*$^{[p]}$*ph*, *warm*$^{[p]}$*θ*, *prin*$^{[t]}$*ce*, *stre*[ŋ^{k}θ], etc. Huber (2007b) argues that in such forms, the identity of the epenthetic stop is made up of the two flanking consonants, in that the nasal supplies the place, while the following fricative is responsible for the laryngeal specification. This means that velars, which Huber (2007b) represents as segments without place definers, must also supply the place element. Note that the explanation according to which the epenthetic velar stop shares the placelessness with the preceding nasal forces Huber (2007b) to postulate two analyses for the epenthetic stop in English. In *trium*$^{[p]}$*ph* and *prin*$^{[t]}$*ce*, the nasal lends the place definer to the epenthetic stop, while in *stre*[ŋ^{k}θ], the epenthetic stop must be placeless in the context of the preceding placeless velar nasal, unless we believe that placelessness can be shared. In the solution advocated in this study, the stop epenthesis in English receives a uniform explanation. A nasal and a following epenthetic stop share a place definer, which in the case of velars is a non-headed |U|.

6. Palatalization revisited

Coronal and velar palatalizations are assumed to be different forms of the same process (Backley 2011: 106). They involve an active headed |I̲| element and both

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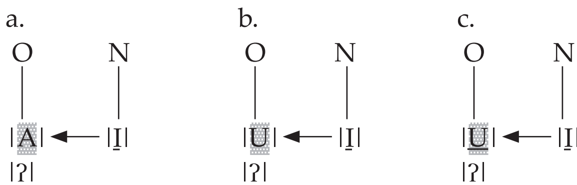
16 In order to simplify the representation in (78), the stop is not specified for the laryngeal characteristics.

17 Since the donor of the occlusion element here is unknown (no plosives in the vicinity), the strengthening could be explained as a case of phonological reinterpretation of some phonetic characteristics. See Cyran and Nillson (1998) for the example of reinterpretation in Slavic.

produce the headed |I̲| segments. For example, in Italian, the palatalization of the velar stop [k] into [tʃ], as in *medico* [mediko] 'doctor' ~ *medici* [meditʃi] 'doctors,' indicates that [tʃ] is represented by |I̲| because it acquires its resonance properties from the triggering segments [i j], which are specified only for |I̲|. Interestingly, it is not only coronals and velars which are palatalized; labials are also targets of palatalization, as evidenced by some dialects of Italian (Roman dialect and Genoese with some neighboring dialects), for example, [pjeno] > [tʃena] 'full' and [bjaŋko] > [dʒaŋku] 'white.' It follows that the palatalization boils down to the replacement of the original resonance element in the internal structure of a coronal, velar or labial by the |I̲| element of the following front vowel or a palatal glide as represented in (79a–c) below. Now, the reason why coronals and velars are more susceptible to palatalization is that they contain non-headed resonance elements which can be easily overridden by the headed |I̲| of the front vowels and the glide. Moreover, in the case of velars, the original |U| is replaced by |I̲| because in many languages these elements do not combine (recall that this is universally a marked combination).

(79) Palatalization



[d]>[dʒ] [k]>[tʃ] [p]>[tʃ]

The possibility that [tʃ] has complex resonance, namely, the incoming |I̲| combined with an original resonance element |A| or |U|, is ruled out on the grounds that the palatalization of coronals (79a), velars (79b), and labials (79c) results in an identical segment, that is, [tʃ] or its voiced counterpart [dʒ]. Finally, it will be recalled that the coronal and velar palatalization processes are extremely common among languages, for instance, Italian, Serbian, Polish, Russian, Old English, Old Irish, and Albanian, among many others (see Section 4.1 in the previous chapter).

As briefly noted in Chapter Two, there is some complication concerning velars and the distribution of the vowels [i] and [ɨ] in Russian. Recall that this distribution depends on the character of the preceding consonant in that the variant [ɨ] goes with velarized consonants while [i] is an elsewhere variant, that is, it occurs independently and after palatalized consonants (see Section 4.1 in Chapter Two). Russian velars are said to be different from the rest of the consonants in that they can be either palatalized or plain (there are no velarized velars in contemporary Russian). Note that by representing secondary velarization as |U|, a solution can be offered to both the loss of velarization on velars (they used to be velarized but lost secondary velarization historically) and the distribution of the vowels in question. The loss of secondary velarization boils down to the suppression of the non-headed |U|, and it affects velars because they contain an identical non-headed element |U|. In other words, it looks like a type of Obligatory Contour Principle, which bans two consecutive elements which are identical (80).

(80) [kˠ] > [k] in Russian

Now, if we represent [ɨ] as a non-headed variant of [i], hence |I| vs. |I̲|, the explanation for the distribution of these vowels can be sought in head alignment in the bridging relation.[18] To put it differently, the velarization enforces the loss of headedness on the following vowel, for instance, [bʲit] 'beaten' vs. [bɨt] 'way of life,' represented in (81).

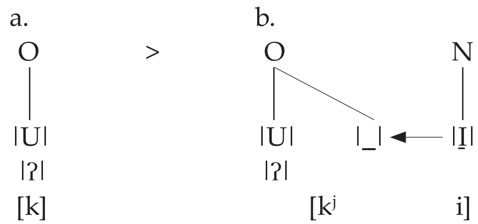
(81)

a. [bʲit] b. [bˠɨt]

In (81), the velarized consonant retracts [i] into [ɨ], which means that the vowel becomes non-headed |I| in the context of the non-headed |U| of the secondary velarization (81b). In other words, they are in a bridging relation (represented by a double line in (81)) which requires head alignment, that is, headlessness in the case at hand. It follows that since velars lost secondary velarization, they are never followed by [ɨ] but can be followed by [i], which triggers velar palatalization as illustrated in (82).

[18] For the development of the alignment and bridging concepts, see Bloch-Rozmej (2008).

(82) [k] > [k^j]



Since velars lost secondary velarization, they can be palatalized in the context of front vowels [i e]. Recall that in contemporary Russian, velar palatalization is allophonic, that is, it depends on the context.[19]

Note that palatalization does not always result in a palatal obstruent, that is, a palato-alveolar or an alveolo-palatal segment, as there are also examples of changes in which labials and velars shift to plain coronals, where the only conditioning factor is a front vowel (van de Weijer 1999; Backley 2011). Since they result in plain coronals, such changes are instances of coronalization. Additionally, they indicate that front vowels and coronals share the resonance element(s). We have already seen numerous examples of such shifts, for example, in Ionic and Attic dialects of Ancient Greek, where the labialized velars *k^w*, *k^{wh}*, and *g^w* became respectively [t], [t^h], and [d] before the front vowels [i e], while *k^wj* became [t] in the syllable initial position; in some dialects of Greek (Lesbos), in which [k] is changed into [ts] before front vowels; in Spanish, where [k] becomes [s] via [ts] before front vowels; and in Dagbani, in which complex stops [k͡p] and [g͡b] are realized as [p͡t] and [b͡d] before front vowels. They have been further confirmed by Plauché's (2001) laboratory study of stop place confusions. Recall that the general conclusion emerging from her analysis points to an asymmetric relation between velars and coronals in that the former are often confused for the latter in the context of the following front vowel.

As with velars, labials can also shift to a coronal in the context of the following front vowel or glide.[20] This is the case of the conservative dialects spoken in the area of northeastern Bohemia (Litomyšl), as evidenced by regular correspondences between Bohemian dialects and Standard Czech, for instance, *město* [mjɛstɔ] > [nɛstɔ] 'town,' *pět* [p^jɛt] > [tɛt] 'five,' *pivo* [p^ji:vɔ] > [ti:vɔ] 'beer,' and *pěkně* [p^jɛkn^{j}ɛ] > [tɛkn^{j}ɛ] 'nicely.' It is analyzed as an instance of palatalization which changes labials into coronals before front vowels. As noted in Chapter Two, a different solution is chosen by the so-called soft labials, that is,

[19] Note that this is a tentative proposal, based on a mere excerpt from a complex phenomenon, which Russian palatalization definitely is. A definitive solution would require a more detailed analysis and so we do not pursue it any further here.

[20] See, for example, Ohala (1979: 358) and Plauché (2001: 34).

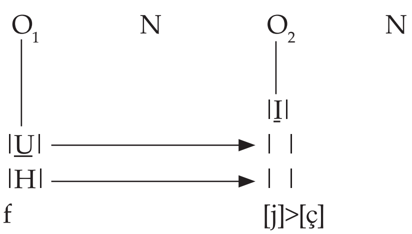
[p^j b^j f^j v^j m^j], in some dialects of Polish. Recall that in both Kurp and Northern Mazovian, the labial consonant remains intact while the glide is strengthened to a fricative. Some examples provided in (45) are repeated here under (83) for the reader's convenience.

(83) Developments of soft labials in Polish dialects (Furdal 1955 and Zduńska 1965)

Standard Polish	*Kurp*	*Northern Mazovian*	*gloss*
[p^j]asek	[pɕ]asek	[pç]asek	*sand*
[b^j]ały	[bʑ]ały	[bʝ]ały	*white*
[f^j]ołek	[fɕ]ołek	[fç]ołek	*violet*
[v^j]oska	[vʑ]oska	[vʝ]oska	*village*
[m^j]ód	[mɲ]ód	[mɲ]ód	*honey*

In both dialects the front glide strengthens to a fricative or a nasal depending on the preceding context. Of particular interest here is the development in Northern Mazovian, in which the glide is realized as a palato-velar fricative [ç] or [ʝ], depending on the voice specification of the preceding labial. Note that after the bilabial nasal, the glide is realized as a palatal nasal [ɲ]. Now, since palato-velar fricatives are represented as a combination of |I̲| and |U|, their appearance in Northern Mazovian is actually predicted by the context. The glide |I| acquires additional elements from the preceding labial obstruent and, in consequence, strengthens to a fricative. This is represented in (84).

(84) Development of soft labials in Northern Mazovian, e.g. [f^j]*ołek* > [fç]*ołek* 'violet'



Apart from the original element |I̲| of the front glide [j], the O_2 position has to interpret the elements of the preceding labial fricative, that is, |U H|. Note that since the glide already contains the headed element |I̲|, the resonant of the labial is interpreted as a non-headed |U|. In the case of the alternation between St. Pol. [m^j]*ód* and N. Maz. [mɲ]*ód* 'honey', the glide [j] becomes [ɲ] by obtaining nasality from the preceding bilabial nasal [m].

There are some instances of changes which apparently challenge the solution according to which velars are represented by the non-headed element |U|.

This is the case of the development of Romance (Spanish and Galician) < Latin [kt] clusters (Huber 2007b: 194). In Latin [kt] clusters, the velar stop is said to gradually turn into the glide [j], occasionally into [w] after [o]. Moreover, on the basis of the spelling records, it is assumed that the process went through the velar fricative [x] stage (spelt <ch>), and supposedly also through [ɣ], to the glide [j]. The glide then could trigger some phonologically local changes. For instance, it fronted a preceding Latin [a] to [e], for example, [aj] > [ej], and it lowered a preceding [u] to [o]. At this stage, the process ceased in Galician and Portuguese. In Spanish, however, the resulting glide palatalizes the coronal stop, which results in [tʃ] and then is lost (Huber 2007b: 194). The examples in (85), which illustrate this development, have been adopted from (Huber 2007b: 195).

(85) Development of Latin [kt] clusters in Spanish and Galician

Latin [kt]	*Spanish* [tʃ]	*Galician* [it]	*gloss*
di**ct**a	di**ch**a	di**t**a	*luck, happiness*
di**ct**atum	de**ch**ado	?	*model, paragon*
stri**ct**us	estre**ch**o	estre**it**o	*strict; narrow*
le**ct**us	le**ch**o	le**it**o	*bed*
ia**ct**are	e**ch**ar	(a)xe**it**ar	*to cast; to lie*
la**ct**e	le**ch**e	le**it**e	*milk*
no**ct**is	no**ch**e	no**it**e	*night*
o**ct**o	o**ch**o	o**it**o	*eighth*
lu**ct**ari	lu**ch**ar	lo**it**ar	*to fight*
tru**ct**a	tru**ch**a	tro**it**a	*trout*

One of the immediate observations is that all (short) Latin vowels [i e a o u] can precede the [kt] cluster. According to Huber's (2007b) interpretation, the velar stop [k] was vocalized to [j] (Galician) and palatalized the following [t] (Spanish). Since [k] vocalized to [j] regardless of the context, it may indicate that the velar instead of |U| contains the resonance element |I|. Furthermore, the same palatalization process affected the Latin lateral in [lt] sequences. As with the palatalization of [k] in [kt] clusters, the lateral in [lt] sequences is vocalized to [j] and triggers palatalization in Spanish (86).

(86) Development of Latin [lt] clusters in Spanish and Galician

Latin	*Spanish*	*Galician*	*gloss*
mu**lt**u	mu**ch**o	mo**it**o/mu**it**o	*much*
pu**lt**arius	pu**ch**ero	(pucheiro)	*type of pot*
auscu**lt**are	escu**ch**ar	esco**it**ar	*listen to*
vu**lt**urnus	bo**ch**orno	(bochorno)	*dry summer heat*

The change under (86) is given an identical explanation to the one in (85) in that both [kt] and [lt] develop an identical reflex [tʃ] in Spanish. In a related process involving the sequence [ks], the velar stop changed in much the same way as in [kt] discussed above in that it was vocalized to [j] and palatalized the fricative [s] to [ʃ] in both Spanish and Galician-Portuguese. Later on, the Spanish reflex turned into the velar fricative [x] < [ʃ], as in Lat. [ks] *axis* > Spanish [k] > [ʃ] > [x] *eje*, Galician [ʃ] *eixe* 'axle, axis.' It is assumed that the <xi> graphs must have indicated the first phase of the change, that is, [ʃ] > [ç] (Huber 2007b: 199). Interestingly, Huber points to some "sporadic occasional developments" (p. 199) between [s] and [ʃ], for instance, Lat. ***s**apone* > Sp. ***j**abón*/Ga. ***x**abón* 'soap,' Lat. ***s**epia* > Sp. ***j**ibia*/Ga. ***x**iba* 'squid.' Huber (2007b) admits that since in such cases [s] is very often followed by a back vowel which could not trigger the palatalization, no immediate solution can be offered for such divergences. Finally, note that Latin [pt] clusters did not change in parallel to [kt], [lt], and [ks] sequences. It is remarkable that [pt] generally simplified to [t], most probably through a geminate stage [t:], for example, Lat. *septem* > Sp. *siete*, Ga. *sete* 'seven' and Lat. *aptare* > Sp./Ga. *atar* 'to tie, fasten.'

Building on the assumption that in Spanish (and Galician) coronals are represented by the resonant element |I|, we can offer an alternative solution here. As already noted in Chapter One, the idea that in certain systems coronals are represented by |I| is not untenable. This solution can be confirmed by the spontaneous palatalization in Spanish, for instance, Lat. ***s**apone* > Sp. ***j**abón*/Ga. ***x**abón* 'soap.' The [s] > [ʃ] change is simply an example of the shift in headedness, namely, the non-headed |I| (coronal) is promoted to the head |I̲| (palato-alveolar) in a prosodically strong position. Now, in [kt] clusters (85), the velar stands in a weak position (pre-consonantally) and so undergoes lenition. Since velars contain the non-headed |U|, lenition is accompanied with the installation of the resonance element |I| of the following coronal, resulting in [j]. This is, however, not the end of the road, as now the palatal [j] triggers the palatalization of the following coronal, that is, [t] > [tʃ]. This development is represented in (87).

(87) [kt] > [jt] > [tʃ]

a.			b.			c.		
O	N	O	O	N	O	O	N	O
|		|	|		|	|		|
|U|		|I|	|_|	←	|I|	|I̲|	→	|_|
|ʔ|		|ʔ|	|ʔ|		|ʔ|			|ʔ|
k		t	[k]>[j]		t	j		[t]>[tʃ]

The same explanation applies to [lt] clusters in (86). Moreover, this solution can explain the fact that [pt] clusters were not affected. Assuming that [p] as a labial is represented by the headed |U̲|, the non-headed element |I| is not strong enough to be installed in the head position of [p]. In consequence, the latter disappears, which results in [t], as in Lat. *aptare* > Sp./Ga. *atar* 'to tie, fasten.' Finally, since [s] is also a coronal specified for |I|, the development of the [ks] clusters receives an identical explanation. The |U| of the velar is replaced by the |I| of the coronal, which later on spreads and installs in the head position of the coronal, changing the latter into [ʃ]. Note that the later development into [x] via [ç] can be explained on the assumption that the original |U| of the velar survived in certain forms, which resulted in [ç] |I̲ U| subsequently simplified to [x] |U|. Note further that the assumption that in Spanish, coronals are represented by the non-headed |I| opens up another option for the explanation of the facts in question. According to this second solution, the velar in the pre-consonantal position is lost, while the coronal obstruent is strengthened, as it appears in a strong, pre-vocalic position. The fortition boils down to the switch in headedness, that is, coronal |I| becomes palato-alveolar |I̲|. In other words, palatalization is a fortition process which proceeds spontaneously in a prosodically strong position both word-initially, as in Lat. ***s**apone* > Sp. ***j**abón*/Ga. ***x**abón* 'soap,' Lat. ***s**epia* > Sp. ***j**ibia*/Ga. ***x**iba* 'squid,' and word-internally, as in *leche* < Lat. *lacte* 'milk.' Whichever explanatory path is chosen, it shows that velars are not |I| segments responsible for palatalization, and so the solution advocated here is not undermined in any respect.

7. Velar > labial shifts in the history of English

The present section focuses on the analysis of selected phonological processes in the history of English, supplemented with some similar developments found in other languages. The discussion here concentrates on one particular aspect of the relationship between labials and dorsals, namely, the velar > labial developments. Recall that this is precisely the relationship which causes major problems for the ET mainstream solution, according to which velars do not contain any resonance elements. In other words, instances of velar > labial unconditioned shifts put the traditional view in jeopardy. Examples of such spontaneous shifts have already been provided. For instance, in the discussion of the development of Latin labio-velars in Romanian (Chapter Two), it was noted that in certain cases, the development encompassed Latin plain velars which shifted to plain labials in Romanian, for instance, Latin *la*[kt]*em*, *pe*[kt]*us*, *o*[kt]*o* > Romanian *la*[pt]*e* 'milk,' *pie*[pt] 'chest,' *o*[pt] 'eight,' etc. Thus, apart from the regular [k^w] > [p] developments, there are numerous cases in which the plain labials in Romanian directly relate to Latin plain velars rather than to labio-velars. Moreover, even though some of the irregular shifts occur after a labial vowel, for example, *co*[kt]*um* > *co*[pt] 'cooked,' the shift is also possible after non-labial vowels, as in *la*[kt]*em* > *la*[pt]*e* 'milk,' *si*[ŋn]*u* > *se*[mn] 'sign,' etc. Another language with the spontaneous velar > labial shift is Northern Saami (see Section 2.2 in Chapter Two). In this language, one of the gradation sub-patterns features the [k] ~ [w] alternation. More specifically, the velar plosive [k] in the strong grade is lenited to [w] before voiceless coronals in a weak grade, for instance, *gakcut* ~ *gavccui* 'to climb,' *raksa* ~ *ravssat* 'diaper,' *teaksta* ~ *teavsttat* 'text,' etc. Since it operates after any vowel, the shift must be recognized as an instance of the unconditioned velar > labial development. Note that the velar > labial shift is predicted by the solution advocated in this study. This is because both classes are related by the presence of the resonant |U| in their melodic make-up. The shift itself boils down to the change in headedness, namely, a non-headed |U| of the velar is promoted to the headed position |U̲| in the labial, as represented in (88).

(88) The velar > labial shift

a. [k] > [p] in Romanian

O	>	O
|		|
|U|		|U̲|
|ʔ|		|ʔ|
[k]		[p]

b. [k] > [w] in Northern Saami

O	>	O
|		|
|U|		|U̲|
|ʔ|		|ʔ|
[k]		[w]

It the following discussion it will be demonstrated that the adoption of this solution can provide a uniform account of some seemingly unrelated phenomena in the history of English. We begin the analysis with some Old English (OE) developments and turn, as the discussion unfolds, to specific phonological phenomena in Middle English (ME).

7.1 Velar fricative vocalization (gliding) in Old English

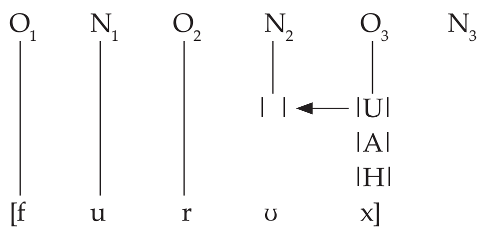
The loss of the velar fricative at a certain stage of the development of English is an unquestionable fact. However, the idea that its disappearance from the language had far-reaching repercussions, very often manifesting themselves disguised as various unrelated phonological phenomena, is not often broadly recognized. It is, therefore, a researcher's task to look at often seemingly unmatching phonological puzzles with the purpose of piecing them together. The development of the glide in front of the velar fricative in OE illustrated in (89) may be recognized as one of the processes which subsequently contributed to the loss of [x] (Hogg 1992).

(89) Gliding before [x] in OE (Wełna 1978: 51)

furh	>	furuh	*furrow*
burh	>	buruh	*borough*
þurh	>	þuruh	*thorough*
holh	>	holuh	*hollow*
mearh	>	mearuh	*marrow*

In (89), the sequences of a liquid followed by the velar fricative, which are found in the forms on the left, are broken by an on-glide in the forms on the right. Furthermore, the ME spelling of some of these forms, for instance, *furgh*, *forough*, *forwe* 'furrow,' *burgh*, *burw* 'borough,' and *thorugh*, *thorowe* 'thorough,' suggests that the phonetic realization of the velar fricative fluctuated between [u], [w], and [x]. These developments are hardly surprising on the condition that velars, just like labials, are specified for the resonant element |U|. More specifically, it is the velar fricative [x] occurring in a prosodically weak position that is the provider of the element |U|. This element is interpreted either as [w] or [u], depending on the constituent affiliation. The explanation of the developments in (89) is as follows: the velar fricative occurs in a typical lenition site and, in order to survive, evacuates some of its melodic content to the preceding position, which results in gliding. This situation is depicted in (90).

(90) furh > furuh



In order to gain stability, the velar fricative in (90) instals one of its elements in the preceding vocalic point N_2. This can be translated as the extension of the interpretational scope of |U|, that is, it gets the interpretation under N_2 and at the same time under O_3. The resonant |U| is realized phonetically as a weak vowel [ʊ] in the vocalic slot, while in the consonantal slot, it defines velarity. Note further that in (90) the velar fricative contains one additional resonance element |A|, which presupposes a slightly uvularized realization of [x]. This representation is tentatively proposed here on the basis of some later developments of the forms in (89) and some other forms discussed in the following sections. As for the latter, note that in ME, the vowel before the glide [w], which originally comes from the voiced variant of the velar fricative,

[w] < [ɣ], is predominantly spelled <o>. Some examples adopted from Wełna (1978: 135) are provided in (91).

(91) Development of ME [o] before [w] < OE [ɣ] (Wełna 1978: 135)

OE		*ME*	
furʒe (furh)	>	furowe	*furrow*
burʒe (burh)	>	borowe	*burrow*
sorʒe (sorh)	>	sorowe	*sorrow*
folʒian	>	folowen	*follow*

The assumption that the ME spelling <o> reflects the back rounded vowel [o] requires a donor of the resonant |A|. This is because [o] is a complex vowel defined by two elements, namely, |A| and |U|. There are two immediate solutions: the source of |A| is either a preceding liquid or a following uvularized fricative. Since English liquids are believed to be defined by the resonant |A|, both options are highly plausible. The final decision on the representation of the velar fricative must be postponed until the following sections provide some independent evidence which may tip the argument in favor of the complex velar solution. Finally, note that in contemporary English, the forms under (89) contain the diphthong [əʊ] or [oʊ]. While in South East England the pronunciation with the former diphthong prevails, for instance, *furrow* [fʌrəʊ], *hollow* [hɒləʊ], and *marrow* [mærəʊ],[21] in American English, the latter is the most widespread realization, for example, [fɚːoʊ], [hɑːloʊ] and [mæroʊ]. Since the element |A| is present in the elemental make-up of both the schwa [ə] and the back mid vowel [o], it points to the conclusion that historically, the source of this element might have been the uvularized spirant.

7.2 Old English Breaking[22]

Old English Breaking (henceforth OEB), also known as fracture, is a general term circulating in the literature. It covers a number of various vocalic developments affecting front vowels occurring before certain consonants and consonant clusters in Old English. OEB is a well described and exhaustively studied phenomenon (see, for example, Campbell 1959; Lass and Anderson 1975; Hogg

[21] Some of the forms in (89) contain the final schwa in present-day English, for example, *borough* [bʌrə] or *thorough* [θʌrə]. Note that in American English, the latter two forms preserved a diphthongal pronunciation, that is, [bɚːoʊ] and [θɚːoʊ] (see also Section 7.4.2).

[22] The discussion of OE Breaking in this section is based on Kijak (2015).

1992; Gussenhoven and van de Weijer 1990, among many others). However, the idea that velars contain the element |U|, which is developed in this study, allows us to look at the OEB phenomenon from a slightly different perspective. In consequence, it may help to flesh out the conjectures of some previous researchers and shed new light on the phonological activity of the velar fricative in the history of English.

The traditional view on breaking assumes the epenthesis of a protective back glide vowel between the preceding front vowel [æ], [e], or [i] (short or long)[23] and the back segment or cluster: [x], [l]+C, [r]+C, [x]+C, the glide being of the same height as the preceding vowel, (Campbell 1959: 54). While short vowels are assumed to have produced a new class of short diphthongs, long vowels resulted in the appearance of long diphthongs, for instance, [i:] > [e:o], as in **līxt* > *lēoht* 'light.' This diphthong is identical to the original one in *Þēod*, but quantitatively different from the short diphthong [eo] in *weorpan* (Lass and Anderson (1975: 75). OEB is discernible in the spelling modification in that the previous <æ>, <e>, and <i> are replaced with the digraphs <ea>, <eo>, and <io> respectively. The last two digraphs, that is, <eo> and <io>, were later usually spelled identically as <eo>. This allows for the assumption that the vowels [e] and [i] developed identical reflexes, [e] > [eo] and [i]/[i:] > (io/īo) > [eo]/[e:o]. Some examples of OEB adopted from Gussenhoven and van de Weijer (1990: 315) and Huber (2007b: 139) are provided under (92).

(92) Old English breaking

a. [æ]/[æ:] > [æa]/[æ:a] <ea>		b. [e]/[i]/[i:] > [eo]/[e:o] <eo>	
ceald	*cold*	eolh	*elk*
healdan	*to hold*	seolh	*seal*
wealh	*foreigner*	weorpan	*to throw*
bearn	*child*	steorra	*star*
mearh	*horse*	feohtan	*to fight*
seah	(he) *saw*	feoh	*cattle*
hleahtor	*laughter*	hweowol	*wheel*
nēah	*near*	miox meox	*manure*
weaxan	*to grow*	lēoht	*light*
eahta	*eight*	wēoh	*holy*

As already mentioned, while the epenthetic glide is reflected in the Old English spelling, the length of the original vowel is left unchanged, which means that

[23] Note that the long, mid, front vowel [e:] does not feature in breaking as it is claimed to be just a dialectal variant of Primitive Germanic [æ:] (see Campbell 1959: 54 and Huber 2007b: 137).

a short vowel evolves into a short diphthong. Moreover, the forms in (92) show that front vowels are regularly broken either before a single velar fricative [x] or one of the consonant clusters: [x]+C, [r]+C, and [l]+C, including [rx] and [lx]. In some cases, the velar fricative was lost in a later development, that is, after the operation of breaking. It affected the velar fricative following a broken long vowel, for instance, *slēan* 'to strike,' *lēan* 'to blame,' *nēar* 'nearer,' and *fēolan* 'to press on' (Huber 2007b: 141). Finally, it is pointed out (Lass and Anderson 1975: 92; Huber 2007b: 139) that since there are some evident gaps and restrictions in the pattern, the breaking is only apparently regular. For instance, [e] and [a] are regularly broken before [x], [x]+C, [rx], [lx], and [r]+C, and although the short vowel [a] also regularly reacts in the context before [l]+C, the mid-front vowel [e] does not, unless the consonant is [x], as in *eolh* 'elk.' However, [e] is broken before [l]+C if there is a preceding [s]: *aseolcan* 'to become languid,' *seolf* 'self,' but *melcan* 'to milk,' *delfan* 'to dig.' Huber (2007b: 142) brings together the restrictions on the operation of breaking and presents them in the form of a hierarchical scale, illustrated in (93). It becomes evident that the most common trigger of OEB is the velar fricative standing alone or in a cluster, as it affected almost all front vowels. Next are liquids followed by the velar fricative, which triggered OEB in most of the front vowels, and then liquids followed by other consonants; [l]+C clusters show the most limited breaking activity. To put it briefly, [x]+C, [r]+C, and [l]+C clusters trigger breaking in the following order: [x]+C affecting virtually all front vowels, [r]+C some, and [l]+C affecting only very few front vowels.

(93) Cluster capacity for OEB (Huber 2007b: 142)

vowel before:	[x]	[x]+C	[rx]	[lx]	[r]+C	[l]+C
[æ]	+	+	+	+	+	+
[æ:]	+	?				
[e]	+	+	+	+	+	
[i]	?	+	+			
[i:]	+	+				

Interestingly, with some restrictions, breaking may affect front vowels before geminates [x:], [r:] and [l:] (Campbell 1959: 54). Thus, similarly to a short [x], the geminate velar fricative regularly breaks preceding front vowels. Moreover, even though there is a scarcity of forms containing the geminate [r:], mainly due to the absence of [r] in West-Germanic Gemination (WGG), some examples of breaking before this geminate can be found, for example, *steorra* 'star' and *fierr* 'farther' (with umlaut) (Huber 2007b: 141). Finally, it is maintained (Campbell 1959: 54) that breaking is not possible before the geminate [l:], for instance, *tellan* 'to tell' and *hell* 'hell'; however, Quirk and Wrenn (1957: 145) claim that breaking is not possible only in a situation when the geminate [l:] is the result of WGG; in other cases, the geminate breaks the preceding vowel, as in *eall* 'all,' *weall* 'wall.' They argue that the reason why [l:] produced by WGG does not trigger breaking is that it originally comes from the cluster **-lj-* preceded by a back vowel [a], for example, Go. *saljan*, *taljan*. It follows that both the geminated [l:] and a short [l] following a mutated vowel have a palatal realization. Similarly, while discussing the exceptions to an otherwise general rule of breaking, Hogg (1992: 103) and Lass (1994: 50) point out that it can be inhibited by the palatal nature of the consonant following the liquid. Thus, apart from the regular diphthongization in *nearwe* 'narrow' nom.pl. < **nærwe* and *sealde* 'he gave' < **sælde*, there are forms in which the vowel remains unbroken due to the palatal consonant following the liquid, for instance, *nerian* 'save' < **nærjan* and *sellan* 'give' < **sælljan*. The latter are affected by *i*-mutation but not breaking. In short, the palatal [j] in **sælljan* is claimed to inhibit breaking by palatalizing the geminate [l:]; however, in **sælde*, the lateral is velarized and hence triggers OEB.

Note that this correlation between palatality and the lack of breaking is puzzling for Huber (2007b: 141). Moreover, since he treats the development of vowels (including back ones) before [r] in Modern English as instances of breaking, the absence of back vowels in OEB is equally problematic for him. Finally, it is worth mentioning that Gussenhoven and van de Weijer (1990: 315) add the glide [w] to the group of consonants which trigger breaking. This is exemplified by the form *hweowol* 'wheel,' given in (92b) above, and some other forms, like *nēawest* 'neighborhood' or *niowul* 'prostrate.'

Most of the solutions proposed to OEB rely on the assumption that the consonants that trigger breaking share certain features. This is the approach adopted by Gussenhoven and van de Weijer (1990), who analyze some historical processes (including OEB) in search of a unified representation of vowels and consonants. They claim that OEB is a case of spreading which involves the feature [+dorsal]. More specifically, they argue that front vowels are broken in the context of the following [x], as it is [+dorsal], just like the labio-velar [w] and velarized [ɫ]. Furthermore, following Lass (1983), they assume that [r] was a velar or even a uvular consonant or that it had secondary velarization, just like [ɫ]. Leaving the phonetic details aside, they conclude that [r], just like [x l w], must have been [+dorsal].

A more detailed analysis of OEB is proposed by Lass and Anderson (1975). Since, as they observe, in the traditional SPE-like model of segmental structure, the consonants which trigger diphthongization do not have much in common, it may lead to a conclusion that in order to account for OEB, one needs two separate processes. They refute this and some other solutions, to finally opt for a hypothesis according to which OEB was an entirely natural (assimilatory) process, and all the consonants causing it had some common specification, which for some reason has escaped the researchers. More specifically, Lass and Anderson (1975) assume some kind of 'back-colored' or velarized [r] and [l]. Now, while the latter is hardly controversial, as the pre-consonantal [l] is velarized in most of the varieties, the same cannot be said about the velarized [r]. Thus, since it occurs in most dialects of Modern English, both British and American, the velarization of the lateral is beyond dispute. The realization of the lateral encompasses a slightly and heavily velarized [l] or a vocoid glide, depending on the dialect; for example, in Scottish and some Northern England dialects, [l] is realized with a very clear resonance, that is, [ɯ], [ˠ], or [o]. Now, on the basis of some evidence from Modern Scottish and northern English dialects, the authors propose to define the rhotic as a uvular continuant consonant [ʀ], leaving some minor phonetic details like fricative and trill unspecified. Further motivation for this step comes from the observation that there is a uvular rhotic in at least some dialects of every Germanic language except Icelandic. They sum up by pointing out that [ʀ] can prove helpful not only in regularizing the context for breaking but in explaining some other phenomena, such as, for instance, West Germanic Gemination. Note that the idea of uvular *r* in OE inspired criticism by Fred Householder in a personal communication with Lass and Anderson (1975: 89, footnote 1). He argued that for the purpose of breaking, it suffices to recognize [r] as an apical, somewhat retracted or retroflexed segment, just as in most of the modern American varieties. Householder provides some more evidence; for example, in Greek and Latin, the vowels which develop before [r] are more open, back, or rounded. Similarly, in Sanskrit, [r] alternates with [ur] in many roots containing apical [r]. The same apical [r] occurs in many Turkic languages and is much more common cross-linguistically than uvular [ʀ]. Finally, Householder indicates that retracted [r] and dark [l] share similar acoustic properties and articulator shapes. On top of that, other researchers (Charles Jones in a personal communication with Lass and Anderson 1975: 89) point out that modern dialects containing uvular [r], those which descend directly from Old Northumbrian, are the dialects in which breaking was rather unproductive. Be that as it may, note that even if Lass and Anderson (1975) accepted the idea of the retracted apical [r], they would not be able to explain the relationship between [r, l] and [x]. In other words, the solution proposed by them cannot account for why the liquids pair only with [x] and not any other segment. This is part and parcel of the phonological model chosen for the analysis, as it lacks a common feature that would characterize the three segments in question. Lass and Anderson (1975) conclude by saying that if there is one process called "breaking" and [+back] is the trigger-feature responsible for the epenthesis of a back vowel, then in order to unify the context, [r] must be [+back]. More generally, they argue that OEB results in the development of the vowel [u] with some other features copied from the preceding vowel through Diphthong Height Harmony and, finally, that if [x] alone can trigger breaking while [l] and [r] do so only if followed by a consonant, it must be a function of some sort of strength hierarchy.

On the other hand, the idea that consonants which trigger OEB have the [+back] specification is only briefly touched upon by Huber (2007b: 146). He points out that this solution reduces OEB to a mere adjustment process in which front vowels are approximated before [+back] consonants, including [x], velarized [l], and the velar rhotic [r]. One of the advantages of this solution is that it provides a ready-made answer for the absence of back vowels in OEB, that is, since they are back, they do not require any back assimilation. Still, it cannot cope with the question of why other velars, like [k] and [g], do not trigger OEB.

For the analysis of the same facts, Huber (2007b) adopts a more advanced theoretical model – Element Theory. Without going into unnecessary detail, he basically follows the idea proposed by Quirk and Wrenn (1957) and Cassidy and Ringler (1971), according to which OEB consists in the development of a vowel glide due to the influence of some velar qualities of the following segments, for example, *fex > *feux > *feox > [feəh] <feoh> 'life.' In other words, the phonetic realization of the broken part is not [a], [o], or [u], as may be suggested by the spelling. Instead, the OEB results in the appearance of [ə], which, together with the original vowel, is responsible for the appearance of new diphthongs, namely, [æə] and [eə] (either short or long).

As already mentioned, the main objective of Huber's (2007b) dissertation is to provide some arguments which could consolidate the opinion that velars lack any resonance elements. Huber (2007b) claims that the lack of a place element in [x] is also responsible for OEB in that the velar triggers the development of a second, contrastive portion following front vowels. Since in his analysis, the schwa [ə] represents the realization of an empty segment, that is, a totally empty vocalic segment with no resonance elements at all, it follows that both the schwa and [x] share this "no-resonance" property. Huber argues that the second part of the diphthong which arises through breaking is simply an empty slot, and the breaking itself is understood as "the approximation of front vowels to the placelessness of [x], by creating an empty slot between the vowel and the consonants" (Huber 2007b: 145). Note that this proposal raises serious problems, some of which have been noted by Huber (2007b: 146) himself. For instance, it is not clear why back vowels are excluded from breaking, that is, there is no formal obstacle which would inhibit the development of a reduced second part of the diphthong after back vowels. Interestingly, the absence of back vowels in breaking phenomena is continued in contemporary English, as evidenced by certain developments. In Modern English, there are instances of breaking which occurs before the liquids [r] and [l] (see, e.g., Wells 1982: 213). While breaking before the Modern English [l] affects, just like OEB, only front glides, for instance, [fiːᵊɫ] *feel*, [seɪᵊɫ] *sail*, [faɪᵊɫ] *file*, and [bɔɪᵊɫ] *boil*,[24] pre-*r* breaking (diphthongization) can affect

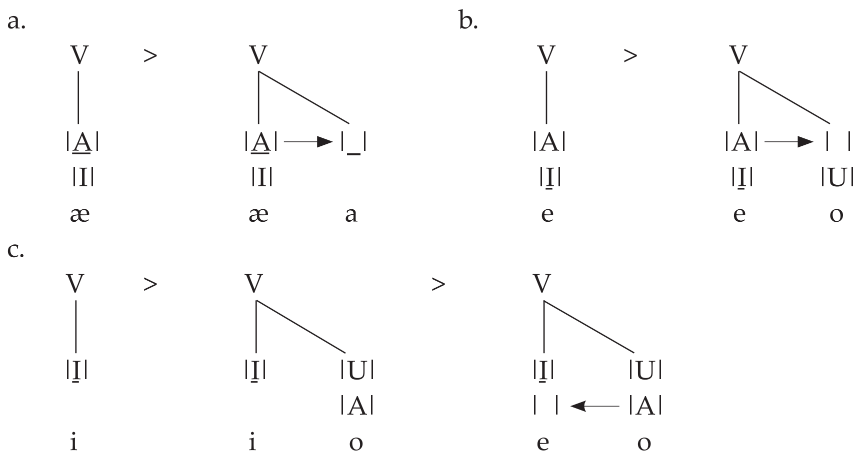
[24] Wells (1982: 258-259) also mentions a process he calls "*l* vocalization." It consists in [l] velarization in a context similar to that in OE and resulting in vocaliza-

both front and back vowels, resulting in centering diphthongs or triphthongs: [ɪə], [ʊə], [eə], [aɪə], [aʊə], and [ɔɪə]. However, it is also possible to interpret both breaking phenomena in Modern English as instances of vocalization.[25]

Another problem related to the placelessness of velars is the lowering of OE [ɪə] to [eə], which must remain unexplained, that is, the source of the element |A| is unknown. Finally, there are some more general questions which call for an answer, such as the absence of velar plosives in OEB or the preconsonantal position of liquids which trigger breaking. These questions are left unanswered.

In his study, Huber (2007b: 143) considers one additional possibility, namely, diphthongization as the spreading of the non-palatal element |A|. It produces contour structures of two vowels similar in height but different in backness. Note that this scenario assumes that the second part of the diphthong is a phonetic back vowel [a] or [o]. Consider the development of short vowels proposed by Huber (2007b: 143) in (94).

(94) Breaking as the spreading of |A| (Huber 2007b: 143)[26]



tion, for example, *milk* is pronounced [miok] rather than [milk]. As for "pre-*r* breaking," Wells (1982: 214) explains that it is a natural phonetic development: "to pass from a 'tense' close or half-close vowel to the post-alveolar or retroflex posture associated with /r/ requires considerable movement of the tongue. If this is somewhat slowed, an epenthetic glide readily develops."

25 For a detailed analysis of pre-*r* breaking as a vocalization process, see Kijak (2009). The phenomenon of [l] vocalization is discussed in Section 7.4.3.

26 Huber (2007b) adopts the model in which syllabic constituents can be branching; hence, both parts of the diphthongs in (94) are associated with a single vocalic slot.

The major problem with the solution depicted under (94) is that the development of the second part of the diphthong is unmotivated in that there is no a local source for the elements which define it. In short, apart from (94a), where |A| spreads from the preceding vowel [æ], there is no motivation for the presence of the elements |U| in (94b) and |A U| in (94c). Huber (2007b: 144) notes that although the presence of |A| could be explained, as it is most probably the element defining the consonants triggering breaking, that is, [r], [l], and [x], the appearance of |U| in the process remains a puzzle. In consequence, he abandons this line of thought and instead follows the empty slot solution discussed above.

Summing up the discussion so far, all the presented solutions are based on the assumption that OE *r* must have shared some feature with other consonants which triggered breaking, that is, [x l w]. This is a reasonable assumption to adopt if we want to capture and unify the context of the process in question. Although the exact nature of this feature varies depending on the theoretical model ([+back], [+dorsal], or placelessness), it is generally agreed that OE *r* must have been some kind of a "back-colored" consonant specified as velar, uvular, velarized, or simply retracted. Be that as it may, the above analyses face one common difficulty: how to explain the nature of the diphthongs which are the effect of breaking.

The solution which is developed in this study assumes that velars are not placeless; quite the contrary, they contain the non-headed resonance element |U|. This explains the propensity of velarized [ɫ] and the labio-velar glide [w] to flock together with velars. Anyway, bringing together [ɫ w] and [x] is not a serious problem for most of the current models of segmental phonology. What seems to be much more challenging, however, is to incorporate the rhotic into this group. According to Backley (2011: 168), all the different variants of the rhotic in various languages, for example, the trill [r], the approximant [ɹ], the flap [ɾ], the retroflex [ɽ], and even the uvulars [ʀ ʁ], are simply the realization of a single element |A|. However, in systems which possess more than one variant of the rhotic, some additional elements or the concept of headedness need to be applied to differentiate between them. Building on the observation that uvulars show a strong inclination to pattern with velars, Backley (2011: 98) proposes to capture their phonological similarity by the element |U| (see Chapter One). Bearing in mind the previous research findings concerning the characteristics of English *r*, it is proposed here that the pre-consonantal and word-final rhotic in OE was uvularized (including a uvular trill or a fricative), and as such it was specified for two elements |A| and |U|. Furthermore, in order to differentiate the velarized *l* and uvularized *r*, we propose to make use of headedness, that is, the element |A| plays the function of the head in [ʀ], but it is a mere dependent in [ɫ], which gives the following specifications: [ɫ] |A U| and [ʀ] |$\underline{\text{A}}$ U|. This allows us to claim that the shared element linking all the consonants responsible for breaking is |U|. It is found in the velar fricative [x], velarized [ɫ], and uvularized [ʀ]. Note further that liquids are additionally specified for |A| and, as already alluded to above, there are good reasons to postulate the same structure for the velar fricative. Table (95) provides the representation of consonants which trigger OEB.

(95) The melodic make-up of the OEB triggers

Velar/uvularized fricative	Uvularized rhotic	Velarized lateral	Labio-velar glide
[x]/[χ]	[r]/[ʀ]	[ɫ]	[w]
|A U H|	|<u>A</u> U|	|A U|	|<u>U</u>|

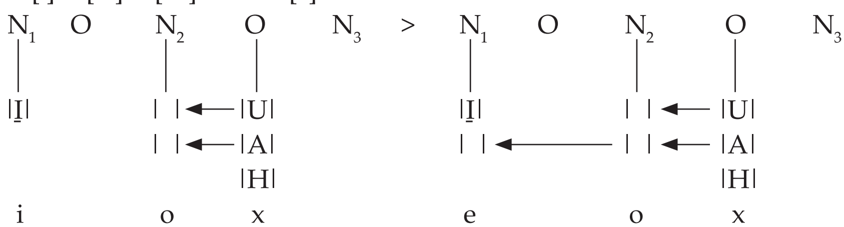
The last (shaded) column of the table in (95) deserves a comment. The glide is separated from the rest of the consonants, as it is included in the analysis of OEB only by some researchers (Gussenhoven and van de Weijer 1990). Moreover, its internal structure is slightly different from the rest of the consonants in (95) in that it contains a single headed |<u>U</u>|. More crucially, the main triggers, that is, [x ɫ ʀ], share the same elements |A| and |U|, which may explain their similar activity with respect to breaking. Finally, they have suffered a similar fate in the history of English: in many cases they were affected by the reduction in the form of vocalization and/or complete deletion. For example, the velar fricative faced various stages of reduction (including vocalization) to be subsequently deleted, leaving some imprints on the preceding segments (see Section 7.4). Historically, the rhotic is either vocalized (prosodically weak position) or reduced to the approximant [r] (pre-vocalically). By the same token, the velarized [ɫ] is vocalized and in many cases deleted.

The representation of consonants proposed in (95) allows us to provide a uniform account of OEB, which boils down to the spreading of |U|, sometimes accompanied by |A|, to the preceding vowel. Moreover, it can explain some peculiarities connected with OEB. Recall that breaking can be inhibited by the palatal nature of the consonant following the liquid, for instance, *sellan* 'give' < **sælljan.* Traditional explanation draws on the nature of the glide [j] which palatalizes the preceding geminate [l:] and in this way inhibits breaking. The question, however, remains how to logically combine these two facts: palatality, on the one hand, and the lack of breaking, on the other. The answer becomes evident on condition that the representations in (95) are accepted. In the context of the following palatal [j], the lateral is not velarized any more, as the element |U| is replaced by |I| of the following palatal [j]. The question which still needs to be addressed concerns the effects of OEB, namely, the character of the resulting diphthongs. It is broadly accepted that breaking was responsible for the appearance of the diphthongs, both short and long. What is less uncontroversial is the source of these new diphthongs. To put it differently, there are two options for breaking; either it is the front vowel which develops a protective back glide before certain consonants or it is some consonants which develop an on-glide (vocalize) in a particular context. In this study we opt for the latter solution, which means that OEB is simply the result of the weakening process affecting certain consonants in a prosodically weak position. When looking at the examples of OEB in (92), it becomes evident that breaking occurs before the pre-consonantal velar fricative or liquid. It also takes place before the single [x] but only if word- or syllable-final. These two contexts, that is, pre-consonantal and word-final, are cross-linguistically the most common lenition sites (Ziková and Scheer 2010). It follows that OEB was triggered by a class of segments containing the non-headed |U| which happened to occur in a prosodically weak position. In order to escape this positional plight, the consonants relocated some of their phonological material to the preceding vocalic position, which in turn resulted in diphthongization. Now, the reason why OEB resulted in a diphthong rather than some sort of modification of the original vowel, like lowering, is the fact that |I| (of the original vowel) and |U| (of the vocalized consonant) do not sit comfortably together within one segment. Although front rounded vowels, which are the combination of |U| and |I|, were present in the vocalic inventory of OE, they were most probably already in retreat, because they were totally lost in ME. Therefore, it is diphthongization which seems to be the most probable effect in a situation when |U| is incorporated into a front vowel. In short, OEB is the consequence of the inability of |U| and |I| to fuse within one segment. Moreover, if, as we claim here, OEB is the spreading of the non-headed |U| (plus |A|) from consonants in a weak position, we have a ready explanation for the absence of back vowels in breaking. The elements |U| and |A| do not have a chance to spread to back vowels as the latter are already specified for these elements. The absence of back vowels in OEB is, therefore, treated here as imposed by the Obligatory Contour Principle, which enforces the avoidance or simplification of sequences of identical segments. Furthermore, it is suggested that the velar plosives [k g] do not belong to the group of consonants triggering OEB due to their internal structure. More specifically, since the real triggers [x ɫ ʁ] (excluding the labio-velar glide [w]) contain two resonance elements |U| and |A| – in opposition to [k g], which contain just one resonant |U| – the former are simply more susceptible to modification in a weak position. Needless to say, this is a tentative explanation, which is not pursued here any further.

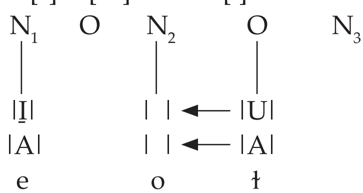
Finally, the explanation of OEB proposed here can combine two disparate hypotheses concerning the effect of the process. According to one hypothesis, the second element of a new diphthong was a full vowel. The proponents of this solution argue that breaking proceeded along the following path: *ea* = [æ]/[æ:] > [æa]/[æ:a], *eo* = [e] > [eo]/[e:o] and *io* later *eo* = [i]/[i:] > [io]/[i:o] > [eo]/[e:o]. The second hypothesis, on the other hand, maintains that the second part of the diphthong was a reduced vowel, that is, the schwa, hence *ea* = [æ]/[æ:] > [æə]/[æ:ə], *eo* = [e] > [eə]/[e:ə] and *io* later *eo* = [i]/[i:] > [iə]/[i:ə] > [eə]/[e:ə]. However, it is equally plausible to assume that at the early stage, OEB resulted in a full vowel which, with time, was reduced to the schwa [ə]. This scenario assumes the spreading of both resonants |U| and |A| in the first phase, with subsequent reduction to single |A| as the second phase. Interestingly, both options are attested in Modern English. For example, even though breaking before the modern English [ɫ] results in the schwa, for instance, [fi:ᵊɫ] *feel*, [faɪᵊɫ] *file*, and [bɔɪᵊɫ] *boil*, in a more recent development, it can also result in a full vowel, as in [miok] *milk* (Estuary English). In the latter case, the vocalization effect, namely, the vowel [o], is a combination of two elements |U| and |A|, which further confirms the internal structure of [ɫ] given in (94). Finally, note that what is an unmotivated lowering in Huber's (2007b: 146) analysis of OEB, that is, [iə]/[i:ə] > [eə]/[e:ə], is a simple consequence of spreading in the solution proposed here. In other words, if the schwa is represented by the non-headed |A|, the lowering can be explained as a simple fusion of the latter element with |I̲| of the original vowel, hence [e] |A I̲|. This and other instances of OEB are represented in (96).

(96) Selected examples of OEB

a. [i] > [io] > [eo] before [x]



b. [e] > [eo] before [ɫ]

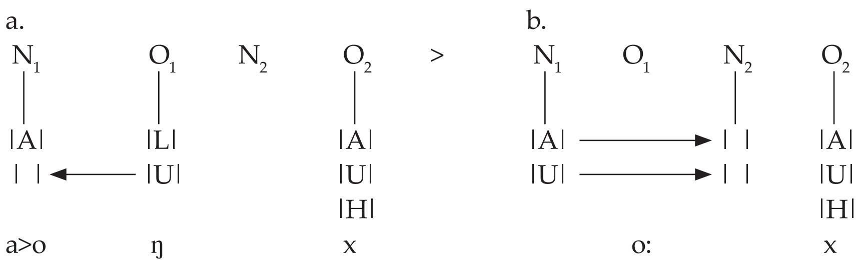


The gradual development of [i] > [io] > [eo] is represented in (96a), where the element |A| extends the scope of its realization, reaching the original vowel N_1. OEB before the velarized lateral is illustrated in (96b). Both developments illustrate the possible stages of OEB in the full-vowel scenario, that is, the solution which assumes that breaking results in a diphthong with a full vowel as a second part. As mentioned above, it is also possible to claim that with time, the glide is reduced to the schwa vowel. In this scenario, the element |U| of the glide is lost, while single |A| gets the schwa interpretation.

7.3 Vowel rounding before velars in Old and Middle English

In Chapter Two, it was pointed out that velars may impose roundness on preceding vowels. For instance, the disappearance of a nasal before the velar fricative in Primitive Germanic triggers some modifications, like compensatory lengthening and vowel nasalization. To cut a long story short, the sequence of a short vowel followed by a nasal and velar fricative homorganic cluster was simplified, that is, the velar nasal was lost, while the vowel was lengthened and nasalized. Interestingly, this development is often accompanied with vowel rounding, as exemplified by the evolution of the Primitive Germanic sequence -[aŋx] into OE [õ:x], as in, for example, *ōht* and *þōhte.* A similar development affected the OE sequence [aŋg], which was first turned into [a:ŋg] (lengthening) and later into [ɔ:ŋg]. It follows that in the latter development, the vowel is not only lengthened but also rounded. In ME, the long vowel [ɔ:] is affected in the same context by shortening to [o], and finally it is realized as [ɒ] in Standard Modern English, for example, EOE *sang, strang* > LOE *sāng, strāng* > EME *sōng, strōng* 'song,' 'strong.' Moreover, the rounding of LOE [a:] to EME [ɔ:] is not confined to the context of the following velar nasal, as it also affected the vowel [a:] in other contexts, as in *wāmb* > *wōmb* 'womb,' *āk* > *ōk* 'oak,' *dāh* > *dōh* 'dough,' *bāld* > *bōld* 'bold,' etc. If we assume the velarized variant of the pre-consonantal [l] and disregard some evident counter-examples, like *nān* > *nōn* 'none,' *stān* > *stōne* 'stone,' etc., we could claim that vowel rounding operated predominantly before a segment defined by the resonance element |U|. The development of the rounded vowel before the velar fricative in OE is illustrated in (97).

(97) Nasal loss and vowel rounding in OE [aŋx] > [õ:x]



In (97a), the velarity of the nasal induced by the following velar fricative is interpreted together with the element |A| under the vocalic position N_1, which results in rounding of the original vowel, that is, [a] > [o]. In the subsequent step, the nasal is lost and the vowel [o] is lengthened by reaching the following nuclear position N_2 (97b). We can see that velars are able to impose roundness on neighboring vowels, which is independently confirmed by the Vocative formation in Czech (see Section 3.1 in Chapter Two). In this language, we recall, palatals choose the front vowel [i], dentals and labials [ɛ], while velars are followed by [u], as in Nom. *muž* ~ Voc. *muži* 'man,' Nom. *holub* ~ Voc. *holube* 'pigeon,' and Nom. *pták* ~ Voc. *ptáku* 'bird,' respectively. In light of the above discussion, it is the preceding velar consonant that is responsible for the round quality of the allomorph.

Interestingly, velars can also undergo vocalization and wind up as a part of a diphthong. However, the result of vocalization often depends on neighboring segments. This is the case of OE [ɣ], which is the source of two glides, [j] and [w], depending on the context. Recall from Chapter Two (Section 2.1.1) that the voiced velar fricative [ɣ] evolves into the palatal glide [j] in the context of a neighboring front vowel, for example, OE *læg*, *sægde* > ME *lai*, *saide* 'lay,' 'said,' etc. In the vicinity of back vowels, however, the velar fricative develops into the labial (back) glide [w], as in OE *dagas*, *boga* > ME *dawes*, *bowe* 'days,' 'bow' (see also Section 7.1). Although both developments contributed to the appearance of diphthongs and the loss of [ɣ] in ME, they are given a slightly different explanation. While the palatal glide [j] arises due to the spreading of the palatal element |I| from a neighboring vowel (98a), the labial [w] is the effect of the switch in headedness (98b).

(98) [ɣ] > [j]/[w]

a. [ɣ] > [j]					b. [ɣ] > [w]				
N	O	>	N	O	N	O	>	N	O
|I|	|U|		|I| →	|_|		|U|			|$\underline{\text{U}}$|
|$\underline{\text{A}}$|	|A|		|$\underline{\text{A}}$|	|A|	|$\underline{\text{A}}$|	|A|		|$\underline{\text{A}}$|	|A|
	|H|			|H|		|H|			|H|
æ	ɣ		æ	j	ɑ	ɣ		ɑ	w

To repeat a point made earlier, velars, just like coronals, are segments specified by non-headed resonance elements which can be easily replaced by the resonance elements of the neighboring segments. This is depicted in (98a), where the element |I| of the preceding front vowel replaces |U| of the velar. In (98b), however, the velar occurs after a non-high vowel, which means the replacement cannot occur; instead a non-headed |U| is promoted to the head position, while the rest of the material becomes suppressed.

7.4 Middle English diphthongization

The elimination of the velar fricative from English was a long and complex process, which presumably had its beginnings already in OE. This segment was not completely lost, however, as its disappearance echoed in various modifications throughout the whole system, not only consonantal but also vocalic. For example, around the early 12th century, the process of velar fricative deletion took an interesting turn. In this period, the velar fricative became the major source of new diphthongs. In other words, before it disappeared, the velar fricative left some traces in the neighboring segments, noticeable in vocalization, diphthongization, and labialization, which are the main topics of the present section.

7.4.1 The voiced velar fricative [ɣ]

The process of diphthongization before the voiced velar fricative [ɣ], a contextual variant of [x], has already been touched upon in the previous section. In what follows, we look at it in more detail. It is broadly assumed that at the outset of the 11th century, the voiced velar fricative [ɣ] evolved into [w] and, together with the original vowel, contributed to the development of new diphthongs. It means that in the case at hand, the diphthongization was preceded by the vocalization of [ɣ]. This development is illustrated in (99) with examples adopted from Fisiak (1968: 51) and Wełna (1978: 122ff).

(99) Diphthongization before [w] < [ɣ] in ME

a. OE [ɑɣ] > ME [aw] > [au]

draȝan	> draȝen	> drawen	*draw*
laȝu	> laȝe	> lawe	*law*
saȝu	> sawe		*saw*

b. OE [ɑːɣ] > ME [ow] > [ou]

āȝan > ōwen	*owe*
āȝen > ōwen, owne	*own*

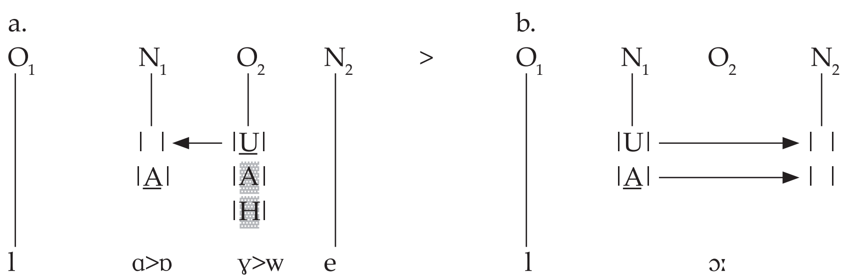
c. OE [oɣ]/[oːɣ] > ME [ow] > [ou]

boȝa > boȝe, bowe	*bow*
(ge)floȝen > flowen	*flown*
plōȝas > plowes	*plows*
slōȝon > slowen	*we slew*

In Late Old English, the voiced velar fricative [ɣ] following a back vowel undergoes the vocalization process (99), the effect of which is [w]. It subsequently becomes part of a new diphthong with some later modifications. The development can be exemplified by *laȝu* > *lawe* > *law,* which proceeds along the following path: OE [ɑɣ] > ME [aw] > [au] > LME [ɒu] > ENE [ɔː]. In light of the discussion in the previous sections, [ɣ] > [w] > [u] is a natural and predicted development.

More specifically, if it is true that velars contain the resonant element |U|, the vocalization can be interpreted as an example of decomposition (lenition) which occurs in a prosodically weak position (intervocalically).[27] The change amounts to the loss of other elements from the internal structure of the voiced velar fricative except for |U| and the switch in headedness, that is, |U| > |$\underline{\text{U}}$|, hence [ɣ] |U A H| > [w] |$\underline{\text{U}}$ A H| (100a). Next, the glide, together with the preceding vowel, constitutes a new diphthong, and subsequently it may be absorbed by the original vowel, resulting in a long monophthong (100b).

(100) OE *laʒu* > ME *lawe* > ENE *law*



In (100a), the surviving element |U| is promoted to the head and is interpreted as [w] under the consonantal point O_2. In the following step, this element spreads to the preceding nucleus, and together with |A|, it forms a complex expression |A U|, which results in a (long) monophthong [ɔː]. The same explanation applies to all the forms under (99) with the proviso that the glide [w] is able to spread in both directions, docking upon both the preceding nucleus and the following one. In the latter scenario, the result is a closing diphthong, for example, *boʒa* > *bowe* > *bow*. Note further that there is no diphthongization in a situation when the voiced velar fricative is preceded by [u]. Since both the vowel [u] and the glide [w] < [ɣ] contain a single element |U|, the development would result in a sequence of two identical elements. Thus, in a situation when [ɣ] follows the high back vowel [u], we can observe the loss of the velar and the lengthening of the original vowel, that is, [uɣ]/[uːɣ] > [uː]. Finally, the representation of the vocalized [ɣ] may be indirectly confirmed by identical diphthongization which affected the original [w], as in OE *clawu* > ME *clawe* 'claw,' OE *blāwan* > ME *blowe*, 'blow,' or OE *flōwan* > ME *flowen* 'flow,' etc. (Fisiak 1968; Jordan 1974; Wełna 1978; Hogg and Lass 1999).[28]

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[27] There are three main lenition sites recognized in the literature. They include the preconsonantal, word-final, and intervocalic positions (see Ségéral and Scheer 1999; Ziková and Scheer 2010).

[28] Wełna (1978: 124) notes that in some cases, the glide [w] is the result of the vocalization of [f] before velars, as in OE *hafce* > ME *havek*, *hauke*, *hawke*, 'hawk.' This

7.4.2 The voiceless velar fricative [x]

It is broadly agreed that the voiceless velar fricative had two major contextual variants in ME: the palatal [ç] and the velar [x]. While the OE spelling <h> or the ME spelling <gh> is assumed to have been pronounced [ç] following a front vowel, for example, *light*, *high*, and *right*, the same spelling <gh> stands for the phonetic [x] in the context of the following back vowel, for instance, *trough*, *aught*, and *enough*. As already noted in Chapter Two, these variants became the primary source of new diphthongs. Thus, while the palatal glide [j] developed between a front vowel and [ç], the labial glide [w] evolved between a back vowel and [x]. Subsequently, these newly developed glides, together with the preceding vowels, formed the respective [eiç] and [oux] diphthongs (Fisiak 1968: 51; Wełna 1978: 126; Kwon 2012: 36). Furthermore, while [ç] merges completely into the preceding diphthong and disappears without any recoverable trace except in the orthographic form, as in EME *hēh* > ME *heigh* [eɪç] EModE *high* [e:] > [i:] > [aɪ] *high*, the development of the velar variant leaves more evident imprints. Word-finally, with only a few exceptions, it is labialized to [f], while in stressed syllables before *t* it contributes to the appearance of new diphthongs [eɪ aʊ ɔʊ] or a back rounded vowel [ɔ:]. The examples illustrating these developments given in (22) have been slightly modified and supplemented, and are repeated here for the reader's convenience as (101).

(101) ME diphthongization before the velar fricative

a. Diphthongization and subsequent labialization of [x]

EME	*ME*	*EModE*	*gloss*
rūh	rough [ɔʊx]	rough, ruff [ɔf]	*rough*
slōh	slough [ɔʊx]	slough, sluff [ɔf]	*slough, n.*
genōh	enough [u:x]	enough, enuff [uf]	*enough*
troh	trough [ɔʊx]	trough [ɔf]	*trough*
coh	cough [ɔʊx]	cough [ɔf]	*cough*
lahhe	laugh [aʊx]	laugh, lauf, laf [af]	*laugh*

b. Diphthongization and subsequent loss of [x]

bōg	bogh	bough [au]	*bough*
plōg	plough	plough [au]	*plough*
slōh	slogh	slough [au]	*swamp*
dāh	daugh	dough [ou]	*dough*

c. Diphthongization before [t]

āhte	aught [aʊx]	aught [ɔ:]	*aught*

development is actually predicted by the solution advocated here, as [f] is a labiodental fricative specified by the resonant element |U|.

þōht		thought [ɔʊx]	thought [ɔ:]	*thought*
faht		faught [aʊx]	faught [ɔ:]	*fought*
slahter		slaught [aʊx]	slaught [ɔ:]	*slaughter*
dohtor		doughter [ɔʊx]	doughter, douter [ɔ:]	*daughter*
dohtig	>	dohti, duhti	doughty [aut]	*doughty*
drūgað	>	drought, drughte	drought [aut]	*drought*
trūht	>	troute	trout [aut]	*trout*

d. Word-finally in unstressed syllables

borough	[ˈbʌrə]
thorough	[ˈθʌrə]
through (prep.)	[θru:]
though (conj.)	[ðou]

Interestingly, some of the forms in (101) evolved divergently in that they developed either a diphthong or a labial fricative, for example, *dough* [ou] < ME *daugh* and *duff* [dʌf] < ME *dogh*, *dah* 'flour pudding' or *slough* [au] < ME *slogh* 'swamp' and *slough* [slʌf] < ME *slugh*, *slouh* 'the skin of a snake.' It was proposed (Bonebrake 1979) that the bidirectional development is dictated by semantics, that is, in order to avoid homophony, both forms evolved differently.[29] The bidirectional development can be further confirmed by the existence of some forms with unstable pronunciations, such as OE *troh* > ME *trogh*, *trough* [tro:f]/[trau] and OE *clōh* > ME *clow*, *clough* > *clough* [klʌf]/[klau].[30] Crucially, in all such forms the modern reflexes of [x] are either a labial fricative or a diphthong with the second labial element. Note further that the first two examples in (101b) must also be included in the group of bidirectional forms. Although, as illustrated above, they developed a diphthongal realization in ModE, they are found with the labial fricative [f] in some northern dialects, as reported by Bonebrake (1979: 31). The forms under (101c) illustrate the development of the velar fricative before *t*. Although these forms developed the velar-less forms, as confirmed by the ModE pronunciation, they are reported to have had labial [f] forms. For instance, the phonetic realization of *ought* as [oft] is reported in some southwestern dialects and *drought* is pronounced with the final cluster [ft], that is, *drou*[ft], in some northern dialects. Moreover, just like *slaughter*, sometimes spelt as *slafter* in EModE, the form *daughter* has the following spelling vari-

[29] For a detailed discussion concerning the development of these forms, see Bonebrake (1979: 28ff).

[30] As reported by Bonebrake (1979: 30), the velar fricative is preserved in the Scottish variety, for instance, [klux]. This is a more general observation as most of the forms in (101), (103), and (104) preserved the [x] in the pronounciation of Scots (older speakers) (Bonebrake 1979: 33ff).

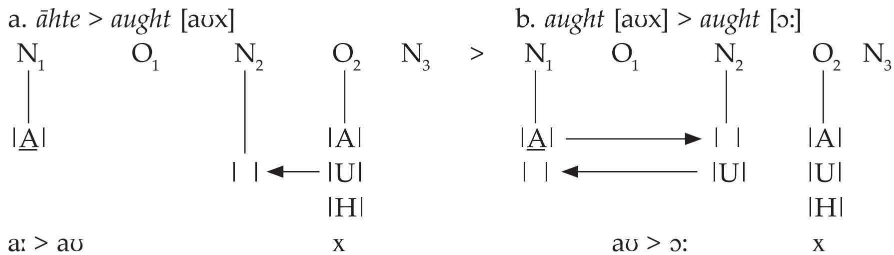
ants: ME *doftir* and EModE *dafter/daufter*. Finally, the forms in (101d) illustrate the development of the velar fricative in unstressed position. In the first two examples, *borough*, *thorough* (adj.), [x] occurs in an unstressed syllable, just like in the last two examples, that is, *through* and *though*, which are syntactically weak (a preposition and a conjunction) and as such unstressed. Segments at the end of unstressed syllables are uncontroversially assumed to be prone to deletion. It follows that the development in both two-syllable words (*borough* and *thorough*) and the unstressed function words (*through* and *though*) results in a final diphthong or a weak vowel, but not the labial fricative [f]. However, on the basis of such early developments like *dwerg* > *dwarf*, Bonebrake (1979) assumes that one of the first modifications occurring in the above forms was labialization of [x]. Thus, it is argued that the forms *through* and *thorough*, which are of a common origin, namely, *þurgh/thurgh*, developed into *þurf* < *þurh* in the preliminary stage. Alternatively, they could be labialized and metathesized, as in *þurh* > *thurf* > *throf*. Such forms with the final [f] have survived in northern and southwestern dialects. What is important for us here, however, is that the earliest stage, *þurh* > *þurf*, is an example of labialization in a labial-free context (after a liquid). Later on Bonebrake (1979) changes her mind, pointing out that in the preliminary stage, the velar fricative [x] in the context of the preceding liquid develops an on-glide [u], hence *þurh* > *þuruh* (see also the discussion in Section 7.1).[31] Although the precise developmental path of such forms is blurred by the inconsistency of spelling exemplified by *þurh*, which apart from ME *þurw* can be found later on in EModE as *þuro*, *thoorrow*, but also *threw*, *throw*, among many others, at the end of the day, all of them developed either a labial vowel or the schwa. For instance, the form *borough* evolved along the similar pattern, with some alternative spellings in ME, for instance, *boru*, *borwe* (dat.), *borewes* (pl.), *borewe* (dat.pl.), and one alternative dialectal form *barf* (Bonebrake 1979: 27). Finally, *though* is also reported to undergo the change [x] > [f] confirmed by the ME spelling *þof*. This form survived in northern and southwestern dialects and in this way was aligned there with *laugh* and *cough* with the final [f]. In the Standard English, on the other hand, it was assigned to a group of unstressed words and evolved along the pattern: ME *thow/thou* > ModE [ðoʊ]/[ðəʊ].

Summing up the discussion so far, the forms in (101a–d) illustrate the process of gliding triggered by the voiceless velar fricative which follows a back vowel, either short or long. This development is confirmed either directly by the forms under (101) or indirectly by the existence of some dialectal variants. The mechanism responsible for the change is almost identical to the one discussed

[31] Note also the development of a vowel in OE forms OE *belȝ* > *bellows*, OE *byrȝ*> *bury* and dialectal developments of *fellow*, *felk*, *felf* with the word final velar plosive [k] or labial fricative [f] (Wright 1905; after Bonebrake 1979: 25).

in the previous section (Section 7.4.1), with the difference that here the voiceless velar fricative survives for some time to disappear only much later. Moreover, as with the developments described in the sections above, the change at hand can be explained as a reaction of the velar fricative to the positional plight. It can be either a word-final position (101a, b, d) or the one before another consonant (101c). As already noted, these two contexts, together with the intervocalic one, are recognized as a lenition site cross-linguistically. Crucially, the source of the glide in (101) must be the following velar spirant defined by the resonance element |U|, as illustrated in (102).

(102) *āhte* > *aught* [aʊx] > *aught* [ɔ:] ‘aught’



In a prosodically weak position, the voiceless velar fricative seeks stability by spreading one of its elements to the preceding nuclear slot N_2. In this way, the resonance element |U| of the voiceless velar fricative, together with the preceding vowel, forms a new diphthong (102a). In (102b) |U| moves further left and it gets mingled with |A| of the original vowel. The complex expression |A U| is then interpreted under both N_1 and N_2, which in consequence gives a long monophthong [ɔ:].[32]

As noted in Chapter Two (Section 2.1.1), diphthongization triggered by the velar spirant is also found in ME irregular weak verb forms represented under (103). Moreover, we have already come across a few instances of diphthongization in weak verb forms when analyzing the forms under (101c). Since the dental suffix [t] functions as a preterite and participle morpheme, the development of the velar spirant in weak verb forms is equated with other developments before [t] represented under (101c). Note that the same suffix can function as a noun derivation morpheme, for example, *draught* (n.) < OE *dragan* (v). Some examples of [x] vocalization with subsequent diphthongization are provided in (103).

[32] In the case of short vowels, diphthongization requires the assignment of a new vocalic slot. This is a common situation found in consonant prevocalization – a phonological process consisting in the development of a vocalic prearticulation by consonants. For a cross-linguistic survey of this process see Operstein (2010).

(103) Vocalization in ME irregular weak verb forms (Bonebrake 1979: 21, Huber 2007b: 169)

	Present	Past	Past Participle
ME	buggen	boht(e)	boht
	buy	*bought*	*bought*
ME	bringen	brought(e)	brought
	bring	*brought*	*brought*
ME	techen	taught(e)	taught
	teach	*taught*	*taught*
ME	thenkan	thoght	thoght
	think	*thought*	*thought*
ME	fehten	foughten	foughten[33]
	fight	*fought*	*fought*

As in (101), the velar fricative in the forms under (103) develops the on-glide [u] by vocalization and is later deleted. This on-glide vowel is still preserved in ModE spelling. Interestingly, the alternative spelling with the labial fricative is also recorded in EModE and in some dialects, for instance, *boft* 'bought,' *brofte* 'brought,' or *þoft* 'thought' (Bonebrake 1979: 49). To conclude, the development of the velar spirant in weak verb forms is identical to the one discussed in (102). In short, the resulting on-glide [u] forms a new diphthong with the preceding vowel. In the subsequent step, the elements of the on-glide and the original vowel get mingled, which results in ModE [ɔː] exemplified by the phonetic realization of the ModE past and past participle forms in (103). Finally, note that the resonance element |U| in velars is responsible for yet another development affecting velar fricatives, that is, labialization. Even though some instances of labialization have already been provided above in (101a), this development deserves more detailed discussion as it instantiates the velar > labial shift.

7.4.2.1 Middle English labialization

Apart from the vocalization processes analyzed in the previous sections, the velar spirant was commonly affected by labialization. Let us start the discussion by providing the relevant examples in (104).

[33] As noted by Bonebrake (1979), the verb *fight* was originally a member of Class III of the strong verbs: *fihten* (inf.) – *faht/fauht* (pret.) – *fuhten/foughten* (part.). In the end, however, it joined the class of weak irregular verbs.

(104) ME labialization (Wełna 1978: 202; Bonebrake 1979: 20)

a.

OE		*ME /x/*		*ModE [f]*	*gloss*
*cohhian	>	cowhen, coughen	>	coff	*cough*
hleahan	>	lahen, laughen	>	laffe	*laugh*
rūh	>	rugh, rough	>	ruff	*rough*
tōh	>	togh, tough	>	tuff	*tough*
genōh	>	enogh, enouh	>	enoff	*enough*
dweorh	>	dwergh, dwarf	>	dwarf	*dwarf*
slūk	>	slugh, slouh	>	slough [slʌf]	*the skin of a snake*
dāg	>	dogh, dah	>	duff	*flour pudding*
clōh	>	clow, clough	>	clough [klʌf]/[klau]	*clough*
troh	>	trogh, trough	>	troffe	*trough*
				[trau]	*baker's pronunciation*

b.

hleohtor	>	lahter	>	laughter
dragan	>	draht, draught	>	draught [dra:ft]

As we can see, the voiceless velar spirant [x] evolves into a voiceless labio-dental fricative [f] in the word-final position in all the forms under (104a).

As with (101), the forms in (104a) are also characterized by the spelling inconsistencies evident throughout ME. For instance, apart from *lahen/laughen* and *trogh/trough*, we also find *low* 'laughed' *lowen* (participle), and *trow/trowes* (pl.).[34] One of the immediate conclusions is that such forms must have undergone diphthongization. The diphthongization stage is further confirmed by the forms with unstable pronunciation, for example, *clough* [klʌf]/[klau], and those which have grown semantically apart and have different phonetic realization, for instance, *slough* [slʌf] 'the skin of a snake' and [slau] 'swamp, bog,' *duff* [dʌf] 'flour pudding' and *dough* [dou] and, finally, *trough* [tro:f] and [trau] 'baker's pronunciation.' Such forms have already been discussed in the previous section. Quite surprisingly, (104b) contains two forms which developed [f] before [t] – a rather unusual development since they are predicted to evolve along the pattern found in (101c) above and result in either a long monophthong or, less commonly, a diphthong. Bonebrake (1979: 37) argues that the reason why they

[34] Bonebrake (1979) points out that the existence of the written forms, such as *lawe* 'laugh' and *lauwe* 'he laughs,' may illustrate the attempts to transcribe a labialized velar. The latter has actually been found in some Scottish dialects, for instance, [lax^{w}], [ljux^{w}] 'laugh' and [rʌx^{w}] 'rough.' Similarly, the labialized velars transcribed as [xf], as in *enough* [inʌfx], have been recorded in Northern English dialects. She argues that all these spelling and transcription variants illustrate the transcribers' and field-workers' attempts to represent a single labial-velar segment.

do not follow the regular development found in stressed syllables before *t* is that both of them are derived forms. Crucially, their development must have reached the already known successive stages, including [aux], [ɔː] and, finally, [af], as confirmed by spelling variants in EModE.[35]

It becomes evident that the forms in (104), (101), and (103) are closely related not only by the fact that they lost the velar fricative but also because the loss of [x] was preceded by rounding diphthongization. Bonebrake (1979: 39) arrives at the same conclusion, saying that "first rounding diphthongization took place which in turn influenced the rounding of the velar fricative." She observes that in ME, the most frequently used spellings of forms containing a word-final or pre-consonantal velar fricative included a diphthong spelt *au* or *ou* or a rounded vowel *o* or *u*, for example, *trough* spelled *trogh*, *trough*. The nonstandard variants also include *trou*, leading to ModE pronunciation among bakers [traʊ]. Similarly, the formation of the second syllable in *dwarf*, namely, *dwerou* or *dwerw*, shows the earlier diphthongization (or gliding). To sum up, during the ME period, the majority of the forms in (104) had two variants: a labial fricative-variant and a diphthong variant. Moreover, it is assumed that basically, the [f] variant followed the diphthong development. In other words, the [x] > [f] shift occurred after the diphthongization or the rounding of the preceding vowel. Since it results in a rounded vowel (predominantly [u]), the diphthongization stage reinforces the idea developed in this study, according to which velars are |U| holders. It is claimed here that the source of this rounding diphthong is the following velar fricative which occurs in a prosodically weak position.

From the above it follows that the presence of the resonance element |U| in velars is responsible for all the developments illustrated in (101), (103), and (104). As for the labialization (104), the [x] > [f] change is interpreted here as the promotion of a dependent |U| to the head position, that is, |A U| > |A $\underline{\text{U}}$|, illustrated in (105).

(105) The [x] > [f] shift

<table>
<tr><td>O</td><td>></td><td>O</td></tr>
<tr><td>│</td><td></td><td>│</td></tr>
<tr><td>|U|</td><td></td><td>|$\underline{\text{U}}$|</td></tr>
<tr><td>|A|</td><td></td><td>|A|</td></tr>
<tr><td>|H|</td><td></td><td>|H|</td></tr>
<tr><td>x</td><td></td><td>f</td></tr>
</table>

[35] *Draught* has been derived from the OE verb *dragan* > ME *drahan*, *drawen* 'draw.' Note that in AmE., the word *draught* is spelled *draft*. It evolved differently from *drought* [draʊt] (101c). For the explanation of the irregular development of *draught*, see Bonebrake (1979: 38).

Note that it does not make any difference here whether labialization is triggered by the preceding rounded vowel or develops directly from the velar, as it must be the presence of the resonant |U| in velars that initiates both alternatives. In other words, it is the velar fricative that stands behind both the diphthongization and labialization, as argued above. The shift itself boils down to a simple operation in which the non-headed |U| of the velar spirant is promoted to the headed |$\underline{\text{U}}$| of the labio-dental fricative [f], as illustrated in (105). Finally, note that the [x] > [f] shift independently confirms the presence of the resonant |A| in the English velar fricative. This is because English labio-dentals are argued to be complex expressions containing both |$\underline{\text{U}}$| and |A| (Backley 2011: 98). Now, the reason why in the vast majority of cases the [x] > [f] shift was preceded by diphthongization is that labialization, which is understood here as a promotion of the non-headed element to the head position, is not a typical lenition mechanism. It follows that in a weak position, the velar spirant first undergoes vocalization resulting in a diphthong or a rounded vowel (a typical reaction of a consonant to a positional plight), and only then is it labialized.[36]

Labialization of velar fricatives in a prosodically weak position is not an isolated case, characteristic of English only. A similar development is reported in some southern dialects of contemporary Polish (see Section 2.1.1 in Chapter Two). In such dialects, the word-final velar fricative of the Standard variety is replaced by the labio-dental fricative [f], for example, *da*[x] ~ *da*[f] 'roof,' *nie*[x] ~ *nie*[f] 'let,' *me*[x] ~ *me*[f] 'moss,' etc. The same shift is also found in the word-initial consonant clusters, as in *t*[x]*órze* ~ *t*[f]*órze* 'coward,pl.,' in which it additionally affects the velar plosive [k], for instance, [k]*to* ~ [f]*to* 'who' and [k]*tóry* ~ [f]*tóry* 'which.' Since in the case at hand the labialization occurs regardless of the quality of the neighboring segments, it must be interpreted as a spontaneous shift, very much like the one represented under (105).[37]

7.4.3 The velarized lateral [ɫ]

As was repeatedly pointed out in the foregoing discussion, liquid vocalization is a cross-linguistically common phenomenon. For instance, in the non-rhotic variety of English, *r* vocalization may result in the weak vowel schwa (Section 2.1.2); the English lateral affected by the same process usually winds up as the back

[36] Since, in principle, lenition produces an expression containing a subset of the elements from the original segment or at least the degradation of the headed element to a non-headed one, English labialization cannot be recognized as a typical weakening process.

[37] Since the presence of |A| in the internal structure of Polish dialectal [x] would require some further study, it is left undecided here.

rounded vowel [u]. Crucially, similar effects of lateral vocalization are scattered around various languages, as evidenced by both their historical developments, for example, in English, Dutch, Medieval French, and Rhaeto-Romance, and active, synchronic changes, as in Slovenian, Serbo-Croatian, Brazilian Portuguese, Mehri, and some dialects of English, Dutch and Catalan (see the discussion in Section 4.3 in Chapter Two). In what follows, we focus on one particular instance of lateral vocalization in the history of English, with a deep conviction that the same explanation we provide below can then be extended to cover other similar cases described in Chapter Two.

The process of lateral vocalization in ME boils down to the development of a transition glide [u] between a back vowel and the velarized lateral [ɫ]. In consequence, a new rounding diphthong arises, while the lateral may be lost. The examples of pre-lateral diphthongization are provided in (106).

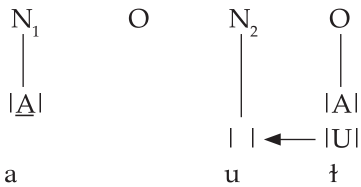
(106) ME diphthongization before [ɫ] (Wełna 1978: 192ff)

a. ME [a] + [ɫ] > LME [au] + [ɫ]		b. ME [o u] + [ɫ] > LME [ɔu] + [ɫ]	
alter > aulter	*altar*	colte > coult	*colt*
malt > mault	*malt*	gold > gowlde	*gold*
falle > faul	*fall*	shuldre > shoulder	*shoulder*
walke > w[auɫk]	*walk*	yolke > y[ɔuɫk]e	*yolk*

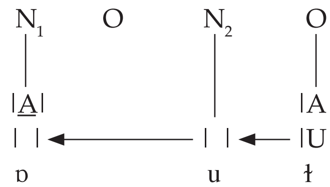
It must be emphasized that the lateral responsible for diphthongization in (106) is velarized, and as such, it contains the resonance element |U|. Moreover, it occurs in a weak position, namely, word-finally and pre-consonantally. Unsurprisingly, then, the lateral undergoes disintegration, and its elements evacuate from the endangered position to a neighboring one. It becomes clear that the glide development in front of the velarized lateral is the result of the spreading of the resonance element |U| to the preceding nuclear slot. Finally, the fact that the prevocalization of [ɫ] does not occur after front vowels is explained here by the repelling character of the elements |U| and |I| in the English vocalic system (see Chapter One).

Furthermore, even though the diphthongization in (106) leads to various MoE reflexes, that is, [ɔː] in (106a) and [əʊ] or [oʊ] in (106b), the mechanism behind these developments is identical. In both cases, it consists in the leftward migration of the resonance element |U| of the velarized lateral [ɫ]. The phonetic interpretation of this element in the preceding syllabic points brings about various modifications, such as vowel raising and lengthening via the intermediate diphthongization stages, which can be schematized as [a] > [au] > [ɒu] > [ɔː]. The second developmental path includes either diphthongization or lowering, with subsequent diphthongization schematized as [o] > [ɔu] > [əʊ] and [u] > [ɔu] > [əʊ] respectively. Middle English liquid vocalization followed by subsequent modifications is illustrated on the example of *malt* > *mault* ‘malt’ in (107).

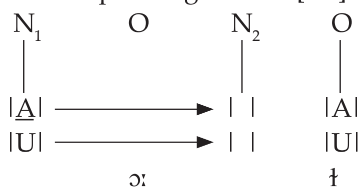
(107) a. diphthongization: [ał] > [auł]



b. raising: [auł] > [ɒuł]



c. monophthongization: [ɒuł] > [ɔːł]



During the initial stage of the change, one of the elements of the velarized lateral gets the interpretation under the preceding nuclear slot (107a).[38] Presumably this is the way a segment gains stability when it occurs in a positional plight. In consequence, a new rounding diphthong arises. In the following step (107b), the element |U|, while still being interpreted under N_2, continues its migration to the left and becomes part of the first vowel containing |A|. The fusion of both elements, that is, |A U|, results in the appearance of the back mid vowel [ɒ]. In the final stage (107c), the element |U| is intercepted by N_1, and the whole expression |A U| gets the interpretation under the consecutive nuclei as a long monophthong [ɔː]. In other words, in a prosodically weak position, the lateral unloads the resonance element |U|, which migrates and docks onto the preceding nuclear position, and then, in some cases, it reaches the initial nucleus, where it fuses with the elemental make-up of the original vowel.

The analysis in this section, brief as it was, clearly shows that the effect of lateral vocalization, that is, the shape of the resulting vowel, and subsequent modifications can be uniformly captured by postulating the resonance element |U| in the melodic make-up of the English velarized lateral.

[38] In the case of short vowels, the incoming |U| must be assigned to a newly formed nuclear point which is incorporated in the representation (see Kijak 2010).

8. Summary and conclusions

This chapter has provided a representative selection of case studies of labial-dorsal interactions in various languages. It has shown that labials, dorsals, velarized consonants, and (back) rounded vowels are related by the presence of the resonance element |U| in their internal structure. These findings contradict the widespread view, particularly prevalent in Element Theory circles, that velars are segments unspecified for any place holder primes. The absolute dominance of velars with secondary labial articulation and labial-velar double articulations as possible complex segments in world languages is explained by the observation that labials and velars share the resonant |U|. Although it plays a different function in both categories, headed |$\underline{\text{U}}$| in labials and non-headed |U| in velars (dorsals), the shared element is responsible for their cross-linguistically common interactions. Moreover, the fact that velars contain a non-headed resonant makes them prone to various changes, including palatalization and different lenition phenomena, like vocalization and gliding. The abundance of diachronic and synchronic processes in which labials shift into velars and velars into labials and the multitude of interactions between velars and labial vowels point to the inescapable conclusion that velars must share the place definer with labials and labial vowels.

The case studies in this chapter, on the one hand, bear out the anti-mainstream proposal concerning the representation of velars and, on the other hand, point to the possibility of enriching their structure with an additional non-headed resonance element in certain systems.

Conclusions

This work has proposed a novel approach to the intrasegmental structure of dorsals based on detailed synchronic, diachronic, intra-linguistic, and cross-linguistic analysis of interactions between labials and dorsals.

The phonological patterning of labials, dorsals, and labial vowels has long been noticed in phonological literature, which contains repeated attempts to account for it in different theoretical frameworks. However, most of these attempts were doomed to failure because of model-imposed limitations. Broadly speaking, the close relationship between labials and dorsals poses a problem for all the theories working with articulatorily based features. Thus, the articulatory distance between both classes of segments constituted a formal problem for both the classical Generative Phonology (Chomsky and Halle 1968) and its successors.

Unfortunately, the problematic nature of the relationship between labials and dorsals has not evaporated together with the evolution of segmental phonology. The phonological patterning of labials and dorsals and the lack of a similar intimacy between, for example, dorsals and coronals make it difficult to explain even in current models adopting privative elements. A theoretical model which stands apart from other competitive frameworks is Element Theory. It opens up new possibilities for the interpretation of apparently unrelated processes which frequently escaped the attention of past researchers grappling with the same problem. Moreover, it is a highly constrained model, which postulates a very small set of purely cognitive primes of segmental structure (neither articulatorily nor acoustically based). These cognitive primes (elements) are used to define both consonants and vowels, and this contributes to the inclusion of new data, which makes the discussion more profound and complete.

The impulse to write this book grew out of dissatisfaction with the previous accounts of labial-dorsal interactions and the desire to understand their uniqueness. For instance, one of the general questions addressed in this study is why dorsals and coronals do not interact on the same scale as do labials and dorsals. To put it differently, why are the alternations [k] > [p] and [p] > [k] much more common cross-linguistically than [k] > [t] or [t] > [k]? What are the phonological properties that labials and dorsals share? None of the previous models of segmental structure, including the early Element Theory, were ready to answer such questions. In the latter approach, the elemental make-up of labials differs radically from that of dorsals (Kaye et al. 1985, 1990; Harris and Lindsey 1995). Labials, together with labial vowels, contain the resonance element |U|. Velars, on the other hand, are proposed either to be represented by a neutral element (Harris and Lindsey 1995), or they are assumed to have empty resonance (Cyran 1997; Huber 2007b). Note that the adoption of the empty resonance solution automatically severs any logical link that would favor labials and dorsals over labials and coronals. Furthermore, the same solution would make us admit that all the phonological phenomena collected and analyzed in this study are nothing more than pure coincidence. This study proves that the explanation of the triangular relationship cannot be sought in the absence of resonance elements in dorsals, as in this situation they could in principle interact with any segments. To say that dorsals can interact with any other segment amounts to saying that the relationship between labials and dorsals is contingent. This is, however, a hasty conclusion which does not find the reflection in linguistic data.

The proposed solution agrees with the Element Theory stance that dorsals are not headed by a resonance element. However, in opposition to the mainstream view, it is claimed here that dorsals do contain resonance elements in the function of operators (dependents). More specifically, it has been argued that what links labials and dorsals is the resonance element |U| which plays a different function in both classes, that is, it is the head in labials but an operator in dorsals. Additionally, in certain systems, the non-headed |U| in dorsals may be accompanied by other resonants, for example, in Old English. The proposed representation stands the test of empirical data from a wide range of languages. It also helps put in a new light the particularly bustling phonological activity of dorsals. The lack of the headed resonant makes them susceptible to both lenition and assimilation phenomena, including palatalization and labialization. The presence of the non-headed |U| commits them to the shifts with labials and to the interactions with labial vowels and glides in the processes of vocalization and gliding. Finally, the present study of the mutual interactions between labials and dorsals opens up a whole new area for both experimental and theoretical research, and the representation of dorsals makes strong predictions relevant to phonological theory, diachronic linguistics, and linguistic variation.

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Artur Kijak

Interakcje między spółgłoskami wargowymi a dorsalnymi w ujęciu fonologicznym

Streszczenie

Głównym celem monografii jest wyjaśnienie bliskich fonologicznych relacji między dwiema artykulacyjnie odległymi klasami: spółgłoskami wargowymi (labialnymi) i grzbietowymi (dorsalnymi). Zaproponowane rozwiązanie sprowadza się do postulowania wspólnego dla tych grup elementu, reprezentującego miejsce artykulacji rzeczonych klas, co pozwala wyjaśnić ich częste interakcje przejawiające się w wielu procesach fonologicznych. Ponadto element ten charakteryzuje grupę samogłosek labialnych i półsamogłoskę [w], tłumacząc w ten sposób ich bliskie pokrewieństwo zarówno ze spółgłoskami labialnymi, jak i dorsalnymi. Zagadnienia poruszane w pracy wpisują ją w szeroki nurt badań nad wewnętrzną strukturą fonologicznych segmentów i wzajemnymi relacjami pomiędzy klasami (fonologia segmentalna), a bardziej szczegółowo, w badania nad właściwościami cech odpowiedzialnych za miejsce artykulacji spółgłosek oraz nad bliskimi relacjami tych ostatnich z samogłoskami. Wartościowym elementem podjętego tematu badań jest niewątpliwie złożoność zagadnienia i bogactwo procesów, w których ujawniają się wzajemne relacje spółgłosek labialnych i dorsalnych. Przykładem może być wokalizacja, epenteza czy dyftongizacja, które to procesy po bliższej analizie mogą przyczynić się do ujawnienia wewnętrznej struktury badanych klas.

Słowa kluczowe: teoria elementów, miejsce artykulacji, spółgłoski labialne, spółgłoski dorsalne

Artur Kijak

Die Interaktionen zwischen labialen und dorsalen Konsonanten nach phonologischer Auffassung

Zusammenfassung

Das Hauptziel der Monografie ist, enge phonologische Beziehungen zwischen den zwei hinsichtlich des Artikulationsmodus entfernten Klassen: labialen und dorsalen Konsonanten auszuführen. Der Verfasser schlägt vor, ein für die beiden Klassen gemeinsames und für den Artikulationsort der Konsonanten repräsentatives Element zu finden, was deren häufige, in vielen phonologischen Prozessen zum Ausdruck kommende Interaktionen zu klären lässt. Das Element charakterisiert überdies die Gruppe der labialen Konsonanten und Halbkonsonanten, indem es deren nahe Verwandtschaft sowohl mit labialen, als auch mit dorsalen Konsonanten rechtfertigt. Die in der Arbeit behandelten Fragestellungen gehören in groß angelegte Forschungen über innere Struktur der phonologischen Segmente und über die Wechselwirkung zwischen den einzelnen Klassen (Segmentphonologie), und genauer in die Forschungen über die Eigenschaften von den für Artikulationsort der Konsonanten verantwortlichen Merkmalen und über nahe Verwandtschaft der letzteren mit den Vokalen. Für große Bedeutung des aufgegriffenen Forschungsthemas sprechen zweifellos die Komplexität des Problems und die Vielfalt von Prozessen, in deren Folge sich die zwischen labialen und dorsalen Konsonanten bestehenden Interaktionen offenbaren. Ein gutes Beispiel dafür sind Prozesse der Vokalisierung, Epenthese oder Diphtongierung, welche nach genauerer Analyse zur Enthüllung der inneren Struktur der hier zu untersuchten Klassen beitragen können.

Schlüsselwörter: Theorie der Elemente, Artikulationsort, labiale Konsonanten, dorsale Konsonanten

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About this book

LABIAL-DORSAL INTERACTIONS

ARTUR KIJAK

Over the past several decades, there has been a huge increase in the number of studies of the consonantal place features. This has brought about the accumulation of a large amount of new evidence and knowledge, and in consequence has contributed to a prevailing view that place features are one of the best studied areas in phonology. What is more, there is little disagreement about the major regions of labial, coronal, dorsal, radical, and laryngeal. However, a closer look at this idyllic picture reveals some cracks, and it turns out that there are still numerous problems calling for explanation. For instance, it has been repeatedly pointed out that even though the major division of consonants into classes is well established, some sounds do not appear to fit neatly into these categories, such as, labio-dentals, which involve both a labial and a coronal component, and some gutturals, which pattern with both dorsals and radicals, not to mention the continuing debate around the nature of the coronal sub-places. One such particular problem will be made the object of investigation in the present study. Specifically, this book seeks to offer an explanation for the phonological patterning of two articulatorily distant consonant classes: labials and dorsals. In this way it contributes to the broader discussion of segmental phonology or, more exactly, to the issue of the consonantal place features. It must be clarified right at the outset that in this study the term dorsal is used to cover velars and uvulars only. Other dorsal consonants, such as radicals (guttural consonants) and laryngeals, are not included in the following discussion, and so they are only briefly mentioned when appropriate.

The deep complexity of the issue is caused by the curiously unique character of the labial-dorsal mutual interactions, in that they involve a radical change in the place of articulation. More frequent sound changes, by contrast, involve a change only in the manner of articulation, for example, [p] > [f], or possibly a change to an adjacent place of articulation, for instance, palatalization. Labial-velar changes also distinguish themselves from other changes because they can take place in both directions. Furthermore, the relationship between labials and dorsals is frequently manifested indirectly via various apparently unrelated processes, such as vocalization, gliding, epenthesis, and diphthongization. It follows that a discussion of the mutual interactions between labials and dorsals must encompass vocalic segments. The inevitability of this move is dictated by the high frequency of the processes in which labial vowels interact with dorsals.