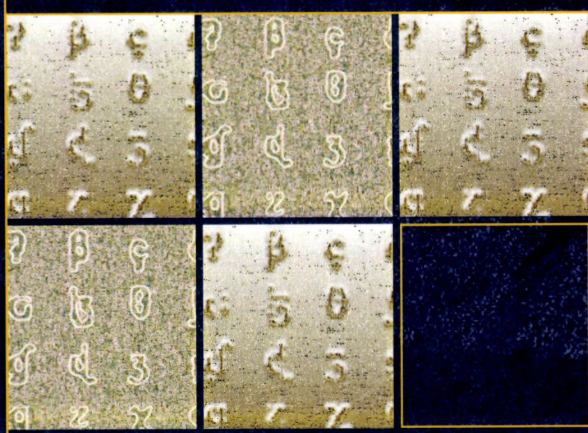
THE TYPOLOGY AND MODELLING OF OBSTRUENT LENITION AND FORTITION PROCESSES



Phonology

András Cser

AKADÉMIAI KIADÓ 1828 BUDAPEST

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0. PRELIMINARY

0.1. Lenitions and fortitions, the typology of phonological systems and the two levels of sound change

The purpose of this work is to establish and empirically motivate the correspondence between obstruent lenition and fortition processes on the one hand, and the typologically supported implicational structure of consonant systems on the other.[1] Lenition and fortition are notions central to most theories and discussions of sound change – and also to general phonological theories that are processual in any sense – and are widely regarded (especially the former) as the most frequent kind of process, or at least one of the most frequent kinds of processes. At the same time trying to understand what exactly is meant by lenition and fortition is usually a highly frustrating endeavour: purported definitions are extremely loose, impressionistic, and rely mostly on batteries of examples as well as on some kind of an intuition of what is meant by "strength" and "weakness". In choosing this topic for research and discussion we were primarily motivated by the sharp contrast between the popularity of these terms and their ill-defined and little understood nature. In this work we are going to define lenition simply as sonority increasing, and fortition as sonority decreasing, change; but as a result of this intentional delimitation, we will be able to make meaningful generalisations and point out certain properties of these processes that have wider implications pertaining to the overall phonological architecture of human languages.

Our investigations will be carried out in the diachronic domain of sound change. The basic assumptions we take more or less for granted and which together make up a frame of reference for the argumentation derive largely from Kiparsky (1995) and Lindblom et al. (1995).[2] In this model sound change proceeds on two levels: a socio-phonetic level and a phonological level. What mediates between these two levels is the variability present in all dimensions of the phonic domain (articulatory, acoustic, geographical, social etc.), which makes linguistic elements abound in competing variants.

Performance gives rise to large numbers of different forms for any segment as long as these forms are made possible by the inherent limitations of articulation and perception. This qualification does not necessarily mean that the phonetic motivation of segment

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[1] My thanks must first of all go to Marianne Bakró-Nagy, the supervisor of my PhD thesis, on which the present volume is based, and Ádám Nádasdy and Sándor Kiss, the referees of the thesis. Several people read the work, made invaluable comments and suggested improvements while it was in progress. It would be impossible to enumerate them all here, but I have to mention Tamás Szende, Péter Szigetvári, Péter Siptár and Miklós Törkenczy as well as an anonymous referee. The writing of the thesis in its original form was supported by a generous grant from the Soros Foundation, the Faludi Ferenc Academy and the Hungarian National Eötvös Scholarship. The publication of the English version was kindly supported by the Research Institute for Linguistics of the Hungarian Academy of Science.

[2] The relevant ideas have gained fairly wide currency by now, and by highlighting two of the best expositions of them we do not wish to do injustice to several other works which we could have mentioned at this point.

variants is always evident. It is more of a generally accepted and in all likelihood well-founded working hypothesis which compels us, when we come across surprising cases, to refer to the limitations of our own actual knowledge or to insufficiency of data etc., rather than to mechanisms of performance that produce these variants independently of, or in contradiction to, the understood phonetic principles of articulation and perception. Nevertheless, we can never be entirely sure that everything that happens on the phonetic level is indeed phonetically motivated. We certainly should not *a priori* exclude the possibility of allophones emerging as a result of processes not accounted for in physiological or acoustic terms. Nevertheless, the fact that one has to look very hard for a process and its opposite *limited to exactly the same phonetic environment* seems to indicate that at least conditioned changes are grounded in the phonetics of the speech process even if not always in an obvious fashion.[3]

In choosing between variants at their disposal, speakers have an important role of a different nature in the process and outcome of sound changes. The choices they make are influenced by various kinds of social patterns and the unconsciously developing attitudes shaped by these patterns as well as by other forces of socialisation. These will be left out of the discussion, since they are strictly sociolinguistic problems. We do not rule out the possibility of systemic (i.e. language-internal) features playing a role in speakers' choices, but we will not attempt to pursue this assumption because we have only found evidence for such systemic aspects becoming important in the final stage of sound change, when a new segment-type is integrated into the phonological system.

The existence of variants does not automatically entail their integration into the system, since most of them will be transient, short-lived or of very limited distribution. The variants of a phonological segment may greatly vary in terms of their stability. Only those variants will ultimately integrate into the system and become basic variants which rise above their functionally equivalent counterparts with respect to the environments that originally gave birth to them (language-internally), and also with respect to their social–geographical distribution (language-externally). In this work we will only be concerned with the first aspect. We agree with Kiparsky (1995) in that integration depends on certain strictly systemic conditions, though we disagree on the nature and the status of these conditions.[4] In our view – and this is the central thesis of this work – such conditions can best be captured as typological constraints.

Thus sound changes proceed on two levels: on the level of phonetic variants and speakers' choices between them, which we may call socio-phonetic level, and on the level of the language system, which we call phonological level. Of the two the second is dependent on the first in the sense that probably no change occurs without prior variability, but changes have entirely different characteristics on the two levels. Phonological integration is channelled (at least in large part) by strictly linguistic, i.e. abstract and systemic constraints. But it is important to understand that these constraints are by no means teleologi-

[3] We will entirely disregard those aspects that bear on the phonetic manifestation but which are not related to the phonic structure of lexical units. Thus we will discuss neither frequency of occurrence nor rate of speech, even though they cannot be regarded as extraneous to language and they crucially influence phonetic variants (and consequently sound changes), see Manczak (1980), Szende (1992).

[4] "Redundant features are likely to be phonologised if the language's phonological representations have a class node to host them" Kiparsky (1995:656).

cal organising principles. Language change is naturally aleatoric, but it has some discernible and definite patterns. The channelling function of the phonological system is *superimposed* on the mass of variants that result from phonetic change in that it licenses or does not license their promotion to a systemic status. From the point of view of the phonological system it is immaterial what comes into being at given points in the speech chain and what articulatory or perceptual repercussions it has. The system only has a say in whether a given variant has a chance of becoming a basic variant or not.

To sum up: we claim that certain systemic constraints operate in the last stage of sound changes, the stage of the integration of a variant into the phonological system, but this does not make the changes teleological. What this means is that there are states of languages – by which, in this work, we mean phonological systems – which seem less stable than other states, and that the difference between more and less stable states seems to be related to the synchronic typology of systems. It is true of other levels of language that certain typological generalisations indeed distinguish stable systems from unstable ones, but certain others do not, therefore their acceptability as diachronic explanatory principles (or synchronic, for that matter) is questionable.[5] In the case of phonological systems, we think typological generalisations that reveal an implicational hierarchy can be more useful: this is what we hope to prove in this book. We are going to look at how obstruent sonority changes (i.e. lenitions and fortitions) are related to, among others, the implicational hierarchy of consonants. The reason why we think this is an important question is that those typological statements which can function as explanatory principles in language change are more likely to capture essential facts about human language than those which only seem to hold in a statistical sense.

The ideas expatiated upon here are related to the important concept of markedness and those phonological theories that revolve around it. However, we will refrain from using the term and will not discuss it in detail because we find it advisable to avoid such a snowball-like concept which, ever since it was introduced into linguistic discourse, has been picking up all kinds of explicit and implicit meanings and unclarified associations. One (but only one) of the uses of the term "markedness" refers to the typological (implicational) status of segments and segment types, and this is the only aspect of segments that we will be concerned with.[6]

Besides the classic discussions of markedness, another work that has influenced our choice of this topic for research was Greenberg (1966). This work distinguishes between more "basic" and "derived" segments (e.g. voiceless and voiced obstruents, respectively) in a typological as well as a diachronic sense. However, in the 1960's no reliable database existed against which to check the validity of statements (so, for instance, the exceptional behaviour of palatals totally escaped Greenberg's attention). Furthermore, he claimed that the appearance of new segments in the system is the result of assimilatory processes, which is, to our mind, an empirically unfounded generalisation.

In the broadest sense the idea that the specific structure of phonological systems may affect the way sound changes proceed comes from the phonology of the Prague School (Trubetskoy 1939, Jakobson 1968 [1941] and 1978 [1931, 1949]). It was developed fur-

[5] Harris–Campbell (1995:195–239) make this point with respect to the diachronic application of the typology of sentence constituent order.

[6] For a useful summary of claims and problems related to markedness, see Lass (1984).

ther and explicated very thoroughly in the trail-blazing work of André Martinet (1955). Since the contents of these works have long been the common treasure of historical linguistics, we do not think we need to dwell on summarising even their major points. From what follows it will be clear that we find implicational dependencies much more important than symmetries and asymmetries in Martinet's sense, though both describe a relation between a segment and the system it is part of. Similarly, our notion of anchored and unanchored segments only superficially resembles Martinet's distinction of integrated and unintegrated segments, though in both cases the underlying idea is that phonological systems have a "licensing" capacity with respect to individual segments or segment types. It is possible that these are equally valid, but independent, dimensions of phonological systems.

In terms of the data from which we drew our conclusions we have relied on two sorts of works, and both need a certain degree of justification. As far as the typology of sound systems is concerned, the obvious choice was Maddieson (1984), a statistically interpreted presentation and analysis of the UCLA Phonological Segment Inventory Database including over three hundred languages. It is by no means impeccable and in certain respects (e.g. geminate consonants) it is notoriously unreliable, but it still remains an extremely useful resource if used with care. Ladefoged and Maddieson (1996) is a comprehensive survey not of systems but of types of sounds based on thorough instrumental phonetic investigation of an even higher number of languages. An extremely well-written book, which one must look very hard to find fault with, it compensates abundantly for many of the shortcomings of Maddieson (1984). We trust that with the help of these two books in the first place we have been able to make generalisations about the typology of sound systems that will be found by and large correct when we will have even more reliable empirical foundations against which to check them.

As for the typology of sound changes rather than of sound systems, the basic question is similar: is our knowledge of them enough to allow for valid generalisations? We can perhaps answer in the positive if we look at a large number of languages but at the same time limit ourselves to those whose history is reliably documented and reconstructed and for which sufficient literature is available so that debated and generally accepted points will be clearly differentiated. As a consequence of this inherent limitation and also of the nature of our own expertise and previous work, the inevitable choice was the Indo-European family along with the Turkic, the Finno-Ugric – and, to a lesser extent, the Dravidian – families. It will perhaps be seen unfair that no languages native to continents other than Eurasia are taken into account, but it is clear that in terms of the reliability of our knowledge (and the availability of sources) of their history, no other family compares with the three mentioned above. Though we were aware that widening the range of languages would make the work perhaps more interesting and the typological conclusions better-founded, we decided not to rely on historical conjectures whose value we cannot, or can only sporadically, judge even to a reasonably limited extent.

0.2. Conditioned and unconditioned sound changes

Here we need to discuss a central taxonomic notion of historical phonology. Ever since the nineteenth century, sound changes have been divided into two major classes. One includes changes that only take place in a certain phonetic environment: these are called conditioned (or context-dependent or combinatory) changes. In the course of these processes, the dispersion of the variants of a segment increases largely as a function of phonetic environment. A conditioned change begins with the destabilisation of the variability of a segment in the sense that the bell-shaped curve representing its dispersion develops into a curve with two peaks. The variants that are drifting away from each other may coexist for a long time after their dispersion ceased to be centripetal. The (new) distribution of the variants may be determined by many factors from syntagmatic phonetic to extralinguistic (Fónagy 1956, Labov 1994, 2001). If the distribution of variants is only determined by extralinguistic factors, the process of drifting is not classified as a conditioned sound change.

Changes in the other class take place with the same result in all environments: these are called unconditioned (or context-free or spontaneous) changes. This category is a theoretical problem for the model outlined above, because this model is based on the assumption that changes emerge as a result of the competition of variants. In the case of conditioned changes there is usually (though not always) a discernible link between the phonetic properties of the environment and those of the outcome of the change. If we posit that the appearance and the drifting away of variants, which may result in sound change in the long run, is a consequence primarily of the phonetic properties of the environment, why should unconditioned changes exist at all? Theoretically it is possible that they do not, at least in the sense that all changes begin in a limited set of environments and are generalised to others only gradually. However, if a change ends up unconditioned, i.e. generalised to all environments in which the given segment originally occurred, we cannot tell what the distribution of variants was prior to the final state, thus it remains a question what phonetic process brought about the variant that ultimately prevailed over the earlier one(s). It seems reasonable to assume in many cases that a change that ended up unconditioned was originally conditioned.[7] Documented changes, e.g. the devoicing of German obstruents in word-final position, often show a gradual extension of environment that lasts for centuries, but similar processes are usually impossible to track at a greater time-depth, in the prehistory of languages. There are two reasons for this.

(i) The environment in which the innovative variant came into being can no longer be distinguished from other environments either because the amount of data at our disposal is insufficient or because the interpretation of the data is obstructed by at present insurmountable difficulties. I will return to this problem below.

(ii) The methodology of historical linguistics and of linguistic reconstruction, like that of any science, allows only for certain kinds of data and allows only for certain ways of drawing conclusions from them. Fónagy (1956) claims that the preoccupation with phonological correspondences, which we inherited from the Neogrammarians, is in fact sometimes an obstacle to discovering otherwise obvious facts.[8] We do not find this particularly worrying, since the standard practice is to consider as many pieces of evidence as is

[7] Such is the case of OE **sk** > **ʃ**, which was probably confined first to the vicinity of palatal vowels, where all velars were palatalised. Nevertheless one must not forget that the same change also took place in German, where velars were not palatalised at all.

[8] A putative example of such an obvious fact would be the etymological correspondence of G *haben* (~ E *have*) and La *habeo* (Fónagy 1956:243). We find the classical correspondences *haben* ~ *capio* and *geben* ~ *habeo* more plausible while, of course, we accept that further explanatory principles may also be valid in etymology, see the masterly presentation of these in Malkiel (1993).

possible and one aspect, however important, cannot normally distort the ultimate results. For instance, when we find two putative cognates that strictly speaking contradict some of the established phonological correspondences, we still accept them as cognates if the rest of the evidence seems to point to their etymological relatedness. What this means for the question whether a change that appears unconditioned in retrospect began as conditioned is that most of the time we are not in a position to decide and thus the wisest choice is probably to take unconditioned changes at face value.

A further problem pertaining to the conditioning of changes is exemplified by the following case. How shall we analyse a common change like this:[9] **k > tʃ / _ i** in these terms? As we have formulated it here and as it is usually formulated, it is obviously a conditioned change in that **k** is replaced by **tʃ** only before **i**. But the phonetic distance between the input and the output warrants breaking down the change into smaller steps: **k > kʲ > c > tʃ / _ i**. In this case, however, the environment only has to be assigned to the very first step (thus **k > kʲ / _ i**), since successively all instances of **kʲ** turned into **c** and all instances of **c** turned into **tʃ**. So only **k > kʲ / _ i** is a conditioned change, all the rest is unconditioned.[10] But is this really a change? Is it not much more likely that this variation has always existed ever since the earliest phases of language in the form of some allophony? Velars have probably always been slightly palatalised before palatal vowels just like adjacent obstruents tend to agree in voicing, but this is better seen as a "persistent rule" rather than as the result of a particular change or set of changes.

We could say that a sound change is conditioned if it involves two segments in complementary distribution of which only one undergoes the change. Thus cases like the palatalisation of **k** would be explained, but we would be stuck with those processes in which two allophones move closer to each other and one is ultimately absorbed in the other (e.g. WGmc **ð > d**). This latter kind of process involves two segments in complementary distribution and results, on the systemic level, in the elimination of an allophony, but we have to regard it as unconditioned, since adding the environment (of **ð**) to the change would be completely superfluous and would result in a formal resemblance between this change and an intervocalic spirantization of **d**, which is phonetically untenable.

It is possible that this whole question belongs to the domain of epistemology rather than linguistics. In the Neogrammarian tradition much of the information that describes phonological systems is encoded in the presentation and discussion of sound changes. Conditioned changes are changes in which there is a phoneme on the left of the arrow but an allophone on its right, whereas unconditioned changes have phonemes on both sides of the arrow.[11] This is unproblematic in itself as long as we are aware of the status of segments and the nature of the changes.

Lack of data and the unrecoverability of the original environment of changes will not

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[9] In the transcriptions we use the IPA symbols throughout the work. In order to avoid having to represent the phonemic or allophonic status of each segment, which would be impossible as well as impracticable in many cases, we use no brackets of any kind; phonetic symbols will simply be in boldface, as is becoming common practice in phonology. When giving data from various languages we normally use the accepted transliteration of the given language. This only refers to words given as examples, never to actual phonological discussions.

[10] This is, for instance, how Hogg (1992) analyses Old English palatalisation.

[11] This is, of course, an oversimplification in that conditioned mergers also have phonemes on both sides of the arrow.

appear problematic in this work because when studying the integration of new segments into the system we need to be concerned not with how a change began but with how it ended. Since the goal of our work is to discover (some of) the conditions on integration, we will regard those changes unconditioned that simply appear as such on the basis of a reliably large set of documented or reconstructed data. By contrast, those changes will be taken to be conditioned whose input changes or remains unchanged in a phonetically characteristic environment.[12] Thus it is immaterial whether an unconditioned change began as conditioned or not even in cases where the original environment can be conjectured with considerable certainty.[13]

0.3. The structure of the work

In Chapter 1 the various definitions of lenition (and fortition) that have so far been proposed in historical linguistics are discussed. Attempts at such definitions tend to revolve either explicitly or implicitly around a couple of focal points, namely the existence of lenition paths or trajectories, the assimilatory nature of lenition, typical environments of such processes and, finally, the reduced or increased amount information carried by lenited and strengthened forms, respectively. It will be shown here that these purported definitions are incoherent and theoretically as well as heuristically of very little use. These two kinds of processes will be identified throughout this work simply as sonority increase (lenition or weakening) and sonority decrease (fortition or strengthening). This will make it possible to formulate certain generalisations with respect to such changes and with respect to their relation to phonological systems.

In Chapter 2 the notion of sonority is discussed in detail, since it is crucial in formulating the central thesis of this work. In order to grasp the sonority scale with as much precision as seems possible, the phonetic correlates of sonority will be discussed, then its phonological models (Government Phonology, Dependency Phonology, the ideas of Clements, Dogil and Luschützky, Rice, Puppel, Basbøll) will be looked at and made the object of theoretical criticism. It is, however, not the purpose of this work to come up with essentially new ideas concerning sonority in itself.

Chapter 3 focuses on the implicational hierarchy of obstruents (and, to a certain degree, of consonants in general), which will be established on the basis of extant typological works, especially Maddieson (1984) and Ladefoged and Maddieson (1996). Many details as well as certain general aspects of such implicational relations have been analysed by others, but as far as we are aware, this work is more comprehensive in its scope than previous ones. This chapter is concluded by a discussion of how sonority relates sychronically to the implicational hierarchy of consonants. It will be seen that, generally speaking, higher sonority involves a lower status in the hierarchy, i.e. lower typological fre-

[12] And this naturally includes what are called negatively conditioned changes, i.e. when a change takes place in the majority of environments and it is the non-triggering environments that can be more easily specified phonetically.

[13] A further argument sometimes adduced in favour of the existence of (ultimately) unconditioned changes is that certain segments totally disappear from given languages after a given period, e.g. **y** and **ø** from English by the Middle English period or **ɨ** (**ɯ**) from Hungarian.

quency as well as a more dependent position in the system. Three classes of exceptions can be identfied at this point: semivowels, laryngeal and palatal consonants.

In Chapter 4 a collection of sonority changes (i.e. lenitions and fortitions) will be presented as culled from roughly a hundred languages. Given the phonetic classes that constitute the classes relevant to the implicational hierarchy, these changes are also transitions between various nodes of the hierarchy. It is on the basis of these changes that the central claim of this work is formulated. It can be summarised as follows: lenitions are overwhelmingly conditioned changes because they turn implicationally more basic sounds into implicationally dependent ones, whereas fortitions can be either conditioned or unconditioned, because their effect is the opposite: they turn implicationally dependent sounds into implicationally more basic ones. Consequently, lenitions can enlarge the phonological system, whereas fortitions can reduce it. Neither is necessary in any case, but we practically never find them in the reverse relation, i.e. lenitions reducing, and fortitions enlarging, the system.

In Chapter 5 a thorough diachronic analysis is given of the obstruent systems of the Germanic languages on the basis of the hypothesis formulated in Chapter 4. The hypothesis is shown to be valid, because (i) the changes occurring in the Germanic languages overwhelmingly do not compromise the implicational patterns of the obstruent systems, and (ii) sonority-increasing changes are nearly always context-dependent, whereas sonority-decreasing changes are partly context-dependent, partly context-free, in many cases the latter. Thus the history of the Germanic languages corroborates the generalisation that is made in Chapter 4 on a typological basis (both synchronically and diachronically).

Finally, in Chapter 6 we turn from diachrony to phonological theory and see how it can accommodate our findings. Drawing largely on the insights of Government Phonology we work out a model of infrasegmental structure from which not only the major diachronic and typological points made in this work emerge naturally, but which also predicts in a simple way many phonological phenomena that have, for the most part, very little to do with the diachronic aspects of the implicational structure of obstruent systems.

1. TREATMENTS OF LENITION AND FORTITION IN HISTORICAL LINGUISTICS

1.0. Introduction

In this chapter we discuss how the notions lenition and its opposite, fortition, are treated in historical linguistics. It is a well-known phenomenon in several sciences that some of the most frequent and widespread processes and entities it tries to describe and analyse are ill-defined, underdetermined in their meaning and scope, and in understanding them more is left to intuition and insight operating inductively on batteries of examples. This seems to be usually the case with lenition, which is acknowledged to be one of the most frequent kinds of sound change, and naturally fortition, its opposite, which is somewhat rarer but by no means unheard of.

It goes without saying that this lack of precision has not prevented linguists from producing outstanding analyses of what are regarded as lenition/fortition processes in individual languages (see Harris-Northall 1990 for Spanish, Russell 1995, Dressler 1972 and Dressler–Hutgard 1980 for Celtic, Oftedal 1985 for both etc.). What will be ventured here is an exposition of those features of lenition/fortition on which their understanding implicitly or explicitly relies in the relevant literature. Some of these traits appear in all discussions of these changes; in certain instances the ones that appear are somewhat confused and undifferentiated (e.g. Hock 1986:80 ff.[1], the headword *weakening* in Bussmann 1996[2]); in certain outstanding books (viz. Lass 1984:177 ff.) many of them are treated thoroughly and distinctly; some simply use one of them as a defining feature (this is the case with all terminological dictionaries that I had access to and here belongs MacMahon

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[1] The first sentences of section 5.2 (Lenition/weakening) are worth quoting in full:

"Among non-linguists, the perhaps most commonly cited cause for sound change is 'laziness'. While this is a dubious explanation for the great variety of changes that are found in the world's languages, it seems to be singularly appropriate for the class of changes which has been termed **weakening** or **lenition**. What the otherwise quite disparate changes covered by these terms share is a 'relaxation' or 'weakening' of articulatory effort, something that has been called 'the lazy-tongue phenomenon'.

This relaxation of effort may take many different forms. The most radical one consists in **loss**... But between the full presence of a segment and its ultimate loss, intermediate stages can often be observed, in which the pronunciation of a segment becomes increasingly relaxed and less distinct from its environment" (emphasis original).

[2] "Phonetically motivated process of sound change that leads to the reduction of sounds and, in extreme cases, to loss of segments; typically this occurs in positions where assimilation is favoured or in syllabically 'weak' positions (e.g. in final position, in unstressed syllables). Two types of weakening are distinguished. (a) Consonant weakening (also lenisization): this denotes a weakening of consonant strength (through a reduction of air pressure and muscle tension or an increase in sonority) to the complete loss of a segment... (b) Vowel weakening: this is a term for all processes that lead to a weakening of the articulatory movements in the sense of an increasing centralization of vowels and finally a total loss of the vowel... Reduction processes occur more often in less 'carefully enunciated' speech styles in informal situations."

It will be clear to the reader how many points are amassed without any order or structure in the two definitions cited.

1994:15–16). Finally, in some of the (older) books, which were standard textbooks in their time, or are now, lenition/fortition do not appear at all (e.g. Sturtevant 1917 and Bynon 1977; the latter does not discuss types of sound change at all).

The "points of crystallization" to be discussed here are the following, in this order: (1) the sequentiality of changes subsumed under the category of weakening (weakening chain/ trajectory/path); (2) apparent interrelatedness of individual synchronic processes triggered in analogous environments, which provides them with a sort of "functional" coherence; (3) preferred environments in which these changes occur and which, in turn, become pivotal for some linguists in defining what is lenition and what is fortition, sometimes in the face of the controversial phonetics of a change; (4) lenition as assimilation to immediate environment and, by implication, fortition as dissimilation; (5) lenition as information loss, fortition as prevention of information loss.

1.1. The weakening chain

As Lass (1984:177) notes, the phonetic connection between the two prototypes of lenition, broadly voicing of voiceless consonants and opening of the vocal tract (e.g. in fricativisation) is far from obvious. However, "the frequency with which the change voiceless → voiced is precursor to opening of stricture argues for an essential similarity; as do the coexistence of [opening-type and voicing-type] changes as exponents of 'the same' process in languages". Here we shall look closely at the first half of this statement, with the second half we will be concerned in 1.2.

It indeed seems to be the case that sound changes which can easily be fitted onto such a lenition chain often follow each other in time in the same language affecting historically identical types, if not tokens, of segments. French is a case in point, where intervocalic voiceless stops run down the whole way to disappearance; other Western Romance languages halt the process at various phases: La *focus* **'fokus** appears in Italian as *fuoco* **fu̯oko** with no change in the stop,[3] *fogo* **foɣu** in Portuguese, *fuego* **fweɣo** in Spanish with voicing and subsequent fricativization, finally, *feu* **fø** in French without any trace of the original stop. Another example is Middle Indo-Aryan, in which every intervocalic voiceless stop gets voiced, then turns into a fricative, which turns into one of the glides, of which the unaspirated ones are eventually deleted, as in Sanskrit *kapha* 'phlegm' > *kabha* > *kaβha* > *kawha* > Prakrit *kaha*. In both cases, where lenition produces a sound that has previously existed in the language, merger results: La *nuda* **nuːda** > Fr *nue* **ny**, La *vita* **wiːta** > Fr *vie* **vi**, with merger already at the stage of the voicing of **t**.

The problems with coherence based on temporal sequentiality in itself are twofold. Firstly, French and MIA are not necessarily typical in that many languages only exhibit small portions of the chain in the course of their documented or reconstructed history. This, however, could theoretically be circumvented by pointing out that if we map all these changes onto one scale, we still get the putative lenition chain. But this in itself is not sufficient as an argument: we still need the phonetic and the environment-based similarity to be able to decide which changes in the individual languages should be considered

[3] Italian has sporadic intervocalic voicing: La *lacus* > It *lago* 'lake'.

at all. Otherwise how would the lenition chain differ from a vowel-chain of the kind **eː** > **æː** > **aː** > **ɔː** > **oː** > **uː**? Sections of this chain are indeed attested in changes undergone by various languages, and at least one has gone through it from beginning to end, viz. English.[4]

Secondly, long-term sequences within a language (e.g. **p** > **b** > **v** > **w** > ∅ in the course of 1500 years or so) are *a priori* difficult to interpret since language (or a segment) never "remembers" where it came from. If **v** turns into **w** in a given period, it does so regardless of whether it comes from previous **p**, **m**, or indeed **w** or **u**. One could argue that chains like the one above are purely accidental and misrepresent the essence of language change: it is not **p** but only **w** that eventually turns into zero. Long-term sequentiality does not exist in human languages.

Hyman (1975:165) suggests that weakness of a segment can be defined with reference to a path towards disappearance, "[A] segment X is said to be weaker than a segment Y if Y goes through an X stage on its way to zero.[5] Strengthening, on the other hand, refers to the reinforcement of a segment". This definition, which implies a lenition trajectory, is clearly comparative in nature. Its drawbacks were pointed out by Bauer (1988), among others, and it suffices for us to consider two of these here. The definition is based on the assumption that we have enough cases of sound changes ending in loss to warrant such a generalisation. To the best of our knowledge, this assumption is unfounded. Even in theory, such a definition could only work if individual changes were mapped onto larger patterns, which is unfeasible for the reason explained above. But (series of) changes that result in the same sound in the long run they started from basically undermine the whole idea (Bauer 1988:386). Consider the following: PIE ***t** > PGmc ***θ** [Grimm's Law] > ***ð** [Verner's Law] > WGmc ***d** > HG **t** [OHG Consonant Shift], cf. La *pa̱ter* ~ G *Va̱ter* (for details see 5.1, 5.5). It has to be acknowledged that a chain of sound changes that affect an etymologically identifiable segment may include weakenings as well as strengthenings, a fact we have no reason to be surprised at, given the essentially aleatoric nature of language change. But in view of this it is impossible to decide which steps in the chain are weakenings and which are strengthenings without reference to their phonetic content, which would again render comparative definitions like Hyman's (or Vennemann's) superfluous. Given the following two chains: **d** > **t** > **θ** > **h** > **∅** and **t** > **d** > **ð** > **∅**, which is a weakening, **d** > **t** or its opposite?

Hyman (1975:166) also suggests that the stronger an element is, the more resistant it will be to weakening, that is, the slope gets steeper and steeper towards zero. This would mean, for example, that the likelihood of **p** turning into **b** is less than that of **b** turning into **β** in identical environments in any language. While this is an attractive hypothesis, it probably needs further empirical confirmation. In fact, counterexamples are not hard to find: Masica (1991:181–2) claims that in Middle Indo-Aryan the propensity of consonants to weaken intervocalically is inversely related to their sonority; in Ossetic, intervocalic stops are voiced, sometimes even fricativised, whereas voiceless fricatives remain unchanged (Thordarsson 1989:464).

[4] For instance, the IE root ***meːn-** (cf. La *mensis* 'month') appears as MoE *moon* **muːn**. For a full history, see any of the standard textbooks on Germanic and the history of English.

[5] In a footnote, Hyman claims to be indebted to Theo Vennemann for this definition. Apart from this, much of what Hyman writes about lenition and fortition draws on Foley (1970).

Hock's (1986:82) contention that any sound in the lenition hierarchy can reach zero without going through the intermediate stages is probably right in that any sound can be deleted on occasion in a given language. We must, however, be careful in distinguishing two different kinds of sound change: loss vs. weakening to zero. Examples for both abound in the world's languages; for the former see Classical Greek $*pep^{h}an{+}\underline{s}t^{h}e > pep^{h}ant^{h}e$ 'you have been shown', French *mett$\underline{r}$e le ballon* **metləbalɔ̃** 'put the ball', Middle Indo-Aryan, in which all two-member word-initial clusters lose a consonant, e.g. Skt *p$\underline{r}$ajvalati* > Prkt *pajjalati* 'ignites' etc. In these cases there is no indication that the disappearing sounds previously went through some phonetic modification. Therefore the question arises how these changes relate to weakening inasmuch as it is defined as movement towards zero. We think the two kinds of changes exhibit different phonetic as well as phonological traits. To take a straightforward example, the loss of French **r** between two consonants and the loss of coda **r** in the non-rhotic dialects of English are not at all the same, since the latter is evidenced to have happened through an intermediate approximant phase, whereas the same is not true for French (or for MIA, for that matter). If sound loss is not distinguished strictly from lenition, this category will be so large as to lack any explanatory power.

The idea that lenition and sound loss should be considered as related processes is probably based on the finding that sound change is overwhelmingly reductive in nature. It is an important generalisation that phonetic changes much more often reduce segment sequences and the phonic substance of words than enlarge it. It is possible that this follows from some deeper diachronic principle and does not only pertain to the level of sounds: one may consider another well-known fact, viz. that changes in the function of grammatical elements usually result in their degradation in terms of structural autonomy and may involve their eventual syntagmatic integration into other word forms (e.g. noun > postposition > clitic > suffix). According to a highly general and widely attested pattern the phonetic "body" of words undergoes continuous attrition which is counterbalanced – if at all – by the attraction and incorporation (not in the technical morphological sense) of other morphosyntactic elements, which function as derivational suffixes for a while but then become opaque and the polymorphemic word becomes monomorphemic without perhaps losing any segmental content at that particular stage.

It is crucial at this point what is meant by reduction. Sound loss can obviously be regarded as a reductive process in a pre-theoretical sense, but lenition is much more ambiguous. In what sense is a fricative "less" than a stop, a voiced segment "less" than a voiceless (or vice versa)? We will not take sides in this matter right now, but wish to indicate that it is not at all to be taken for granted that loss and lenition are similar (let alone the same) processes. If both are first studied independently, then one may ask how they relate to each other, but without a prior conceptual and analytic separation even the question makes no sense.[6] But this problem will not be pursued in this work.[7]

[6] This question, as we see it, is similar to the relation of subject and agent. If subject is defined as the agent in the sentence, the relation between them cannot be clarified precisely because they are taken to be the same thing. However, if subject is defined in syntactic, and agent in semantic terms, and if they are studied independently, then the principles underlying their relationship can be studied.

[7] Mowrey–Pagliuca (1995) is an important and interesting work on the reductive nature of sound change. In it they claim that the common denominator of lenition and disappearance is the reduction of neuro-muscular activity: "Our conceptualisation of reduction processes crucially depends on choosing a level at which

1.2. The functional unity of the synchronic reflexes of lenition

The standard example for the second kind of coherence-factor (different changes subsumed under the concept of lenition as exponents of "the same" process in a language) is the set of (Proto-) Celtic lenitions (more frequently called mutations, especially with reference to the synchronic alternations they introduced). Let us take Modern Welsh as an example:[8]

Basic	**k**	**g**	**t**	**d**	**p**	**b**	**m**
Lenited	**g**		**d**	**ð**	**b**	**v**	**v**
Spirantised	**χ**		**θ**		**f**		
Nasalised	**ŋh**	**ŋ**	**nh**	**n**	**mh**	**m**	

These alternations in Welsh as well as the other Modern Celtic languages are only grammatically and/or lexically conditioned (e.g. feminine nouns trigger lenition, as in *da* 'good' → *merch dda* **ða** 'good girl') and constitute intricate patterns whose details need not concern us here. But the question why these count as "the same" on the whole must be asked, since much hinges on it. The first problem is that there is a possibility of confusing the synchronic and the diachronic aspect of the question: the way Lass presents it ("the coexistence of [opening]-type and [voicing]-type changes as exponents of 'the same' process in languages... argues for an essential similarity", see 1.1) seems to leave room for misunderstanding on the reader's part, though certainly represents none on his own. Furthermore, as an argument, it is irrelevant for the following reason.

It is a well-known fact that Celtic consonants underwent extensive voicing and fricativisation in intervocalic or intersonorant position in the early Middle Ages, which resulted in a widespread pattern of alternations in the individual languages. These alternations were later morphologised or lexicalised due to interference with further sound changes, such as apocope. Thus in a synchronic grammar of a Celtic language the lenition rules will make reference mainly to morphological or lexical information. This indeed endows these rules with a non-phonetic "sameness" but, historically speaking, it obscures the fact that diachronically the only element common to them was that they happened roughly at the same time and in the same phonetic environments and they all resulted in growing sonority. The question of environments turns out to be important at this point; it will concern us in the following two sections.

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reduction is potentially measurable across the entire range of articulatory activity. Common consonantal lenition patterns... are *not* consistently characterizable as reductions in terms of either vocal tract shape or spatially-defined gestures, or on the acoustic level" (57., emphasis original); "We have chosen neuro-muscular events over spatially-defined gestures as our independently controllable primitives not only because of the derived nature of the latter... but also because the longer-term continuity of reductive changes is describable in neuro-muscular terms but not on the gestural level of description" (57.). At the same time they acknowledge that the "[i]nvestigation of neuro-muscular activity in speech is still in its infancy and therefore many of the claims we put forward here will rely on purely theoretical argumentation coupled with reasonable interpretations of the articulatory factors underlying the processes we will examine (65.)." The actual analyses they put forward are quite questionable: they claim, for instance, that the change **ɸ > f** is a weakening because exactly one muscle ceases to function in the articulation.

[8] Here based on Russell (1995:233). The author there does not include the pairs **l̥ – l** and **r̥ – r**, which alternate in a similar but more restricted set of environments. Dressler (1972) and Dressler–Hutgard (1980) are further useful works on Celtic lenitions.

1.3. Environments

As for the positions which favour lenition or fortition, everyone concurs that intervocalic position is conducive to the former; hence the idea that at least intervocalic weakening, of which we have already given several examples, is assimilatory in nature (see 1.4). Another point on which there seems to be agreement is that consonants in unstressed syllables more often undergo lenition than those in stressed ones; see English *mess* **mes** but *messes* **ˈmesɪz**, with the second form showing lenition (dating from late Middle English) at the end of the unstressed syllable (but not intervocalically!): word-final sibilants in English only become voiced if they are in the coda of an unstressed syllable. It is also commonly assumed that pretonic position is more of a strengthening (or at least non-weakening) site and post-tonic position is typically a weakening site. Verner's Law, among others, contradicts this, because in that change intersonorant and final fricatives were all voiced except in immediate post-tonic position, i.e. the strong position that prevented weakening was not pre- but post-tonic.[9]

Further suggestions and generalizations are: lenition is typical of intervocalic, word-final and syllable-final positions, and this is what constitutes the "formal evidence" of the unity of such changes "[b]eyond the perhaps overly impressionistic notion of 'relaxation of effort'" (Hock 1986: 83–84).[10] Hyman (1975:168) gives the same environments for lenitions, but he is at odds with word-final devoicing; he circumvents the problem by suggesting that since word-final devoicing is *ex hypothesi* not strengthening but weakening, strength of elements must depend on their position, e.g. a voiceless obstruent is stronger than a voiced obstruent intervocalically, but weaker finally – an explanation which runs the risk of circularity.[11] He adds that fortition is typical of word-initial and post-consonantal (by implication, onset) position. Lass (1984:181–2) argues that both syllable-initial and intervocalic are weakening contexts, but an adjacent consonant protects another consonant from lenition. This latter claim explains why geminates fail to undergo weakening where single consonants do so, it also explains examples like the failure of fricativisation after obstruents in Grimm's Law,[12] but it (more interestingly) counterpredicts

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[9] Examples are given in 5.1, where the law is discussed in detail.

[10] But note that Hock regards word-final devoicing as strengthening as well as assimilation (p. 80). An example of coda weakening is **k** > **x** > **j** / _ {**t**, **s**} in Gallo-Roman, e.g. La *tractare* > Fr *traiter* [trete] 'to treat'.

[11] The problem is not that the strength of a segment taken in a given sense could not possibly depend on its position in the chain, see for instance Ní Chasaide (1989) for a discussion of this point. The problem is that Hyman attempts to define weakening phonetically, then assign typical environments to it, and where the two are in conflict, he has recourse to the idea of position-dependent strength. It is, of course, true that a voiced stop is more prominent perceptually than its voiceless counterpart in utterance-final position, whereas the opposite holds intervocalically. The reason for this is that in this way they differ more from their immediate environment.

A similar kind of confusion can be traced in Lavoie (2001:7), though not in a diachronic context: "Coda position often licenses fewer contrasts than other positions… and word-final alternations could be described as the loss of features, such as voicing, that are marked in that position. Although final devoicing is often called lenition, I argue that it represents coda neutralization and is not properly considered lenition… Including final position in weakening leads to the undesirable conclusion that both voicing and devoicing are lenition. If so, the phenomenon lacks a general directional tendency. This is problematic because it is the general directional tendencies that have held together the diverse group of alternations." To our mind, this passage also represents what we regard as the confusion of the taxonomic and the explanatory function of scientific constructs, see 1.4.

[12] See the labial obstruent in La *pater* – E *father* and in La *spuo* – E *spew*, not ***sfew*. For details, see 5.1.

coda weakening: the example is the weakening of Pre-Classical Greek **s** which happens intervocalically and word-initially, but not before other obstruents: IE ***wi:sos** > Gr **i:os** 'poison', ***septm̥** > **hepta** 'seven', but ***esti** remains **esti** 'is'.[13] Kiparsky (1988:381) uses the cover term "prosodically weak positions" for unstressed syllable and codas as typical environments for lenition (see 1.5).

Escure (1977) sets up a full hierarchy of positions which favour lenition and, inversely, fortition and attributes to it the power to predict that if lenition occurs at any point in the hierarchy, it will also occur in every environment above that point, and if fortition occurs at any point in the hierarchy, it will also occur in every environment below that point. The full hierarchy is set out in Escure (1977:58); for our present purposes it suffices to know that preconsonantal and prepausal position is at the top, intervocalic position with or without intervening boundaries follows and post-pausal prevocalic is at the bottom. This would predict that intervocalic lenition implies coda lenition and initial lenition implies both; conversely, intervocalic fortition implies initial fortition and coda fortition implies both. These implications, as has been pointed out by, among others, Bauer (1988), do not stand up to empirical evidence: there are languages where devoicing takes place word-finally or in every coda, but nowhere else (e.g. Russian and German, respectively). Further counterexamples are furnished by Greek (see the behaviour of **s** above), or Old English, in which fricatives are voiced in intersonorant position, but not in coda, and are usually devoiced word-finally.[14] Modern English flapping also takes place intervocalically, but not syllable- or word-finally.

Harris-Northall (1990) combines the two hypotheses in discussing lenition in Spanish. Like Escure, he sets up a detailed hierarchy of environments in terms of how conducive they are to lenition and, like Hyman, regards both intervocalic voicing and word-final devoicing as lenition.

In Lass (1984: 164 ff.) we find the following interesting passage on the relation of lenition and environments:

> "[A]ny less than maximally weak segment in a weakening environment will have a tendency to alter the type of weakening, i.e. to prevent descent down either the opening or the sonorisation scale from going as far as it would under 'ideal' conditions. And this suggests that we have to define 'strength' not only in absolute (resistance to airflow) terms, but in terms of power to induce assimilation: so that in this case, for instance, nasals are weaker than vowels in ability to induce lenition, and stronger than vowels in ability to prevent it. So that we might want to set up two inverse scales, one of strength per se, i.e. resistance to lenition, and one of sonorancy, i.e., power to induce lenition."

There appear three important concepts here, which are, to our mind, not sufficiently distinguished from each other: (i) weakening (in Lass' terms, i.e. voicing and/or the opening of the vocal tract), (ii) assimilation and (iii) the capacity to weaken adjacent segments,

[13] Lass does not say that every coda is a protective environment, though it would explain the retention of word-final **s** in Greek, see **i:os**, which he does not mention at all.

[14] Details are given in 5.4.1–2, where we discuss the Old English obstruents.

i.e. to function as environment triggering weakening. It is not at all clear that there should necessarily be any kind of interdependence between them.

Empirical problems arise here, for instance, with nasals. What shall we do when, as in Middle Greek, nasals voice adjacent stops, but vowels and liquids do not (ClGr **pente** > MGr **pende**, but **ommation** > **mati** 'eye')? Nasals are also often more resistant to weakening environments than stops or fricatives. We do not find that the scalar classification of the propensity to (not) undergo and to trigger weakening is particularly helpful, and neither is the assumption that the two scales are identical (or inverse, which is the same).

We can see that the relevance attributed to preferred environments in *defining* what is and what is not a lenition or a fortition has serious consequences. If one assumes that weakening does not happen in codas, one has to systematically dismiss cases like Greek **p** > **f** and **k** > **x** / _ **t** or the similar French example above as dissimilations rather than lenitions. If one assumes that everything that happens word-finally is weakening, then both English voicing and devoicing changes will be weakenings. By contrast, if these processes are first defined in a context-independent fashion, empirical generalisations concerning environments will be much more meaningful and have a greater chance of standing up to scrutiny. Nevertheless, one should not be too optimistic about this approach either. As will be exemplified in Chapter 4, two closely related dialect groups of Italian, which have essentially identical segment inventories and phonotactic rules, display weakening vs. strengthening of the same segment (**d**) in the same environment. To illustrate these changes we anticipate 4.2.1.3 and 4.1.2.2 here:

(1) Southern Italian dialects {**b d g**} > {**v ð ɣ**} / V _ V and # _(**r**)V
ex: La *bene* > *vene* 'well, OK', *pedem* > *peðe* 'foot', *decem* > *ðece* 'ten'[15]
(2) Lazio dialect of Italian **d** > **t** / V _ V and # _ V
ex: La *pedem* > *pete* 'foot', (*illa*) *dies* > *la ti* 'the day', *decem* > *tieši* 'ten'[16]

Let us take another Italian case. In the Tuscan dialect, original V**br**V sequences regularly result in V**bbr**V: La *febris* > *febbre* 'fever', *februarius* > *febbraio* 'February'. In the northern dialects, by contrast, one finds corresponding V**vr**V : Milanese *fever*, Lombard *fevre*. Thus precisely the same environment yields **b** > **bb** vs. **b** > **v** in two closely related dialects again. The latter change is generally held to be weakening, the former may be considered strengthening (as is traditional), but definitely not the opposite. We hope these two examples will make it clear how careful one must be in formulating generalisations about the environments of lenition and fortition.

[15] Rohlfs (1966:194–6, 203–9).
[16] Rohlfs (1966:203–6).

1.4. Lenition and assimilation

Most of those who take sides in the question affirm that at least certain instances of lenition are essentially assimilatory processes.[17] This is quite understandable if one considers that the most typical position for lenition is intervocalic or intersonorant; and both voicing and opening of the vocal tract can easily be conceived of as assimilation of consonants to vowels, the most sonorous sounds of all. Kiparsky (1988:381) makes the attractively general claim that "[w]eakening processes result from loss of feature specifications associated with a segment with or without concomitant spread of marked feature specifications from a neighboring segment". The *with* cases would cover traditional examples of assimilation, the *without* cases would cover examples like the glottal replacement of coda **t** in English (as in *that man* **ðæʔ mæn**), where the whole of place specification is lost and it does not spread to what remains from any of the adjacent segments.[18]

As Kohler (1984) says, intervocalic obstruents tend to be reduced in fast speech because the articulators, due to their inertia, cannot cover the whole trajectory necessary to articulate them,[19] but this is because "the energy expenditure generally drops from the beginning to the end of a syllable" – thus the intervocalic consonant at the beginning of the next syllable has less articulatory energy left to it, unless that syllable is stressed –, not because of the vowels themselves. This practically results in a sound that is more like the vowels that flank it, but the process itself is induced by different factors, so cannot be regarded as genuine assimilation.

Another argument against interpreting intrevocalic lenition as assimilation is that if a vowel assimilates a consonant to itself (as it does in the case of palatalization), one is enough to perpetrate the change. This implies that if vowels caused lenition, they could cause it in any consonant adjacent to them, whether it be word-initial, word-final, or part of an intervocalic cluster.[20] It may well be argued that in these cases other forces override the assimilatory power of vowels (e.g. restrictions on syllable structure). In that case, however, assimilation to vowels in strength will be confined to intervocalic position (unless one claims that coda weakenings of the type **akta** > **axta** are caused by the vowel – an interpretation that seems warranted in Hebrew, for instance) and we have again no way to decide whether intervocalic weakening really is a case of assimilation. Finally, lenitions like the voicing of stops in post-nasal, but not intervocalic, position in Middle Greek (see 1.3), will always be cited as counterevidence to the hypothesis. Or are nasals more voiced than vowels?[21]

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[17] See Lass (1984: 174, 182). In Malmkjaer (1991), sonorization (= voicing; no mention is made of lenition in general) is simply defined as a subcase of assimilation. The heading (*Historical linguistics*) was written by James M. Anderson. The same is found in the typology of Natural Phonology, for references see 1.5. Harris-Northall (1990:127) says: "we defined voicing as a weakening process for intervocalic voiceless stops... while the weakening of word-final stops included devoicing, at least in Old Spanish. This will cease to be a paradox when we realize that 'weakening' in many cases... is characterized by the tendency of the segment to undergo assimilation to (one of) its neighbours."

[18] Though it may, in which case the result will be **ðæp mæn**.

[19] This is suggested by others as well, e.g. Ní Chasaide (1989)

[20] *Pace* Lass, who claims (1984:182) that two vowels are "more sonorous" than one.

[21] In principle it can be argued that they are. There are three ways of regarding a segment more voiced than another: phonologically in terms of redundant vs. contrastive voice, or inertia with respect to processes, phonetically in terms of a propensity to devoice. To our knowledge no convincing case has so far been made for nasals being more voiced than vowels.

Some claim that word-final devoicing (originating in utterance-final position) is assimilation to the utterance-final pause. This arguably has a phonetic basis (Kohler 1984), and contradicts the generalization that lenition is assimilation but fortition is dissimilation.

Hock (1986:84) says (having acknowledged that intervocalic voicing can be interpreted as assimilation): "[T]he argument can easily be reversed. For assimilation can be considered as a special type of weakening, in which the distinctly different articulatory gestures required to articulate phonetically different segments are made less distinctly. Given that weakening tends to be restricted to medial and final environment, while assimilation is not so restricted, it is perhaps best to treat the two phenomena as related, but different processes." As for his first statement, this excludes a phonetic definition of lenition/fortition, since both **b** > **p** and **p** > **b** could be interpreted as weakenings if they resulted from assimilation to another obstruent: **bt** > **pt** and **pd** > **bd**, respectively. As for the second statement, its logic can be reversed *if* one accepts that lenition is assimilation, since assimilation is also bound to environments, namely those environments that trigger it (a following or preceding obstruent for voicing agreement, a following palatal vowel for palatalization etc.).

It is no accident that examples of the kind just given (**bt** > **pt** and **pd** > **bd**) are not found in the literature on lenition and fortition: this is a sign of the confusion of the taxonomic and the explanatory function of the concept. Though many take it for granted that lenition involves voicing and assimilation, they would not include changes like **pd** > **bd** probably because it can be naturally classified with a different, highly general category, the universal voicing assimilation of adjacent obstruents. The concept of lenition becomes unnecessary here in its taxonomic function, so no use is made of its explanatory function – an illogical leap.

The issue here is a rather far-reaching one: the conditioning of lenition and fortition. Conditioning of sound changes in general can be segmental (as in the case of palatalization), one may include distant assimilation and dissimilation here as well as changes where the phonetic connection between the environment and the resulting segment is not so straightforward; or prosodic: conditioned by stress or syllable structure. Theoretically one cannot exclude lenitions and fortitions being conditioned either way, but drawing a precise picture presupposes a more extensive corpus of data and a well-founded delimitation of what are genuine examples of these processes. Nevertheless, as a starting point and a null-hypothesis it is advisable not to regard either lenitions as a subset of assimilatory processes or vice versa.[22]

1.5. Lenition and information content

The idea that lenition and fortition affect the extent to which sounds contribute to the information content of words is articulated prominently in Natural Phonology. The comprehensive expositions of the views relevant here are Donegan–Stampe (1979) and Dressler (1984). Here we find the classification of all phonological processes and, by implication,

[22] As we would not wish to claim that compensatory lengthening and total assimilation are the same, despite their convincingly demonstrated formal identity.

sound changes into three categories (taken over, for example, by Kiparsky 1988): prosodic processes, which affect rhythm and intonation (syllable structure is not included here), fortitions (dissimilation, diphthongisation, syllabification of glides and epenthesis) and lenitions (assimilation, monophthongisation, desyllabification, reduction and deletion). Fortitions "intensify the salient features of individual segments and/or their contrast with adjacent segments"; they have a perceptual teleology, may be context-free but are usually favoured in "strong positions", i.e. consonants in onset, vowels in syllable-peak,[23] especially in positions of greater prosodic prominence and duration. Lenitions, in contrast, only have an articulatory teleology, namely, to make things easier to pronounce by assimilating sounds to their environments, are usually context- and/or prosody-sensitive, and are typical of "weak positions": syllable-final consonants, short and unstressed vowels are likely to be weakened.

As we have already seen, sweeping generalisations are not particularly helpful in discussing notions like lenition and fortition. We suspect that those made by Natural Phonology also do not point in the right direction, not least because they dangerously simplify the problematic relation between lenition/fortition and assimilation/dissimilation. It is clear that information reduction (i.e. the disappearance or narrowing of significant distinctions between words) may be connected to lenitions, but in reality only when the lenitions involve the neutralisation of phonemic contrasts. This happened both in Romance and in Middle Indo-Aryan (see 1.1), but not because of the lenitions *per se*, but because the lenitions resulted in fusions, which can, in other cases, be the consequence of fortition too.[24] Or what shall we say about the roughly simultaneous Greek sound changes **wt** > **ft** and **pt** > **ft**, which lead to partial fusion, but the first is strengthening and assimilation, the other weakening and dissimilation? Sound changes that do not fit the simple model of Natural Phonology are not at all hard to find. In Uyghur (Johanson 1991b) voiced and voiceless stops merge, but their distinctions are taken over by (not necessarily adjacent) vowels. The same is true of those South East Asian languages in which voiced and voiceless stops also merge but the tone of the entire word diverges as a function of their (previous) quality. Thus systematic fusion takes place on the segmental level, but no homophony results.

The other possible interpretation of the relation between lenition and information content treats the concept of information not in the sense of distinctiveness but as an aspect of the acoustic structure of segments. This will be further explored when we discuss the phonetics of sonority (2.2). All we wish to say at this point is that there are, indeed, great differences in the perceptibility of segments depending on their phonetic context. Lenition can theoretically be defined as a change in a phonetic chain whereby the perceptual salience of its segments is compromised. On such an interpretation this would be the characteristic common trait of lenitions, and not some categorial feature, but we are not at all sure that the putative generalisations discussed so far would hold of such processes.

[23] The qualification is probably made to exclude glides. But then why is the syllabification of a glide a case of fortition?

[24] The emergence of Italian **dʒ** is a case in point, because it results both from the palatalisation of velar stops and the strengthening of **j** (**ge** > **dʒe** as well as **ja** > **dʒa**).

1.6. Summary

This survey of the relevant literature shows, we hope, that the most popular sound change, lenition, and its counterpart, fortition, lack reliable definitions. It is not clear what the common features of processes so categorised are, which jeopardises the legitimacy of these categories themselves. If one refers to too many criteria (like Hock above), it becomes impossible to say in any given case which particular points are decisive just then and why. Not even the (meta)theoretical status of the notions cited is made clear: as we have shown (1.4), their taxonomic and explanatory functions are not sufficiently differentiated.

The idea of the lenition chain or hierarchy is empirically unsupported and unacceptable theoretically too, because it presumes long-term processes in language history. Synchronic alternations involving lenition always go back to sound changes which affected a given class of segments in the same way in the same environment, so synchronic phenomena cannot serve as a basis for the definition of diachronic phonological ones. There is also not much that one can say on the typical environments of lenition and fortition without first giving them context-free definitions – or we define them with reference to the environment, in which case their phonetic properties will become secondary. This would be an interesting line of research in itself (e.g. what tends to happen to sounds word-initially, word-finally etc.), but it is not one we wish to pursue in this book. We are also not sure the generalisations resulting from such research would coincide in any significant way with the traditional classes of lenition and fortition. The correspondence between these changes and assimilation and dissimilation, respectively, is also frequently presented as obvious, but we find that it is probably much more fruitful to investigate the two types of processes independently precisely in order that we will be able to formulate real generalisations (which, however, is again beyond the scope of this work). Finally, we also do not find that lenition and fortition on the one hand, and information content on the other, are significantly related.

Consequently, in order to avoid conceptual confusion and practical problems of classification, we rely only on the relative sonority of the input and the output of a change in defining lenition and fortition. Sonority-increasing changes belong to the former, sonority-decreasing changes to the latter. What follows from this is that the sequentiality of such (or other) changes is simply irrelevant, furthermore, we will be able to make claims about the environments of such changes *because* we define them irrespective of the environment.[25] The same is true of assimilations, which are clearly not a subclass of lenition (nor vice versa). According to our working definition, assimilations and dissimilations that increase sonority are lenitions (**pd** > **bd**, **ben** > **men**, **mn** > **mr**), the ones that decrease it are fortitions (**bt** > **pt**), but this will hardly have any consequences. Most such changes (such as contact voice assimilation of obstruents) will not be discussed here simply because the properties of these would not add anything to the claims we will put forward regarding the typological aspects of lenition and fortition. They are thus excluded

[25] To anticipate the only real (and unsurprising) generalisation that we have arrived at with respect to environments, changes that are confined to intervocalic position are always sonority-increasing. We have not found any further significant tendencies. Word-finally, for instance, devoicing is cross-linguistically frequent, but other forms of fortition are not. For detailed discussion the reader is referred to 4.7.3.

not on the basis of definitions or principles, only for practical considerations.[26] We actually do not think the question whether increase or decrease of sonority is assimilation or dissimilation (in any combination) is a phonologically or diachronically interesting one. The typology of assimilations and dissimilations is certainly a field worth exploring, but it has to be explored *before* one relates these to other kinds of changes. This question we leave at that, and turn now to the concept of sonority.

[26] This, in itself, is not a very original idea. As we have seen, the exclusion of such changes is usually a practical necessity, given the lack of viable definitions and criteria. In the case of contact voice assimilation of obstruents, one may of course exclude it on the basis that it is not a real change, but a universal phonotactic restriction, a "persistent rule".

2. SONORITY

2.0. Introductory

Sonority is one of those central notions of phonological theory that are inevitably referred to in the analysis and discussion of various problems but are, at the same time, basically hardly defined, with an unknown basis somewhere in the vocalisation makeup or the phonological design of natural language. The purpose of this chapter is to survey first its functions (2.1), which are perhaps the most obvious aspect, then its phonetics (2.2) and finally the phonological models of sonority (2.3) that have been proposed and to evaluate them without, of course, pretending to be able to give decisive judgements.

The common core of different sonority scales as given in the literature looks as follows:

(3) *The sonority scale*

vowels ↑
glides
liquids
nasals
fricatives
stops

Some of the problematic points pertaining to the scale are:

(i) It is not evident whether, among obstruents, voicing or stricture is more relevant, more precisely: how do voiced stops and voiceless fricatives relate to each other? The reason why this question has not been perceived as worrying is that within the range of phenomena that involve sonority, these two classes of obstruents never need to be compared. For instance, they are basically never adjacent in any word or morpheme, which makes it unnecessary to compare directly their position in the syllable structure. They also do not turn into each other immediately in the course of sound change, hence there is no need to ask whether such a change would be weakening or strengthening. Phonetically, though, fricatives must be designated as generally more sonorous, because they involve more acoustic energy. The accommodation of affricates into the scale is also an unresolved problem.

Phonologically, the relation between stops and fricatives is rather controversial in general. Phonotactic patterns do not point in the expected direction. Many languages, like English, have **sp, st, sk**-type initial clusters while do not have its mirror image. Greek has both **sp, st, sk** and **ps, ks** as initial clusters, and it also has stop+sonorant, but no fricative+sonorant in the same position etc.

(ii) Since the sonority scale was worked out mainly on the basis of European languages, it is not clear where voicing values other than voicelessness and modal voice should be ranked (i.e. breathy voice, creaky voice).

(iii) Liquids are a problematic class in themselves in that the phonetic properties underlying their unity are by no means as evident as in the case of stops, fricatives or nasals (Ladefoged–Maddieson 1996:182). Phonetic works often ignore such a class (e.g. Laver 1994, Kassai 1994). From the point of view of sonority, however, this again has not been seen as a problem, given that their behaviour is phonologically, especially phonotactically, highly uniform in many languages. In fact, the class of liquids is the class of consonants that has been identified on a phonological, rather than phonetic, basis in the tradition of taxonomic phonetics – primarily their phonotactic properties. Yet it does not follow from this that their representation is generally unproblematic in phonological theory. It is because of this, as will be seen, that e.g. Rice (1992) is unable to locate trills in the sonority hierarchy.

(iv) Some subclassify vowels and establish a rank within their class in such a way that open vowels are more sonorous than close ones. This can be argued for on an experimental phonetic basis (Szende 1995:92, for instance, gives a chart of the comparative intensity values of Hungarian vowels). In phonology, Harris (1994:56), for one, assigns close vowels to the same class as glides.

(v) Purely laryngeal elements (the most frequent being **h ɦ ʔ**) often defy classification in terms of sonority since they behave sometimes as fricatives, sometimes as approximants, sometimes as vowels.

2.1. Sonority-related phenomena

2.1.1. The syllable

2.1.1.1. The internal structure of the syllable

The idea that sonority plays a crucial role in defining possible and impossible syllables goes back to the 1860s (Laziczius 1963:147–150). Although a wide array of linguistic data shows rather inconsistent patterns of syllable structure and the definitions of sonority vary according to authors and theories, its central function in syllable structure is not a matter of debate because the hierarchy itself, at least in its crude form, is a common core of all discussions of sonority. Syllable structure as such will not be discussed in this paper so we will not delve into its particular problems. Most generally, the sonority contour of a syllable is subject to the following principle:

(4) *Sonority Contour Principle*

> The nucleus of the syllable is constituted by the element of highest sonority; going from the nucleus towards either boundary of the syllable, sonority must not rise.

This principle explains the general pattern of the syntagmatic alternation of sonority rises and falls and, in particular, a high number of phonotactic constraints in many languages at a desirable level of generality. It can be naturally extended to less frequent phenomena like heterogeneous nuclei, i.e. those filled by diphthongs, and many others. The literature on this question is huge, for a bird's-eye-view see Kenstowicz (1994), Blevins (1995), Törkenczy (1994).

Sonority has other functions as well in the phonological system of natural languages, and in some cases it seems that the sonority scales based on the various functions do not coincide.

2.1.1.2. The accessibility hierarchy

The sonority scale does not only predict in what order segments may come within a syllable, it also functions as a hierarchy of accessibility for nucleus, i.e. as an implicational hierarchy of the availability of segment types for syllable peak. This means that it is not possible, for instance, for there to be a syllabic nasal in a language that lacks syllabic liquids (Basbøll 1994), whereas the opposite is possible, because liquids are higher on the sonority scale than nasals.

2.1.1.3. The syllable contact law

It has been convincingly demonstrated by Murray and Vennemann (1983), Vennemann (1988 etc.) that sequences of adjacent but heterosyllabic elements are also subject to sonority-related constraints. A syllable contact is preferred if the sonority of the final segment of the first syllable is higher than that of the first segment of the second syllable. Several historical changes can be explained with this principle, such as developments triggered or undergone by onset **j** in the old Indo-European languages (syllabification to **i** in Latin, assimilation to preceding obstruent and **l** and metathesis with other preceding sonorants in Pre-Classical Greek, gemination before **j** in West Germanic, the strengthening of post-consonantal **j** in Romance etc.).

2.1.2. Weakening processes

Weakening processes or lenitions, whether diachronic or synchronic, are frequently defined on a basis other than sonority (see Chapter 1), yet sonority-increase is usually classified as weakening, whereas sonority-decrease as strengthening. It seems that sonority is an often tacitly assumed guiding principle in the classification of phonological processes in this category (see Lass 1984:177 sqq.). Linguists clearly rely on it to a great extent in their intuitions, whether they make it explicit or not. This is why lenition trajectories significantly overlap with the sonority hierarchy. We discussed this question in detail in Chapter 1.

2.1.3. Other phonological processes

There are phonological processes that clearly cannot be consistently described without reference to sonority but are not reducible to syllable-related regularities. One such phenomenon is found in Indic. In the course of the transition from Old to Middle Indic, all medial consonant clusters were reduced to geminates (with the exception of nasal+stop clusters) and all initial clusters to a single consonant. It was the consonant of higher sonority that assimilated to the one with lower sonority (or, word-initially, disappeared) in each case. The direction of the assimilation thus depended on the original order of the two segments. Examples are:[1]

(5) *Middle Indic consonantal assimilations*

	Sanskrit	Pali/Prakrit	gloss
progressive assimilation			
	supyate	suppati	'sleeps'
	cakra	cakka	'wheel'
	ratri	ratti	'night'
	vipra	vippa	'Brahmin'
	vajra	vajja	'thunderbolt'
	viklava	vikkava	'alarmed'
	prajvalati	pajjalati	'ignites'
	atman	atta	'self'
regressive assimilation			
	karkaśa	kakkasa	'rough'
	carcari	caccari	'kind of song'
	arpita	appita	'entrusted'
	kharjuri	khajjuri	'date-palm'
	ulka	ukka	'meteor'
no change			
	antara	antara	'interior'

This highly general change can indeed only be coherently described with reference to sonority, which, of course, also defines permitted syllables in the same language(s). But the change itself, to the best of our knowledge, cannot be captured in terms of syllable structure.

2.2. The phonetics of sonority

2.2.1. The articulatory correlates of sonority

In terms of articulation, sonority corresponds to the degree of stricture in the vocal tract that typifies a given segment. We find it convenient to distinguish three degrees of aperture: complete closure (as in stops and nasals), friction (as in fricatives) and the highest degree of openness, complete in the relevant sense (as in resonants or approximants). These result in ever higher sonority in this order. This explains why nasals and laterals are assigned their traditional positions in the hierarchy. Nasals are half stops, since they are characterised by complete closure in the oral cavity, but they are also half approximants,

[1] Masica (1991:173–177). Words are written as conventional, so *y*=**j**, *c*=**tʃ**, *v*=**w**, *j*=**dʒ**, *ś*=**ʃ**.

because the outward flow of air through the nasal cavity is unimpeded (i.e. highest degree of openness). It would be physiologically possible to articulate nasals with friction at the velic opening, but this is not attested in the world's languages as a manner of articulation different from non-fricative nasality (Ladefoged–Maddieson 1996:103). In the case of liquids, there is constriction or even complete closure in the mid-line of the vocal tract, but it is either too short or of insufficient muscular tension to let air accumulate behind it and thus produce noise at burst – this is how trills, taps and flaps are articulated –, or the air bypasses the closure through resonant-degree openings on the two sides of the tongue – this is how laterals are articulated, which are mostly resonants. It goes without saying that lateral fricatives pattern, from our point of view, with other fricatives. Approximants *sensu stricto* are not accompanied by any kind of constriction that could result in noise anywhere along the vocal tract.[2] In producing the prototypical glides **j** and **w** the tongue is often closer to the roof of the mouth than when articulating the corresponding high vowels, but we find their classification as fricatives (as is general in the German and East European phonetic tradition, see Laziczius 1963) unwarranted if they do not involve a perceptible noise component.

2.2.2. The acoustic correlates of sonority

In acoustic terms, sonority appears to correspond to two factors: the amount of expended energy and the extent to which that energy is filtered, i.e. channelled to narrower subdomains of the spectrum. In the articulation of stops, the amount of energy and the concomitant acoustic information is very small, since during the closure phase that amount is zero, and even the noise that results at burst is short and transient. It is well known that the identification of stops crucially depends on the formant transitions they produce in neighbouring vowels and sonorants, with the help of which the loci that typify the individual stops can be derived. In the case of voiced stops energy expenditure is continuous, but still small compared to that of sibilants or sonorants.

The general and recurrent acoustic properties of fricatives have not, to the best of our knowledge, been described to an extent comparable to other kinds of sounds. Although excellent case studies and descriptions of a narrower range exist,[3] the acoustics of fricatives is still characterised by statements like this: "It seems that in the case of the pairs **f, θ** and **v, ð** in English, the inconsistencies between speakers is so great that it may be *profitless to try to characterise the acoustic spectra of the fricatives themselves*" (Ladefoged–Maddieson 1996:173, emphasis added). Nevertheless, a few general points can be made here too. "Non-strident fricatives produced at the front end of the vocal tract are weaker in intensity and show widely spread noise over a wide range... of the frequency range... The turbulent noise often appears in higher frequency regions for strident fricatives..." (Fujimura–Erickson 1997:75–6). The spectrum of (especially labial and dental) nonsibilants is much more even, that of sibilants, by contrast, often shows concentration of energy at certain points and is virtually null in the lowest frequency regions.

[2] It is a matter of debate whether **h** and **ɦ** have any noise and thus whether they are to be classified as fricatives or approximants (Ladefoged–Maddieson 1996:325–6).

[3] E.g. Fónagy–Szende (1969), Shadle et al. (1991).

Nonsibilants articulated in the back of the oral cavity or the lower half of the vocal tract (velars, uvulars, pharyngeals) show a relatively high amount of energy in the lower frequency regions, similar to other nonsibilants, but at the same time show a much less even distribution of energy over the entire spectrum, similar to sibilants.

In the case of voiced fricatives, the low-frequency periodicity of voicing is added, which enhances energy expenditure. Thus the following sub-hierarchy can be given for obstruents: voiceless stops << voiced stops << voiceless non-sibilants << voiced non-sibilants << voiceless sibilants << voiced sibilants. In the literature it is often noted or hinted at that voiced nonsibilants frequently lack a perceptible noise component (Ladefoged–Maddieson 1996:165, 324, Kassai 1994:625). In such cases we find it advisable to classify them as approximants rather than fricatives. It is clear, however, that the two classes are not categorically distinct, and natural languages display a number of phenomena transitional between the two.

The acoustic structure of nasals is characterised by a strong low-frequency resonance, which is stronger than all other components in the stationary phase of the nasal consonant. But it is also characterised by antiformants (antiresonance) which cause "a selective absorption of acoustic energy at a frequency and its vicinity due to a resonance of a subsystem, such as the nasal cavity, that is coupled to the main acoustic tube... The spectral effects of antiformants are opposite to those of formants" (Fujimura–Erickson 1997:81, see also Ladefoged–Maddieson 1996:116–7 and Stevens 1997:484–8). Consequently the formant structure of nasals is somewhat weaker than that of liquids or vowels, and the acoustic energy that characterises nasals is thus lower. Interestingly, it is lower even than that of sibilants, but it has to be noted that the typical strong frequencies of nasals occur in a region to which human hearing is more sensitive than to the frequency regions of sibilants.

Lateral approximants (voiced in the default case) are characterised by well-defined formant-like resonances (Ladefoged–Maddieson 1996:193–6, Stevens 1997:488–490). As in the case of nasals, the first formant is the strongest, but, unlike in nasals, the third is often stronger than the second. In the case of trills, only voice can be perceived during the closure phase, but the open phases mostly show clear formant structures, and the bursts are not normally accompanied by burst-like noise or friction, though the latter may occur. An approximant-like phase may also occur between the last closure and the following vowel (see the spectrograms in Ladefoged–Maddieson 1996:220). Fujimura–Erickson (1997:83) claim that laterals have an antiresonance much like nasals but at a much higher frequency. Their spectrograms (p. 106) clearly show the difference between nasals and laterals.

Approximants in the narrow sense (i.e. glides) show an almost completely vowel-like structure with clear formants. The basic difference between vowels and glides is that the spectral characteristics of the latter change more rapidly, they are inherently less stable temporally and often appear as continuous formant transitions with respect to the preceding or following vowels (Fujimura–Erickson 1997:77, Ladefoged–Maddieson 1996:322–7, Stevens 1997:488–490). It is also seen (e.g. in Stevens 1997:488–490) that glides sometimes have "flatter" formants than vowels. In sum, glides and vowels are the most sonorous segments because they display the highest level of acoustic energy as well as the most well-defined acoustic structure and consequently the highest degree of filtering.

2.3. Phonological models of sonority

2.3.1. Government Phonology

Phonological theories strive to express sonority within the internal structure of segments. In GP,[4] segments consist of phonetically interpretable elements, but are, strictly speaking, unstructured. Within the segment an asymmetrical relation can be defined over the elements which picks one as head and others as dependents. The elements can be phonetically interpreted in themselves[5] in two different ways (vocalic and consonantal). They function similarly to unary features; no rule can make reference to their absence.

Stops contain the stop element (**ʔ**) in all cases, whose isolated manifestation is [ʔ] and whose salient feature is a sudden drop in acoustic energy. Fricatives always contain the noise element (**h**), whose isolated manifestation is [s] and whose acoustic property is noise. In stridents **h** is the head, in non-strident fricatives it is an operator. Stops only contain the noise element if they are released, i.e. usually in non-preconsonantal position. In want of the noise element they cease to be real obstruents. Contrastively voiced segments contain **L**, contrastively aspirated segments contain **H** – these are the two laryngeal elements.[6] Nasals contain both **N** (i.e. nasality) and **ʔ**. The representation of liquids is a matter of debate, but they surely do not contain noise or nasality. Glides have the same representation as the corresponding vowels.

So to what extent does GP capture sonority? Voiced obstruents are composed of more elements than their voiceless counterparts. Fricatives are composed of fewer elements than released stops and of the same number of elements as unreleased stops but the elements themselves are different in the latter case too (and head–operator relations are not the same either). Nasals contain one **N** more than unreleased stops. Liquids are composed of fewer elements than nasals.

Generally speaking, then, the composition of segments does not relate to sonority in any consistent fashion.[7] In some cases the content of a segment gets poorer with increasing sonority, as in the case of released stops and fricatives of the same phonation type. In other cases the content of a segment gets richer with increasing sonority, as in the case of voiceless vs. voiced obstruents or fricatives vs. nasals. Of course it must be borne in mind that in this theory the number of elements within a segment is determined by what is contrastive and what is not: redundant phonation features, for instance, will not be included in the representation.[8]

It is problematic that in some cases the complexity of segments, while inversely proportional to their sonority, is directly proportional to their typological frequency and correlates to their position in the implicational hierarchy of segment types (see Chapter 3).

[4] The comprehensive discussions which we have used are Szigetvári (1998) and Harris (1994). The earliest exposition of the theory is Kaye, Lowenstamm and Vergnaud (1985).

[5] Which is perhaps the most radical innovation vis-à-vis other theories.

[6] For problems related to these two elements, see Szigetvári (1996).

[7] In spite of the fact that Harris (1990) explicitly criticises other theories for not representing sonority and the essential unity of lenition processes segment-internally.

[8] We mention in passing that sonority was meant to be encoded by the notion of charm in earlier versions of the theory. Charm, however, has not proved particularly useful and has tended to be neglected recently. See Szigetvári (1998:173–4).

The relation of (in this sense) marked vs. unmarked segments is well captured in the case of nasals vs. stops, or the different phonation types of stops, but on the contrary with fricatives vs. stops, where stops, the most primitive consonants typologically, have a more complicated structure than fricatives, though the latter are rarer and are lower in the implicational hierarchy (i.e. fricatives imply the presence of stops in the system but not vice versa).

2.3.2. Dependency Phonology

In DP[9] distinctions of manner of articulation are encoded within the phonatory subgesture which is itself dominated in infrasegmental structure by the categorial gesture. The other subgesture within it is the initiatory subgesture, whose structure has not been worked out in as much detail as that of its sister. Ewen (1995) already assigns all sonority-related features (i.e. basically all manner and major class features) to a single node. The (former) phonatory subgesture is composed of various combinations of two basic elements (or unary features), maximal consonantality (|C|) and maximal vocalicness (|V|). These two can be represented more than once in any one instantiation and can be related symmetrically or asymmetrically. The major manner classes have the following representation:

(6)		
	Vowels:	V
	Liquids:	V>{V,C}
	Nasals:	V>C
	Voiced fricatives:	{V,C}>V
	Voiceless fricatives:	V,C
	Voiced stops:	C>V
	Voiceless stops:	C

The sign > points from head to dependent, the comma separates elements that are equal in the structure. As can be seen, the representations capture growing sonority by gradually assigning a more and more "dominant" position to the (|V|) element. It is also apparent that typological unmarkedness is related to the simplicity of the structure: the two most basic segment types, voiceless stops and vowels have the simplest, liquids and voiced fricatives the most complex phonatory subgesture.

These two properties of manner representations in DP follow from the fact that they were worked out precisely in order to encode sonority and markedness. It is, however problematic that in this way Dependency Phonologists are compelled to assign phonetically (and largely functionally) unrelated features to the same node. So what is the basis of their feature geometry?

> "One criterion for the grouping of features which is appealed to in dependency phonology, but which has been largely ignored in feature geometry [viz. of other theories – A. Cs.] is that a set of features which takes part in hierarchy-based processes should be considered to be part of the same group, or, in geometrical terms, to be dominated by a single node. This applies particularly to... the manner and major class features, which are involved in hierarchy-based processes such as weakening and relations such as syllabification" (Ewen 1995:576).

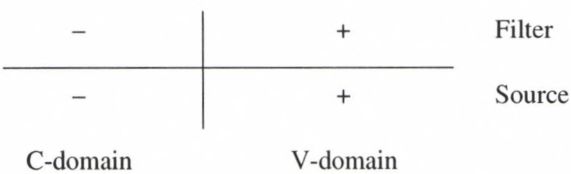
[9] See Anderson–Ewen (1980, 1987), Durand (1990:276–312), Ewen (1995).

In view of this it is not a merit of DP that it can represent sonority relations, since it cannot really represent anything else. Why should oppositions like stop vs. fricative, voiced vs. voiceless, nasal vs. oral be all expressed in the same node in a feature geometry? Furthermore, taking it for granted that the sonority scale defined by syllable structure is the same as that defined by weakening processes is an unwarranted simplification (fricatives never "weaken" into nasals etc.) and definitely not something that a theory should be based on.

2.3.3. Puppel's model

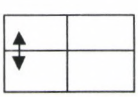
The basic insight of DP is developed further by Puppel (1992). He divides infrasegmental structure into a C- and a V-domain which are cross-cut by the Source (initiation, whose exponent is [voice]) and the Filter (articulation, [continuant]). The C-domain is characterised by a negative specification for both (i.e. a typical C is a voiceless stop), whereas for the V-domain they are positively specificied (i.e. a typical V is a voiced continuant). Thus the structure of a segment consists of the following four domains:

(7)

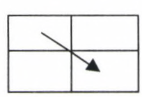


Puppel defines manner classes on the basis of what he calls preponderance (or headness) of one of the four domains. Where the head is C (i.e. in the case of stops), the preponderant domain is C-Filter:

(8)



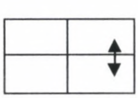
voiceless stop[10]
(C)



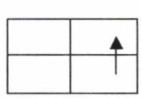
voiced stop
(C>V)

Where the head is V (i.e. in the case of sonorants), the preponderant domain is V-Source:

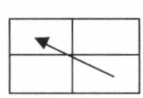
(9)



vowel
(V)



liquid
(V>{V,C})



nasal
(V>C)

[10] In fact, for voiceless stops and vowels there is not one preponderant domain. This is not explained by the author.

Where the head is the combination V,C (i.e. in the case of fricatives), the preponderant domain is V-Filter:

(10)

voiceless fricative (V,C) | voiced fricative ({V,C}>V)

By deriving manner classes, Puppel also derives sonority from the preponderance of one of the four domains. Actually only three of the four can be heads, but we never learn why the C-source domain cannot be preponderant within the segment. An even more worrying fact is that Puppel does not make it clear what his central notion, preponderance, consists in, although he explicitly claims it to be a phonetic property:

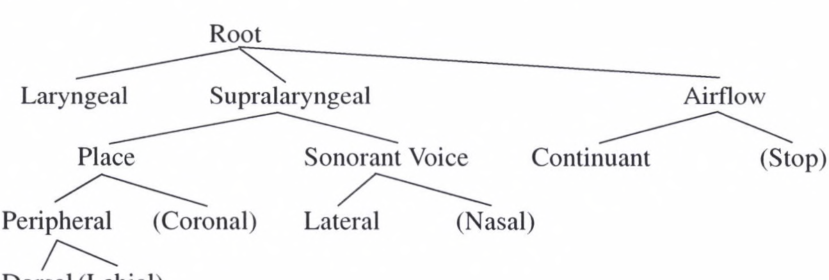
> "[A]ny possible arrangement of the segment types... into a ranking sequence necessarily involves the determination of the filter or source as head or as modifier. What it means in more phonetic terms is that in considering a particular segment type, one must first examine the filter characteristics such as the presence of occlusion or its absence, degree of constriction and corresponding presence or lack of turbulence, as well as the source characteristics such as the abducted state of the vocal folds... and then consider inter-dependencies between them" (Puppel 1992:472).

This is all we get as an explanation – not much to go by. Phonetically it would be reasonable to claim that in the case of obstruents, especially if they are voiceless, the Filter domain should be dominant, since the only source of acoustic information is the obstruction in the vocal tract. Puppel's model does not reflect this well known fact. In the light of all this it is questionable if it is really a model of sonority at all.

2.3.4. Rice's model

The model expounded in Rice (1992) is based on the assumption that sonority is directly proportional to the internal complexity of segments. The hypothesised feature geometry is the following:

(11)



The features in parentheses are default values under their nodes and are thus not represented: an empty Sonorant Voice node is automatically interpreted as Nasal, an empty Place node as Coronal etc. This is crucial for the model, since without underspecification segment types could hardly differ in the amount of "material" they consist of. Thus nasals have less structure than laterals, coronals than peripherals and stops than fricatives.[11] The unmarked character of coronals has been well known and amply discussed,[12] but markedness relations among manner classes, especially for sonorants, are much less unequivocal. In order to argue for the unmarked status of nasals, Rice claims that they undergo but do not trigger assimilation and have less constrained distributions than other sonorants. The first argument is palpably false: nasality is a frequently spreading feature, and nasals usually undergo place, but not manner assimilation. The second argument is also ill-founded in our view. It is enough to point out that in English as well as Hungarian and Latin a branching onset may contain a nasal in second position only after one fricative, if at all (E *smile*, Hu *smúz* 'sycophantic talk'), whereas liquids can be found after almost all stops and one or two fricatives (La *praeda* 'loot', *fructus* 'fruit', E *clue, fly*, Hu *drága* 'expensive', *friss* 'fresh').

Rice also claims that evidence for this feature geometry comes from language acquisition and the implicational hierarchy of sound types. Due to our incompetence, we do not wish to say anything about the former, but we note that the literature known to us shows a rather more complicated picture. As regards the implicational hierarchy, nasals are indeed higher than liquids in terms of phonation types, as are stops with respect to fricatives. But even this consequence of the model is undercut by the fact that Rice is unable to assign trills any structure within the framework, even though in the implicational hierarchy trills appear to go hand in hand with laterals. It is also a weakness of the theory that it cannot integrate glides and vowels.

2.3.5. Basbøll's model

Basbøll (1994) derives sonority simply from the set-theoretic relation of inclusion, starting from the prototypical syllable-peak. This latter means vocoids (central oral resonants), which are by necessity sonorants – hence the next class. Sonorants are nearly universally voiced, voiced segments are a proper subset of non-open glottis segments, which are in turn a subset of the largest set, that of segments. With this, Basbøll takes it that the sonority scale, whose independence from syllable structure he stresses, is given:

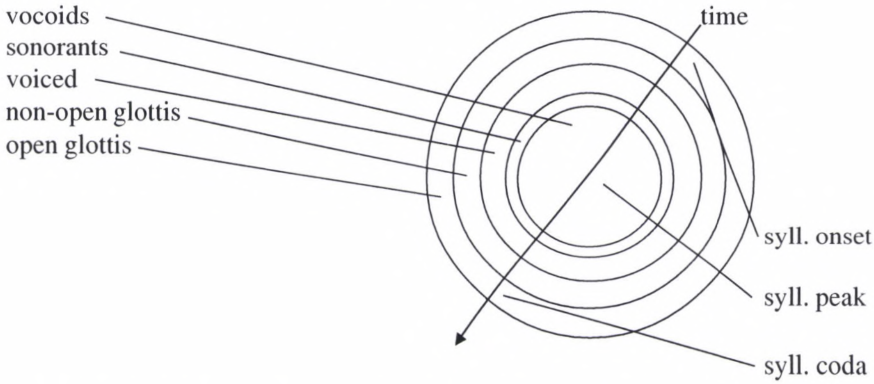
(12) vocoids ↑
(non-vocoid) sonorants
(non-sonorant) voiced segments
(non-voiced) non-open glottis segments
open glottis segments

[11] Even though Rice does not rank obstruents with respect to each other. To our knowledge, the undifferentiated treatment of obstruents goes back to Clements (1990).

[12] See e.g. Szigetvári (1994), Paradis–Prunet (1991).

If we cut the sets through with the time axis, the model becomes dynamic and the sonority template of maximal syllable structure is obtained:

(13)



This, as Basbøll (1994:64) claims, is the only possible relation between the manner classes empirically as well as logically. This seems a bit far-fetched, as implied by the author himself when on the next page he considers the alternative hierarchy vocoid–sonorant–perceptually continuant–segment.

It is difficult to say anything about Basbøll's model since he gives no arguments for it, apart from a handful of well known commonplaces and generalities. With a slight change in the features we could get completely different sets and consequently a completely different sonority scale. Cutting through the sets with the time axis to dynamically obtain the syllable template seems nothing more than playing around with the graphic representation, hardly interpretable in any coherent theory – except for the consequence that it explains why syllable structure is symmetrical.

2.3.6. Clements' model

Clements (1990) derives sonority from the +/– values of the features [syllabic, vocoid, approximant, sonorant]. In Clements–Hume (1995) [syllabic] is dropped, with syllabicity reinterpreted as a prosodic configuration rather than a melodic feature. All features are underlyingly fully specified, so we get no differences in the amount of structure a segment has. The scale thus arrived at is the following:[13]

(14)

	[sonorant]	[approximant]	[vocoid]	sonority
obstruent	–	–	–	0
nasal	+	–	–	1
liquid	+	+	–	2
vocoid	+	+	+	3

[13] Clements–Hume (1995:269).

As can be seen, sonority simply means the number of plus values for the three features. Clements (1985) and (1990) assign the three features [sonorant], [approximant] and [vocoid] to the supralaryngeal node, from which an interesting consequence follows:

> "By assigning the major class features to the supralaryngeal node rather than to the root node, we predict that laryngeal "glides" – segments which only have laryngeal specification – are not ranked in any position on the sonority scale, and are not characterized for any major class features. This seems correct from a cross-linguistic perspective. Laryngeals tend to behave arbitrarily in terms of the way they class with other sounds..." (Clements 1990:322).

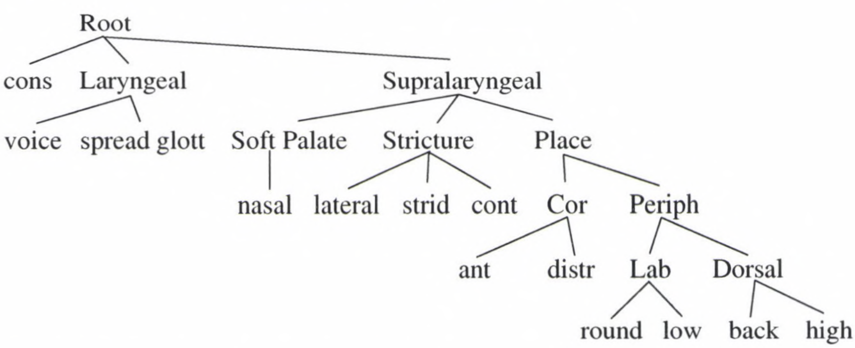
Although it involves an important insight, this wording is somewhat exaggerating because laryngeals are idiosyncratic, but not arbitrary.

These (and only these) features are placed on the Root node in Clements–Hume (1995) – allegedly because they only spread in the case of total assimilation, not in themselves. The weakness of this theory is that, since sonority is only defined by these features, which do not include, for instance, continuancy, Clements is also unable to sub-rank obstruents and thus stops and fricatives remain unranked with respect to each other.

2.3.7. Dogil's model

In Dogil (1992) and Dogil–Luschützky (1990) sonority is inversely related to the internal complexity of segments. Their feature geometry is the following:[14]

(15)



Sonority decreases with the increase in left-branching in the tree (i.e. the contrastive use of features on the left). For this they need underspecification, similarly to Rice (see 2.3.4). In this model we get the following sonority scale:

(16) vowels ↑
approximants
nasals
obstruents
laryngeals

[14] Dogil (1992:330). Dogil–Luschützky shows a slightly different geometry, which is beside the point now.

It is noteworthy that the segments of lowest sonority are laryngeals, segments that only consist of a Laryngeal gesture. Nasals lack this gesture as compared to obstruents, approximants lack the Soft Palate gesture as compared to nasals, while vowels lack Stricture with respect to approximants. They regard the subclassification of these groups (glides vs. liquids within approximants, trills vs. laterals within liquids, stops vs. fricatives within obstruents) as possible but language-specific and so do not account for it in their model of sonority. All these refinements are explained with reference to a different, cross-classifying dimension called strength. Similarly to Rice's and dissimilarly to Clements', their model makes major class features unnecessary. Sonority-related phonological processes (syllabification in the first place) disregard feature specifications and are only sensitive to the structure of the tree.

The authors claim that this definition of sonority is phonetically grounded:

> "[S]onority is the degree of branchedness in the feature-structure. Notice, however, that this formal definition has straightforward substantive support. The sounds, the representations of which include more branches, automatically involve more components in their production, and, the more components involved, the less sonorant the sound is" (Dogil–Luschützky 1990:18).

This is, unfortunately, false because of underspecification. Phonetically speaking, the production of, for example, voicing is independent of its contrastivity, hence it is "substantively" the same in nasals and voiced fricatives. Phonologically different applications of individual articulators will not often be found to differ phonetically.

2.3.8. The model of Farmer Lekach and Kiparsky

The model of sonority presented in Farmer Lekach (1979)[15] and developed further in Kiparsky (1981) finds its roots in the first decade of generative phonology and is closely related to the underspecification theories seen earlier. In it major manner classes are defined by the hierarchically arranged features [syllabic, consonantal, sonorant, nasal, continuant], which all have marked and unmarked values with respect to each other. The hierarchy of features and their individual values follow from the implicational hierarchy of segments. The way we arrive at the sonority scale is the following:

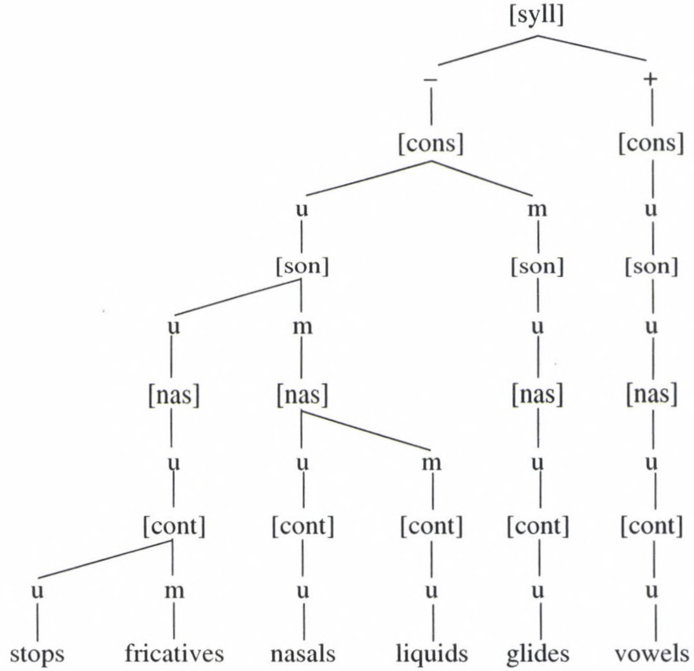
Topmost in the hierarchy is [+/–syllabic], followed by [+/–consonantal]. The unmarked value of the latter is [+] both with [–syllabic] and [+syllabic], its marked value ([–]) is only available with [–syllabic]. These two features then define the class of vowels ([+syllabic, u consonantal][16]), glides ([–syllabic, m consonantal]) and "real" consonants ([–syllabic, u consonantal]). The next feature is [+/–sonorant], whose unmarked value is [–] with [+consonantal], [+] with [–consonantal]. This latter redundantly characterises vowels and glides, whereas within the class [+consonantal] the marked value distinguishes sonorants ([–syllabic, u consonantal, m sonorant]) from obstruents ([–syllabic, u conso-

[15] The author claims the model to be based on Kean's (1975) dissertation *The Theory of Markedness in Generative Grammar*, which I have not been able to consult.

[16] In these matrices *u* stands for unmarked, *m* for marked.

nantal, u sonorant]). The next feature is [+/–nasal]. Within obstruents, glides and vowels, it can only have the redundant unmarked value ([–]), within sonorants it can be unmarked ([+]) or marked ([–]). Thus we can differentiate between nasals ([–syllabic, u consonantal, m sonorant, u nasal]) and liquids ([–syllabic, u consonantal, m sonorant, m nasal]). The feature lowest in the hierarchy is [+/–continuant]. It can only have two values within the class of obstruents, in all other classes it has the unmarked value ([+] for nasals, [–] for the rest). For obstruents, [–] is unmarked, [+] is marked. The full matrices and their derivation are as follows:

(17)

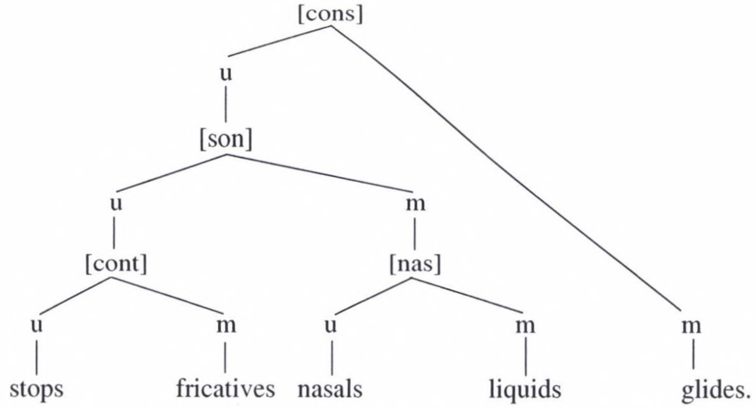


[syll]	–	–	–	–	–	+
[cons]	u	u	u	u	m	u
[son]	u	u	m	m	u	u
[nas]	u	u	u	m	u	u
[cont]	u	m	u	u	u	u

If the unmarked value always precedes the marked value in the tree, we get the sonority scale at the bottom from left to right. The higher a features has a marked value, the more sonorous the segment is. Kiparsky (1981:248) gives the tree in the following, somewhat simplified form:[17]

[17] We have here mirrored the chart so that its structure will be parallel to that of the former.

(18)



As can be seen, markedness in this model is a relational term, that is, a given value of a given feature can only be marked or unmarked with respect to a given value of another feature. The only exception to this is [syllabic], which has no marked and unmarked values. This appears to capture the empirical fact that all languages have syllabic and nonsyllabic segments. The fact that [syllabic] is no longer a feature in phonological theory would not in itself undercut the validity of the model because it could, in principle, still hold for consonants.

There are, as we see, three serious shortcomings here. (i) No mention is made of phonation features, although the typological importance of phonation types can hardly be overemphasised. (ii) No arguments are given for this particular hierarchy of features. In this context one must remember what, among others, Steriade (1995:118–9) says: redundancy relations within a segment can often be interpreted in two different ways. Voiceless obstruents, for instance, are unmarked both with respect to voiced obstruents and voiceless sonorants. (iii) The markedness statements made by the authors are of completely different weight. It is true that nasal vowels are marked with respect to nonnasal vowels but to claim that sonorants *en bloc* are marked in the same way with respect to obstruents is utterly disproportionate.[18]

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[18] The reader should not be misled by the fact that nasal vowels are not included in the chart, since if they exist in a language, they cannot be otherwise represented than by branching [nasal] into marked and unmarked.

3. THE TYPOLOGY OF CONSONANT SYSTEMS

3.0. Introductory

Our model of the typology of consonant systems and the conclusions we draw from it are based on Maddieson (1984) and Ladefoged–Maddieson (1996). The former is the most detailed book of its kind to this day; it describes and selectively analyses the contents of the UPSID,[1] which included the segmental inventory of 317 languages at that time. Those who know and use this book are aware of its weaknesses, these were discussed in reviews[2] after the book was published. The most serious flaw in it, to our mind, is the unsatisfactory treatment of (consonant) length: this is the chief reason we mostly omit discussion of geminates and (de)gemination. We do not have resources that would make it possible to generalise over typological and diachronic aspects of geminates to a sufficient degree.

The implicational relationships between manner classes are central to our concerns when making typological claims. The notion of implication can be used in three different senses in this context, in order of increasing strictness:

(i) A segment class presupposes another segment class within the same phonological system, e.g. there are no voiced fricatives in a system that lacks voiceless fricatives.

(ii) A given segment class cannot be represented by more segments (=base variants) than a given other segment class, e.g. there are not more voiced fricatives in a given phonological system than voiceless fricatives.

(iii) A given segment presupposes a homorganic segment of a given different manner of articulation, e.g. if a language has **z** it also has **s**.

When making implicational claims we will indicate in which of the above three senses we mean them. A further terminological remark: if a segment *x* is implicationally dependent on segment *y* and the phonological system that includes *x* also includes *y*, the segment *x* is called an anchored segment; if the system lacks *y*, the segment *x* is called an unanchored segment. Since the topic proper of this work is the class of obstruents, the implicational relations obtaining between (classes of) sonorants will be discussed somewhat less extensively.[3]

[1] UCLA Phonological Segment Inventory Database.

[2] The most important being Lass (1986), Bell (1986), Pagliuca–Perkins (1986). They point out the uneven representation of language families/groups, the insufficient filtering of genetic relatedness, statistical mistakes, the problem of the phonetics of the "base variant" and the extremely inconsistent and unreliable treatment of length.

[3] At several points we will refer to languages by their "Maddieson-number", especially when we need to list many of them. The numbers of the languages thus referred to is given in Appendix 1.

3.1. Stops and affricates

The most basic type of stops is voiceless: these segments exist in 91.8% of the UPSID languages.[4] Among those languages in which there is only one series of stops (there are 50), there is only one in which this single series is voiced, not voiceless, but Maddieson (1984:27) says this may be considered a descriptive inadequacy on areal grounds.[5] Languages with two series always have either a plain voiceless or a voiceless aspirated series, the other one being usually modally voiced or occasionally prenasalised or produced with some other kind of pulmonic mechanism. Some languages contrast a plain voiceless and a voiceless aspirated series of stops. In the overwhelming majority of languages the two series are from the set of voiceless, voiceless aspirated and voiced.

Languages with three series always have voiceless and voiceless aspirated stops or both, which contrast with a voiced, glottalised, pre- or post-nasalised series. The same is true of languages with four series: they all have voiceless or voiceless aspirated stops or both. With the exception of Zulu and Southern Nambiquara they also have a voiced series.

Maddieson makes the following specific claims (1984:39, where their statistical validity and a few further claims are also found):

(i) All languages have stops.
(ii) A language is most likely to have two series of stops.
(iii) A language is highly likely to have a series of plain voiceless stops.
(iv) If a language has only one stop series, that series is plain voiceless.
(v) If a language has two stops series, it has a voice onset time contrast between them.
(vi) If a language has three stops series, it is most likely to have two series with contrasting voice onset time and one "glottalic" series.

The conclusions we draw from these findings are the following. All languages that have at least two series of stops have plain voiceless or voiceless aspirated stops, thus these constitute the primary phonation type of stops.[6] The secondary phonation of stops is, as we have seen, modal voice; it may be plain voicelessness if primary phonation is voiceless aspirated, not plain voiceless. Secondary phonation naturally presupposes primary phonation in sense (ii) of implication; furthermore, according to my own counts, also in sense (iii), the strictest sense. There are only five languages in UPSID that have **g**

[4] In terms relevant to the discussion in this chapter, affricates belong to the class of stops, and this is how the latter term will be used here.

[5] But see Ladefoged–Maddieson (1996:53): "Most languages with only a single series of stops... are reported to have voiceless stops... We suspect, however, that there may be two major types of stops involved. In some languages, such as the Polynesian group... actual vocal fold opening seems to be required; in others, such as most of the Australian languages, the stops may be produced with no actual opening required, with vibration ceasing due to lack of efforts to sustain it... Australian stops seem to be more prone to having voiced variants." The wording here is extremely cautious.

[6] For the typology of phonation and airstream mechanism see Ladefoged–Maddieson (1996:47–90) and Laver (1994:161–200). Throughout this work we include both under the term phonation because their difference is immaterial in this context. I will generally omit discussion of articulations that only occur in a handful of languages and are thus typologically marginal (e.g. clicks) or are not reliably described in the individual languages.

but neither **k** nor **kʰ**; in the case of labials, the number is higher: there are 26 languages that have **b** but neither **p** nor **pʰ**, but many of these languages are genetically related (9 out of the 26 are Semito-Hamitic, see 3.4.2).

3.2. Fricatives

In the UPSID there are altogether 21 languages that entirely lack fricatives. It is noteworthy that of these 15 are spoken in Australia (especially given that the database only includes 19 Australian languages); it is clear that this is a strong genetic-areal feature of this language group.

For fricatives the primary phonation is unequivocally voicelessness, whereas the secondary phonation is modal voice. The third phonation type, ejective fricatives, occurs only in a handful of languages: in the entire database there are only ten languages that have one or more ejective fricatives, and there are only four with a laryngealised fricative (none of them has more than one). Voiceless fricatives outnumber voiced ones by a ratio of three to one, according to Maddieson's own count (1984:45). There are only two places of articulation where there seem to be more voiced than voiceless fricatives: labial (**β** vs. **ɸ**) and interdental (**ð** vs. **θ**). Maddieson (1984:46) gives the following tentative explanation: "It seems to be the case that /β/ and /ð/ in many languages are of relatively recent origin and this may be related to their unexpectedly frequent occurrence."[7] He also draws attention to the fact that these sounds often derive from the weakening of voiced stops or appear in the language due to lexical borrowing (ibid.). To this we may add that since, with the exception of Ewe (114), no language in the database contrasts **β** and **v**, the former may well be the voiced counterpart of **f**, as is highly likely in Kirghiz and Pashto. Furthermore, the difference between **β** and labial or labiodental approximants (e.g. **ʋ**) is highly elusive. The fricative **β** may easily derive diachronically from approximants, which is not true of other (mainly sibilant) fricatives, such as **z**. Maddieson explicitly claims this about **v** and **ʝ**: "The voiced palatal fricative /j/ [in updated IPA notation /**ʝ**/ – A. Cs.] may derive from an approximant /j/ and seems unrelated in its occurrence to the voiceless fricative /ç/. As for the voiced labio-dental fricative /v/, this is perhaps found unpaired [i.e. without **f** – A. Cs.] in some cases because it derives from the common approximant /w/" (1984:48). Or, as often happens, a segment is classified as a fricative which would better be described as an approximant – suspect cases include Spanish (Lavoie 2001:125–7) and Hungarian (Siptár–Törkenczy 2000). We will return to this in 3.4.1.

As for **ð**, Maddieson claims it is unpaired (unanchored in our terms) in many cases because he considers that its voiceless counterpart can only be **θ**. However, in five out of the eight languages that he claims have unpaired **ð** its voiceless counterpart appears to be **s**, i.e. **ð** is anchored by **s** rather than **θ**.

It is generally true that voiced fricatives imply voiceless fricatives in sense (ii) unequivocally, and in sense (iii) with much higher than chance frequency. The latter is not true in the case of the above two fricatives, and **ʝ** is unpaired in five out of the seven languages in which it occurs. In the case of **ʝ** and **β** this may be because they often derive from – or are descriptively confused with – approximants.

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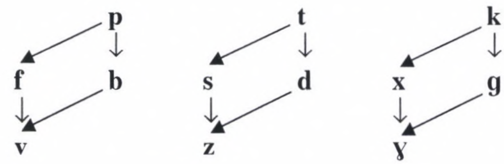
[7] Where by frequency the author means the number of languages in which a given segment occurs.

3.3. The implicational hierarchy of stops and fricatives

Stops as well as fricatives are capable of exhibiting several types of phonation. The primary phonation is voicelessness, for stops it may be aspiration. Segments of the secondary phonation type imply the corresponding segment of primary phonation at the same place of articulation (sense iii), and fricatives imply stops of the same phonation type at the same place of articulation, more precisely: fricatives of primary phonation imply stops of primary phonation, fricatives of secondary phonation imply stops of secondary phonation, and so on. This state of affairs can be represented schematically in the following way, here with three places of articulation and two phonation types:

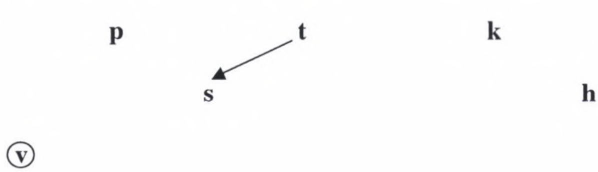
(19)



The segments **b** and **f** are anchored by **p**, and they in turn anchor **v**, and the same for the other places of articulation.[8] Place of articulation may not be exactly the same for a set of consonants so related, as labials here show. In the place of **v** a language may have **β**, or **ɸ** in the place of **f**, among coronals **θ** or perhaps **ʃ** in the place of **s**. In languages like Nenets the voiced counterpart of **s** is **ð**, not **z**; in Araucanian, Hopi and Chukchi the voiced counterpart of **s** appears to be the retroflex fricative **ɹ̆**; in Senari the stop counterpart of **ʃ** is **c** rather than **tʃ**. Of course, judging such systemic correspondences requires circumspection: one is not to assign segments to arbitrary and phonetically unfounded classes for the sake of structural coherence.

Arguments for this hierarchy and the concept of anchoring do not only come from the typology of consonant systems. Let us take a look at the phonological integration of loanwords in Finnish. Voiced stops and **f** are left intact in borrowings, whereas voiced fricatives are not: *baari* 'bar', *filmi* 'film', *radio* 'radio', *gramma* 'gramm' as opposed to *ruusu* **ruːsu** 'rose', not ****ruːzu**. Voiced stops and **f** do not occur in the native vocabulary of Finnish, except for **d**, which is found in the oblique cases of nouns as the weakened variant of **t** and is thus not to be regarded as a base variant. Voiced fricatives are also not found in Finnish with the exception of an unanchored **v** (for this kind of anomaly see 3.4.1). The native obstruent system of Finnish can be represented in terms of anchoring as follows:[9]

(20)

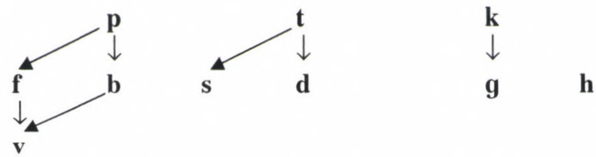


[8] The arrow points from the anchoring to the anchored segment.

[9] The purely laryngeal **h** is not usually anchored by anything in natural languages as far as we can judge; but this is probably a question that is worth looking into in more detail.

If we add to the chart those segments that only occur in borrowings, we get the following modified picture:

(21)



Voiced stops may become anchored because in the original system (20) voiceless stops are there to anchor them. Voiced fricatives, by contrast, cannot be anchored because the system lacks voiced stops and voiceless fricatives that could, in pairs, anchor them. It is a fairly straightforward conclusion that Finnish tolerates those segments in loanwords that its phonological system can anchor, and not only the ones it already includes.[10] Segments it cannot anchor are replaced by anchored ones (like **z** by **s** in *ruusu*) – but it must be borne in mind that many cases, perhaps the majority, of replacements in the world's languages in general have to be explained with reference to other principles.[11]

The relevance of the implicational hierarchy is shown in a different way by the history of the Hungarian phonological system. It is clear that, of the voiced fricatives, only those remained in the language that are and have been anchored (**v z** and **ʒ**). The ones that ceased to be anchored – because the anchoring segments disappeared or changed their manner of articulation through phonetic change – either disappeared or turned into approximants (**j** and **ɣ**).[12]

The implicational structure given in this section has specific classes of exceptions. It is these exceptions that we will now explore in detail.

3.4. Anomalous obstruent systems[13]

3.4.1. Unanchored v/β

One of the most frequent anomalies appears to be the presence of an unanchored segment which is described as a voiced labial or labiodental fricative. In the database we find 28 such languages.[14] The overwhelming majority of the languages exhibiting this anomaly are Amerindian or Polynesian; of the 21 Indo-European languages listed in the UPSID only Lithuanian has an unanchored **v**. However, the list of languages with unanchored **v/β**

[10] Of course, one could always argue that the actual obstruent system of contemporary Finnish is (21), not (20). The argument we have given would hold even in that case, though not for the present, but for a recent state of the language.

[11] Anchoring does not explain, among others, the replacement of **f** by **b** in borrowings in Czech, e.g. *bažant*, cf. G *Fasan*.

[12] For the history of the Hungarian phonological system see Bárczi (1962) and Kálmán (1965). Original **j** was anchored by **ç** and **ɟ**, of which the former disappeared from the system, **ɣ** was anchored by **x** and **g**, of which the former again disappeared or turned into **h**.

[13] Languages with anomalous obstruent systems are listed in Appendix 2.

[14] 007, 011, 051, 053, 067, 068, 404, 407, 421, 513, 608, 609, 625, 626, 715, 727, 728, 737, 738, 743, 811, 812, 824, 825, 827, 828, 903, 910.

may be misleading: in many cases, as we pointed out above, it may be assumed that the actual segment is an approximant rather than a fricative. In Hungarian, for instance, the realisation of this fricative is different before and after vowels: postvocalically it is a fricative proper (*sav* **ʃɑv** 'acid'), whereas prevocalically it is an approximant (*vas* **ʋɑʃ** 'iron', *savas* **ʃɑʋɑʃ** 'acidic').[15] This is true phonetically as well as phonologically, since prevocalic V does not cause voicing in a preceding obstruent, while all fricatives induce voicing assimilation. It is highly suggestive that in 18 out of the 28 languages Maddieson does not list any labial or labiovelar approximant, whereas only one of these languages lacks **j**. Labial approximants occur in five UPSID languages altogether,[16] and none of these five is indicated as having **v/β** as well (though there is one in which **ʋ** and **w** contrast[17]).

Of the ten remaining languages Spanish may be left out because the base variant is perhaps **b** rather than **β**, since the latter occurs intervocalically, between liquids and vowels, occasionally in syllable coda, i.e. in a more restricted set of environments. On the basis of these and the previous considerations we actually doubt if this anomaly really exists; it seems, in any case, that it is of a narrower relevance than may seem at first glance.

3.4.2. Lack of *p*

There are 25 languages in the UPSID which lack a labial stop of primary phonation (**p** or **p^h**) but have a labial fricative of primary phonation and/or a labial stop of secondary phonation, thus their entire labial obstruent subsystem is unanchored.[18] Lack of **p** is clearly an areal phenomenon proper to the Middle East and North Africa: 11 languages out of the 25 are Semito-Hamitic and six are Nilo-Saharan. Here belong also six Indo-Pacific languages, furthermore Mongolian and Vietnamese.

There is no overlap between languages lacking **p** and those showing the **v/β**-anomaly, since we did not add languages here whose only labial obstruent is **v** or **β**, and we did not find any languages in the database that both lack **p** and have unanchored **v/β** (i.e. languages that have a **f–v** or a **b–v** labial subsystem).

3.4.3. Lateral fricatives

In the UPSID there are 21 languages that have at least one lateral fricative (**ɬ, ɮ** or ejective **ɬ'**) but lack lateral affricates (**tɬ, dɮ** or **tɬ'**).[19] Lateral stops are not indicated by Maddieson in any language, and such sounds are unknown in the general phonetic literature as well.

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[15] See Siptár (1994:204–5, 214–6) and (1995:31–32), but especially (1996).

[16] In the segment list six languages are enumerated, but when describing the segmental inventories of individual languages this particular segment is not mentioned in Ket.

[17] Namely Luvale. Ladefoged–Maddieson (1996:141, 324) point out that in two languages spoken in Nigeria, Isoko and Urhobo, **v**, **w** as well as **ʋ** all contrast.

[18] 066, 200, 202, 206, 210, 212, 219, 250, 251, 252, 254, 256, 257, 258, 261, 262, 263, 266, 303, 602, 606, 610, 611, 621, 622.

[19] 014, 126, 207, 208, 254, 269, 270, 401, 405, 406, 501, 512, 704, 705, 706, 743, 748, 753, 757, 759, 900.

Lateral affricates are indicated in 14 languages altogether.[20] Of the languages with unanchored lateral fricative(s) nine are North-American Indian languages. In two languages (Ik and Hupa) there is a lateral affricate, but it is ejective, thus not of primary phonation.

3.4.4. Overabundance of palatals

Of all places of articulation, it is the palatal region that appears to present most difficulties from a typological–implicational point of view. Palatal consonant subsystems are often multiply anomalous; problems pertaining to nasals and liquids will be discussed later, here we concentrate on the problems of obstruents. We consider **c, tʃ, ɟ, dʒ** to be the most basic palatal stops and **ç, ʃ, j, ʒ** to be the most basic palatal fricatives. In some cases it may be safely assumed that **ʃ**-type sounds implicationally belong not to the palato-alveolar but to the alveolar region (represented primarily be **t, ts**-type stops). In Pomo, for instance, the coronal obstruent subsystem looks as follows: dental **t̠, t̠'**, alveolar **t, d, t', ts, ts'**, plus two fricatives, **ʃ** and **s**, of which the latter may be either dental or alveolar. In this language it may be reasonable to assume that **s** belongs to the dental and **ʃ** to the alveolar region. This is perhaps even more so in Mixe, where the coronal obstruent subsystem is the following: dental **t̠, d̠, s̠**, alveolar **ts**, palato–alveolar **ʃ, ʒ**. The last two of these belongs to the stop **ts**, though of course **ʒ** still remains unanchored in want of a voiced alveolar stop.

All in all we find 25 languages in the database that have unanchored palatal or palato-alveolar obstruents.[21] Most of these unanchored obstruents are fricatives. In three of these languages there are three such sounds (in Kabardian in fact more), in nine there are two, in twelve there is only one. Palatal and palatalised obstruents display anomalous behaviour in several respects, see 4.7., and further 6.2. for the modelling of the phenomenon.

3.4.5. Unanchored ɣ

In the database there are thirteen languages which have a voiced velar fricative but either have no voiceless counterpart or no stop counterpart to it.[22] If we exclude Spanish on the basis that the base variant is **g** rather than **ɣ**, there are only twelve left. They do not pattern genetically or geographically in any significant fashion.

Here again there may be reason to doubt whether the segment in question is in fact a fricative in all cases. Maddieson indicates voiced velar approximants in only six languages in the entire UPSID, it is thus conceivable that voiced velar approximants are often categorised as fricatives due to the same descriptive inconsistency as that suspected in the case of labials (see 3.4.1).

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[20] 208, 260, 700, 701, 702, 703, 705, 709, 730, 731, 732, 733, 734, 911. Of these languages nine (208, 260, 701, 702, 705, 731, 732, 734, 911) have at least one lateral fricative.

[21] 004, 008, 010, 064, 068, 202, 203, 210, 211, 253, 254, 256, 257, 260, 261, 270, 601, 715, 729, 744, 805, 817, 900, 901, 911.

[22] 011, 050, 103, 116, 203, 270, 350, 359, 404, 510, 804, 836, 908.

3.4.6. Unanchored **ð**

If we disregard Spanish we find two languages in the database (Cheremis and Koiari) that have an interdental fricative but no corresponding voiceless fricative and voiced stop. In Koiari **ð** is the only fricative in the dental–alveolar region.

Maddieson (1984:45 sqq.) claims that there are many more languages with unanchored **ð** but, as we claimed above, the fricative of primary phonation that anchors it can be **s** as well as **θ** and this is what reduces drastically the number of **ð**-anomalous languages. It is also not out of the question that, similarly to **β**/**v**, approximants are sometimes categorised as non-sibilant fricatives in the dental region too. This issue is explicitly raised by Ladefoged–Maddieson (1996:144) in connection with Danish.[23]

3.4.7. Contrast between dental–alveolar and interdental fricatives

There are six languages in the database that show a **θ–s** contrast but in the dental–alveolar region only one stop corresponds to these in each phonation type.[24] Burmese, just like English, which is not included in the UPSID, also shows a **ð–z** contrast. One of the two fricatives – and we see no clear criteria to decide which – is clearly unanchored. The basis of this phenomenon is that fricatives make use of a well-defined acoustic contrast that is not available for stops.

3.4.8. Unanchored uvular obstruents

At first glance there are ten languages in the UPSID in which there is at least one unanchored uvular fricative; in two there is a stop as well. On closer scrutiny, however, it appears that in the Semitic languages, in Mandarin Chinese (500) and in Basque (914) they are in complementary distribution with velars within the paradigmatic system: in Modern Hebrew there are three velar obstruents (**k**, **g**, **x**) and one uvular (**ʁ**); in Socotri (254) there are three velar (**k**, **g**, **k'**) and two uvular obstruents (**χ**, **ʁ**); in Mandarin Chinese there are two velar obstruents (**k**, **kʰ**) and one uvular (**χ**), similarly in Basque (**k**, **g** vs. **χ**).

So we can safely assume that in these languages there are in fact no unanchored uvulars, only in the remaining six. Neo-Aramaic (255) and Tuareg (257) have **k**, **g** vs. **q**, **χ**, **ʁ**; Sui (403) has **q**, **qʰ**, **ʁ** next to a complete velar series, but no **χ**; Kunimaipa (620) has **ɢ** but no **q**, Yukaghir (907) has **q**, **ʁ** next to **k**, **g**, but no **ɢ** or **χ**; Georgian (910) has **q'**, **χ**, **ʁ** but no **q**.

3.4.9. Pharyngeal fricatives

In linguistics two kinds of consonants are customarily called pharyngeal: one kind is pharyngeal, the other epiglottal.[25] The UPSID indicated pharyngeal fricatives in thirteen languages; of these eight have two. No pharyngeal stop ever corresponds to these frica-

[23] "[T]he constriction in present-day Danish **ð** is often so weak that there is little audible friction, and the sound might be better classified as an approximant."

[24] 213, 402, 417, 509, 709, 810.

[25] "The sounds in Semitic languages that are called pharyngeal fricatives are often neither pharyngeals nor fricatives" Ladefoged–Maddieson (1996:168).

tives; thus they are unanchored unless we assign them to the velar or the uvular stops.[26] It seems that this region is not particularly amenable to the articulation of stops, though epiglottal (but not pharyngeal) stops have been reported in a handful of languages (Ladefoged–Maddieson 1996:37), and some phoneticians claim that stops can be formed at any point of the vocal tract.[27] The evidence shows that the typical pharyngeal–epiglottal obstruent is a fricative rather than a stop. It is noteworthy that no language shows a voiced pharyngeal–epiglottal fricative without a voiceless counterpart.

3.4.10. Retroflex fricatives

Some languages, like Hopi (738) seem to have retroflex fricative(s) that are anchored by alveolar stops. Four languages show definitely unanchored retroflex stops: Armenian (022), Tarascan (747),[28] Chukchi (908) and Araucanian (837), in which there is a voiceless retroflex affricate and a voiced retroflex fricative, but nothing "between" the two.

3.4.11. Miscellaneous

Apart from those discussed above there are about ten languages with an unanchored segment each that does not fit into any of the categories established above. We mention a few of these as illustration. In Georgian, there is one more ejective stop than egressive (the odd one out is **q'**), but typological considerations and the parallel patterning of fricatives make it clear that ejective cannot be the primary phonation for stops. Mongolian and Acoma lack **k^h** and **k**, respectively, thus the entire velar series is unanchored.

The consonant system of Kewa (610) is the following: **t, c; ^{m}b, ^{n}d, g; ɸ, s, x; m, n, ɲ**. It is definitely problematic typologically, but it is unclear how. Either one says that velars and palatals form one series, in which case the only anomaly is the lack of **p**; or one starts from the observation that (prenasalised) voiced stops and voiceless stops show complementary distribution in terms of place of articulation (with the exception of **t–^{n}d**) – although we are not quite certain what sort of an analysis could then follow.

In Ewe (114) and Iai (422) a **f–ɸ** contrast is found, but they only have one voiceless labial stop; this problem is parallel to that of the **θ–s** contrast, discussed in 3.4.7.

3.5. Nasals

Our typological knowledge of nasals is based on a classic work on the topic, Ferguson (1963), whose results were essentially corroborated and elaborated on the basis of the UPSID in Maddieson (1984:59–72). For nasals the primary phonation is modal voice,

[26] The following languages have pharyngeal fricatives that definitely cannot be assigned to stops of other places of articulation: 256, 407, 911, 912.

[27] "[A]lthough there is no IPA symbol for a voiceless epiglottal stop, this is an articulatorily possible sound… [I]t would be physiologically possible to make place-neutral stop articulations at virtually any point along the continuum of the vocal tract from the lips to the larynx" Laver (1994:206).

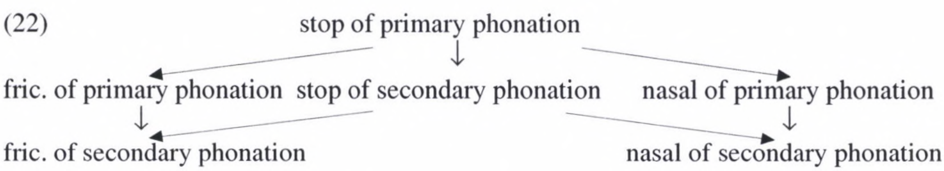
[28] In the chart of the sound system of this language (p. 386) the retroflex fricative is shown in the column of palatals – clearly a misprint, since in the list of segments (p. 231) it is correctly listed among the retroflex consonants.

secondary phonation is voicelessness, tertiary phonation is laryngealisation or breathy voice. Nasals of secondary phonation occur in incomparably fewer languages than stops of secondary phonation. Of the 1057 nasal phonemes in the database 88.4% are voiced, 3.4% are voiceless, 3.2% are laryngealised, there are two breathy voiced in Hindi-Urdu[29] and one in !Xu.

Just like fricatives, nasals never distinguish more phonation types than stops do in any given language. Nasals do not distinguish more than three phonation types. Three phonation types are found in several South-East Asian and North American Indian languages.[30] Nasals of primary phonation imply stops of primary phonation in the strict sense. There are six exceptions to this in the UPSID; significantly, all the six languages have an unanchored palatal nasal.[31] Nasals of secondary phonation always imply nasals of primary phonation at their own place of articulation; we have found no exception to this generalisation. Nasals of secondary phonation also imply stops of secondary phonation at their own place of articulation.[32] We have found only two exceptions to this: Hopi and Aleut. In these two languages sonorants as well as fricatives contrast a voiceless and a voiced series, but the only stop series is voiceless.

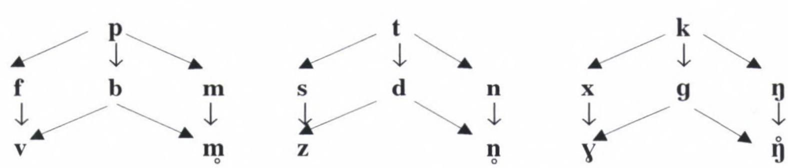
Nasals interestingly do not show any implicational dependence on fricatives. It is easy to find languages in which the number of nasals exceeds that of fricatives: Tavgy (=Nganasan) has nasals at four places (**m**, **n**, **ɲ**, **ŋ**), but fricatives at only two (**s**, **ð**). It thus seems that nasals stand in the same relation to stops as fricatives do. We can represent this relation schematically with two phonation types like this:

(22)



With three places of articulation the chart looks like this:

(23)



[29] Had Maddieson included more Indo-Aryan languages or languages of that geographical area, there would be many more in the database, breathy voice being a strong areal feature.

[30] Ladefoged–Maddieson (1996:107).

[31] Ewe (114), Efik (119), Songhai (200), Javanese (409), Chamorro (416), Auca (818). Of these the number of places of articulation for nasals exceeds that of stops only in two (Efik, Auca). We find it impossible to anchor **ɲ** in the remaining four languages too.

[32] Maddieson (1984:69) generalises over the relation between nasals and *consonants* at the same place of articulation, but the data make it clear that the implicational relation strictly holds between nasals and stops, not just any kind of consonant.

3.6. Liquids

The class of liquids includes two kinds of sounds, lateral approximants and *r*-type sounds. The phonetic similarity between these kinds (or between two kinds of *r*-sounds for that matter) is by no means evident. Their classification is typically based on phonological (for instance phonotactic), rather than phonetic criteria. As far as we can judge they behave in a unitary fashion with respect to the implicational hierarchy. This means the following in particular:

(i) Neither the number of lateral approximants and of *r*-type sounds taken separately, nor the number of all liquids together exceeds the number of nasals.

(ii) Neither lateral approximants and *r*-type sounds taken separately, nor the set of all liquids together distinguish more phonation types than nasals.[33]

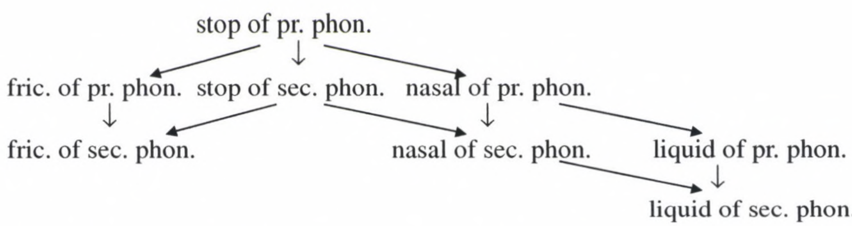
(iii) The phonation types of liquids are identical to those of nasals in all cases.

Given that liquids are almost exclusively dental or alveolar it is impossible to say anything about the implicational relations that hold between them and nasals in the strictest sense, i.e. with respect to place of articulation. Liquids thus do not exactly fit into the overall pattern in the same way as nasals, fricatives and stops do. But note that liquids at more specific places of articulation bear out the generalisations significantly. The palatal lateral **ʎ** is found in thirteen UPSID languages, and all of these have the palatal nasal **ɲ** too. The retroflex lateral is found in 21 languages, only four of which do not have a retroflex nasal. Of those four languages, however, only two contrast a dental/alveolar and a retroflex lateral, in the remaining two the retroflex lateral may correspond to the dental/alveolar nasal.

The unique nature of the articulation of laterals is underscored by the fact that they are dependent implicationally on nasals, even though there are no such sounds as lateral nasals. Given this it would probably be unwarranted to assign laterals to a position dependent on lateral affricates even in those languages that have the latter type of sounds.

In sum, liquids can be incorporated into the implicational hierarchy in the following way:

(24)



The number of languages that contradict this pattern is extremely low. Mongolian has the following sonorant inventory: **m**, **n**, **r**, **l**, **l̥**, **j**. Here there are two nasals of the same phonation type but three liquids, which distinguish two phonation types. It must be added that it is often very difficult or impossible to decide whether a voiceless lateral is an approximant or a fricative.

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[33] This is hinted at in Ladefoged–Maddieson (1996:198): "As seems to be the usual pattern for languages with voiceless lateral approximants, there are also voiceless nasals in Iai"; here they also mention a language, Toda, which contradicts this generalisation.

3.7. Glides (approximants in the narrow sense)

If we define glides as approximants minus laterals, their most frequent kinds are the palatal and labiovelar vowel-like consonants of natural languages, i.e. the glides corresponding to the vowels **i** and **u**. Glides at other places of articulation (palatolabial, labiodental, velar) are attested in only a handful of languages in the UPSID. The palatolabial glide **ɥ**, for one, is found in four languages altogether. Since the sources are not likely to be entirely free of the mistakes that occur in the classification of *v*-type sounds as well, these sounds will be left out of further discussion as marginal.

Since glides are typical only at the vocalic places of articulation, they cannot be compared to other consonants on that count. What can be investigated is only their phonation types. There are twenty languages in the database that show more than one phonation type within this class; primary phonation is naturally modal voice. With respect to these twenty languages one may look at what other class glide phonation types are dependent on. It appears that in four languages they are dependent on obstruents (either on stops or on fricatives, we have not always been able to decide), in six on nasals (what this means is that either there are no liquids in the language or they distinguish fewer phonation types than glides), in ten on liquids.

These numbers can be interpreted in two ways, but probably neither of the two is statistically well-founded, given the low numbers involved. Ten cases as opposed to four and six seem to be a (relative) majority and thus warrant assigning glides a place below liquids in the hierarchy. But if we contrast the ten languages that fit the hierarchy with the ten that do not, the proportions are much more balanced, which means that glides are more independent of other consonants than those are of each other. It is nevertheless true that glides never represent a phonation type that other classes of consonants in the same language do not. Apart from the fact that they are implicationally dependent on obstruents, we cannot say much.

An obvious explanation to their exceptional status could be that they are not "true" but vowel-like consonants and historically often derive from vowels. But the fact is that the phonation types of glides do not appear to be dependent on those of vowels. There are several languages in which vowels can be only voiced, whereas glides can be voiceless or laryngealised.

3.8. The phonology of the implicational hierarchy of consonants

Discussion of the phonological conclusions relevant for a representational theory of segments will be reserved for Chapter 6; before that, in Chapter 4 and 5 diachronic processes will be looked at in detail. For now suffice it to say the following.

One dimension of the hierarchy is phonation type. In the present context this is understood in a broad sense as including the different parameters of laryngeal as well as pulmonic mechanisms. Another dimension of the hierarchy corresponds to the extent and nature of the constriction. Stops represent the strongest, fricatives a medium, approximants the weakest constriction. The articulation of nasals involves the two extremes, since in the oral cavity a complete closure is made similarly to stops, while the air passes unimpeded through the nasal cavity and therefore no friction and no noise results. Liquids are also articulated with an approximant-type constriction, but – as opposed to real approximants

– their articulation also involves an obstruction in the midline of the oral cavity. The obstruction in their case, however, is either restricted to the midline and so the air can pass on the two sides of the tongue (and a lateral articulation is made) or is so short that, even if repeated, it is not sufficient to result in noise when released (as in the case of *r*-type sounds).

As can be seen, the manner types that are immediately connected in the hierarchy are minimally different in each case as far as constriction is concerned. This is why nasals and fricatives are completely independent of each other; they do not have a single feature in common. Note that consonant systems, as opposed to vowel systems, are organised around the principle of minimal, not maximal difference. The odd segments out are glides, which are phonologically highly independent of other segment classes (from our point of view), and which are phonetically akin to vowels rather than other kinds of consonants.

Our findings make another interpretation possible too. It may be the case that the principle of minimal differences is valid only within the class of obstruents, since all languages have obstruents and sonorants, which in itself means a maximal difference within consonants. This may be an important aspect of the phonic makeup of human languages, but its wider implications will not be pursued here. We will focus on how sonority changes are related to phonological systems.

3.9. The implicational hierarchy and sonority

It can also be seen that sonority plays a crucial role in the implicational hierarchy of consonants. In particular this means the following:

Within the ranks of obstruents it is clear that the higher the sonority of a segment is the more dependent that segment is implicationally. The primary phonation for obstruents is never any form of voice; it is always voicelessness, either with aspiration or without it. Furthermore, fricatives are generally dependent on stops. Voiced stops and voiceless fricatives are not related immediately within the hierarchy, which may be connected to the fact that their relative ranking with respect to sonority is also dubious. Languages with two series of stops but no fricatives are not predicted (so far) to be excluded, but in fact there are only five such languages in the UPSID, which shows that such systems are generally not preferred.[34] Two series of obstruents are nearly always one of stops and one of fricatives. Nasals are more sonorous than obstruents and are dependent on them (namely on stops) implicationally. Liquids are more sonorous than nasals and are also dependent on them. Within the classes of sonorants, however, it is very hard to assess phonation types in the same way as for obstruents. It cannot be said that modal voice (the primary phonation for sonorants) would result in a less sonorous segment than secondary phonations (like voicelessness). The behaviour of glides is even less typical; all we have been able to say about them is that they have no phonation type exclusively of their own.

Palatals sometimes contradict the generalisations made so far; their patterns occasionally (but not very often) do not fit the hierarchy and do not bear out its predictions. As we

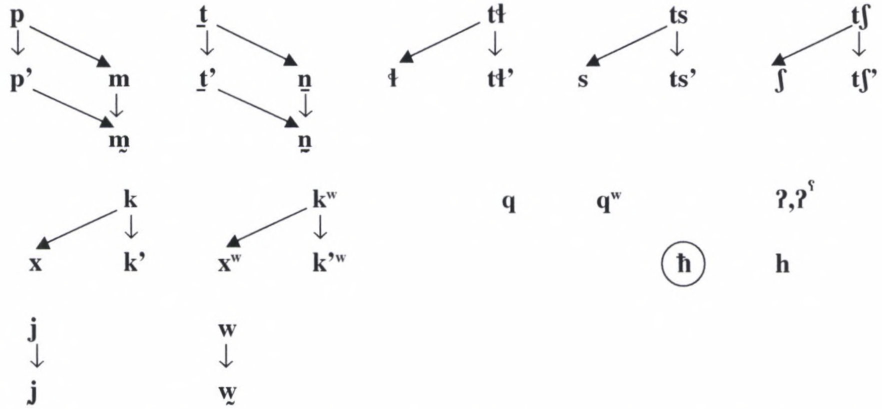
[34] These languages are: 361, 362, 619, 624, 818. In 420 there is a **h**, but it is not clear whether that segment is to be classified as a true fricative. If it is, then there are six such languages.

have seen, unanchored nasals are always palatal – though there are only six in the UPSID. In 3.4.4 we saw that there are unanchored fricatives of the same place of articulation in many languages. The irregular behaviour of palatals will be further discussed in 4.7 and 6.2.

Laryngeals, especially the most frequent laryngeal consonant **h**, are very hard to fit into the system.[35] Since laryngeals pose very specific problems for all aspects of phonology, whether it be phonological theory, typology or historical phonology, their analysis would go far beyond the limits of this work, so we will not be concerned with them.

3.10. Illustrations

a) Nootka[36]

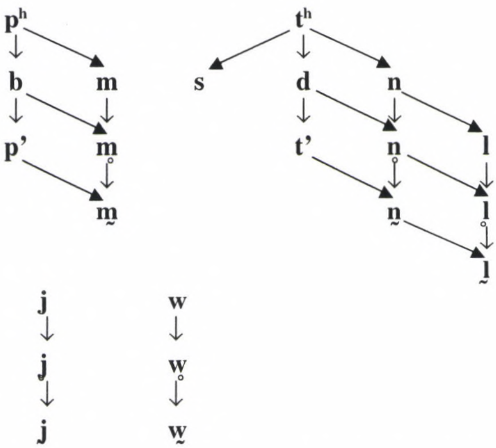


The primary phonation for obstruents is voicelessness, secondary phonation is ejective. For sonorants primary phonation is modal voice, secondary phonation is creaky voice. Stops in the narrow sense and affricates are in complementary distribution in terms of place of articulation. The only unanchored segment is pharyngeal **ħ**.

[35] Maddieson (1984) indicates a glottal stop in 146, but **h** in 202 languages. This means that **h** is independent of **ʔ**.

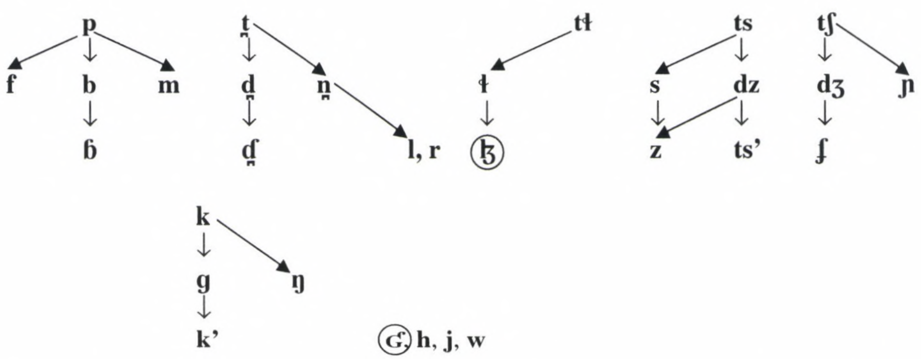
[36] Based on Maddieson (1984:378).

b) Klamath[37]



There are no unanchored segments in the system, but obstruents and sonorants represent primary, secondary and tertiary phonation in different phonetic categories. We have not been able to decide which is secondary and which is primary phonation; the chart is thus not to be taken as indicative in that respect.

c) Ik[38]

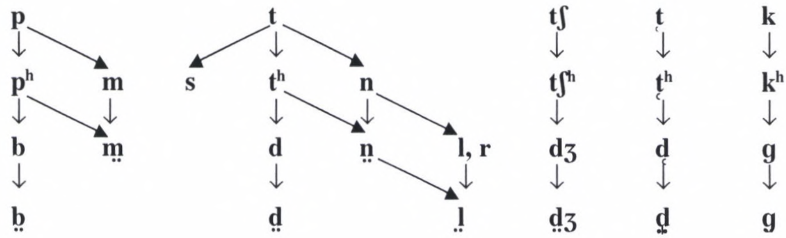


It is an interesting feature of this system that the tertiary phonation of stops is twofold: for the labial, palatal and uvular stops it is implosive, for the alveolar and the velar stops it is ejective. Note that Ik is the only language in the database that contains a palatal and a uvular implosive (ʄ ʛ). The latter of the two as well as ɮ are unanchored.

[37] Based on Maddieson (1984:370).

[38] Based on Maddieson (1984:304).

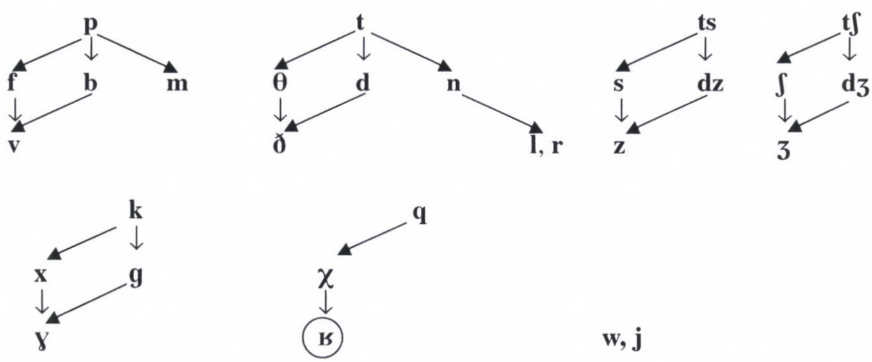
d) Hindi–Urdu[39]



β̤,j,ɦ

The secondary phonation of sonorants is voiced aspiration. That breathy voice actually means voiced aspiration is convincingly argued with respect to Hindi in Ladefoged–Maddieson (1996:58–60). Thus it is not surprising that the voiced aspirated sonorants are not dependent on the voiced aspirated but on the voiceless aspirated obstruents, since primary phonation for sonorants is voice, on which aspiration is "superimposed" just like on the primary phonation, voicelessness, of obstruents. **β̤** is a bilabial approximant. There are no unanchored segments.

e) Shughni–Roshani[40]



There is no voiced uvular stop so the voiced uvular fricative remains unanchored.

[39] Based on Maddieson (1984:270).
[40] A Pamir Iranian language, based on Payne (1989:424–5).

4. SONORITY CHANGES IN THE NON-GERMANIC LANGUAGES

4.0. Introduction

In this chapter we list those sound changes that affect sonority in the languages we have investigated with the exception of Germanic, which is postponed for more detailed discussion to Chapter 5. We culled the changes in all cases from sources that are seen as authoritative and standard descriptions of the historical phonology of given languages and language groups. Our goal has been to be as comprehensive as possible in the sense that well documented processes that can be regarded as "regular" changes, i.e. affecting the majority of given segments, should be all included. We have left out those changes that result in syntagmatic fusion (e.g. **sk** > **ʃ**), since it would be very hard to regard these as changes in the sonority of one segment, though not theoretically impossible. We have also left out changes that appear sporadic, insufficiently documented or phonetically unclear. Obviously it would be a quite hopeless enterprise to collect all sound changes that occurred in the history of even the best documented languages. We classify the changes on the basis of the sonority of the input segment and the output segment of the process, but do not subclassify sonorants because our main interest is in changes affecting obstruents. Thus we establish the following classes:

1. phonation changes among obstruents
2. stop > fricative and fricative > stop
3. stop > sonorant
4. fricative > sonorant
5. sonorant > stop
6. sonorant > fricative

Not surprisingly some changes will reoccur in the list several times, even among languages that are only distantly related or not related at all.

4.1. Phonation changes among obstruents

4.1.1. Voicing

4.1.1.1.
Middle Greek {**p t k**} > {**b d g**}/ N_
Ex.: ClGr **pente** > MGr **pende** 'five'[1]
Voiced stops, in all likelihood, no longer existed in the language at the time of this change, or existed only marginally in loanwords. The fricativisation of original voiced stops (4.2.1.6) had progressed considerably, it was perhaps completed by this time. There is no intervocalic voicing.

[1] Browning (1969). The designation of the language in the first line of the items refers to the output of the change.

4.1.1.2.
Proto-Brittonic {**p t k**} > {**b d g**}/ V_V
Ex.: ***katu**- > Welsh *cad* 'battle'[2]
Voiced stops existed in the language at the time of this change, but not in intervocalic position, because there they had turned into fricatives (see 4.2.1.7).

4.1.1.3.
Hungarian {**p t k**} > {**b d g**} (>{**v z v**}) / V(**r**)_V
Ex.: FU **orpa(sз)* ~ *orwa(sз)* > *árva* 'orphan', **kätз* > *kéz* 'hand', **(j)ikä* > *év* 'year'[3]
Originally there were no voiced stops in the language, they appeared via this voicing. It is unlikely that these segments should have passed through a voiceless fricative phase, since the only Proto-Ugric voiceless fricative **s** did not voice in intersonorant position (e.g. Hu *osz-ol, -lik* 'be dispersed'< PU **os-* < FU **osa*).

4.1.1.4.
Hungarian {**p t tʃ k**} > {**b d ɟ g**}/ N_
Ex.: PU **kumpa* > *hab* 'froth', FU **kunta* 'hunting group' > *had* 'army', *lonča* > *lágy* 'soft', **tuŋke-* > *dug* 'tuck'[4]
This change is the most important internal source of voiced stops in Hungarian. Nasals were usually lost after the voicing (according to Bárczi 1962 before it). Previous voiced stop (resulting from 4.1.1.3) became fricatives.

4.1.1.5.
Permic {**p t c tʃ k**} > {**b d ɟ dʒ g**}/ N_
Ex.: PU **kumpa* > Vot *gi̮bed* 'peat', Zyr *gi̮bẹd* 'tussock', PU **lamte* > Vot–Zyr **lud* 'meadow', **kunce* > Vot *kiz,* Zyr *kuǯ* 'urine', FU **wanca* > Vot *vi̮ǯ,* Zyr *vuǯ* 'step over', FP **waŋka* > Vot–Zyr *vug* 'handle'[5]
Like in Hungarian, this is an essential source of voiced obstruents in Permic. And like in Hungarian, the nasal is usually lost after the voicing.

4.1.1.6.
Proto-Permic {fricative and affricate} > {voiced} / S_S
Ex.: FP **pečä-* > Vot *pužim,* Zyr *požẹm* 'pine', **sacз-* > Vot *suǯ́,* Zyr *suǯ* 'reach', PU **kuse-* > Vot *ki̮z,* Zyr *kiz* 'cough'[6]
This change is an important source of voiced sibilants in Permic.

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[2] Russell (1995:114–5, 231–257).
[3] Rédei (1986–89), Sammallahti (1988:515–6), Kálmán (1965), Bárczi (1962).
[4] Rédei (1986–89), Sammallahti (1988:519–520), Kálmán (1965), Bárczi (1962).
[5] Rédei (1986–89), Sammallahti (1988:532). The only instance of **mp** in Uralic is **kumpa*, see Bakró-Nagy (1992).
[6] Rédei (1986–89), Sammallahti (1988:532). The ending -V**m** is a derivational suffix.

4.1.1.7.
Old Indic {**p t ṭ k**} > {**b d ḍ g**} / _# {V or C[voiced]}
Ex.: **vāk bʰavati* > *vāg bʰavati* '(a) sound is made', **abʰarat idam* > *abʰarad idam* '(he) took it away'[7]
Voicing only took place across word boundaries. Intersonorant voicing within words dates from much later (see next change). Within words, obstruent contact voice assimilation operated.

4.1.1.8.
Middle Indic {**p pʰ t tʰ ṭ ṭʰ tʃ k kʰ**} > {**b bʰ d dʰ ḍ ḍʰ dʒ g gʰ**} / V_V
Ex.: Skt *kapha* > MI *kabha* 'phlegm', *śōka* > *sōga* 'sorrow'[8]
This voicing resulted in fusion between original voiced and voiceless obstruents in this environment. The sounds traditionally called voiced aspirated may also be designated as breathy voiced.

4.1.1.9.
North-West New Indo-Aryan {stop and affricate} > {voiced} / N_
Ex.: Skt **paɲtʃa** > Sindhi **paɲdʒa** 'five', **aŋka** > **aŋgu** 'mark'[9]
Already in Middle Indic the only obstruents in intersonorant position were the stops and affricates following nasals. This is because intervocalic obstruents had been lost, next to another consonant they had formed geminates through assimilation. Voiced stops, but not fricatives, had been part of the phonological inventory since the earliest times.

4.1.1.10.
Chagatai **t** > **d** / #_
Ex.: *taqî* > *daqî* 'and', *ti-* > *di-* 'say'[10]
Both segments had existed earlier, so the inventory was not enlarged. This voicing is typical of several Turkic languages. In many of them, among them Chagatai, no voicing happens in intervocalic position: *itip* 'doer', *ataš* 'namesake'.

4.1.1.11.
Azerbaijani **k** > **g** / #_ and at the end of polysyllables
Ex.: *kara* > *gara* 'black'[11]
This voicing of **k** is in complementary distribution with fricativisation (see 4.2.1.18), which only happened word-internally and at the end of monosyllables. Voicing contrast is known to have existed already in the earliest periods of Turkic, so this change did not introduce new elements at the systemic level.

4.1.1.12.
Azerbaijani **tʃ** > **dʒ** / _V in non-initial syllables
Ex.: *aγacîn* > *aγaǧîn* 'tree GEN'[12]
The affricate **dʒ** is generally held to be a relatively recent segment in Turkic. The majority opinion is summarised in Bazin (1959a); for a different view see Doerfer (1976:28).

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7 Wackernagel (1896:327–8).
8 Masica (1991:180–1).
9 Masica (1991:203).
10 Eckmann (1959b:146–7).
11 Caferoğlu–Doerfer (1959).
12 Caferoğlu–Doerfer (1959).

4.1.1.13.
Karaim {**k kʲ p**} > {**g** (> **ɣ**) **gʲ b**} / V_V
Ex.: *topraqî* > *topraɣî* 'its territory', *yuräkimä* > *yurägimä* 'into my heart', *ğävapî* > *ğävabî* 'his response'[13]
This voicing did not involve **t** and only affected nouns, not verbs (*tapar* 'find', *cîqa* 'come out'). It did not introduce new segments.

4.1.1.14.
West Middle Iranian {**p t tʃ k**} > {**b d dʒ g**}/ V_
Ex.: *pitā* > *pid* 'father'[14]
Voiced stops had existed in Iranian, though not in the environment of this change specifically in West Middle Iranian, because there they had previously turned into fricatives (see 4.2.1.24, 25).

4.1.1.15.
Sogdian {**p t ts** (?) **tʃ k**} > {**b d dz** (?) **dʒ g**}/ N_
Ex.: Old Iranian *panca* > Sogdian *panǰ* 'five'[15]
Voiced stops are new in the inventory because original voiced stops had turned into fricatives in all environments in Sogdian, see 4.2.1.25. The present voicing was later generalised to all positions following a voiced segment.

4.1.1.16.
East Middle Iranian {**ft xt**} > {**βd ɣd**}
Ex.: Old Iranian *hapta* > **hafta* > Ossetic *avd* 'seven', *rixta* > *liɣd* 'escaped'[16]
The voiced fricatives resulting from this change had not existed in the earliest varieties of Iranian, but this was not their only source. The voicing specifically of clusters is somewhat untypical but clusters of voiced obstruents are characteristic of certain East Middle Iranian languages, especially of Sogdian.

4.1.1.17.
Khotanese and Tumshuqese {**f θ x**} > {**β ð ɣ**} / #_**r**
Ex.: **χrausa-* > **ɣruːs** 'to call'[17]
The same input segments are lost intervocalically and turn into stops initially if not followed by **r** (see 4.2.2.6). This change is one of the sources of voiced fricatives.

4.1.1.18.
Pashto {**p t k**} > {**b d g**}/ N_
Ex.: **hampānika-* > *banə́y* 'belly', *han-tāpakah* > *dobay* 'summer', *hankāra̯ia-* > *gor* 'see'[18]
The nasal disappeared much like in Hungarian and Permic. No new segment was introduced.

[13] Pritsak (1959a).
[14] Sundermann (1989:108).
[15] Sims-Williams (1989:178–180).
[16] Sims-Williams (1989:178–180).
[17] Emmerick (1989:213–4).
[18] Skjærvø (1989b).

4.1.1.19.
Ossetic {**p t tʃ**} > {**b** (> **v**) **d dz**} / V_, C[voiced]_
Ex.: **karta-* > *kard* 'sword', **tāpaya-* > *tavun* 'to heat', **ham-pūta* > *æmbud* 'rotten', **panca* > *fonʒ* 'five'[19]
The segment **b** remained unchanged only after **m**, it proceeded to **v** in all other voicing environments. The outputs are not new to the system with the exception of the voiced affricate **dz**. Note that **x** and **f** are not voiced in the same environment.

4.1.1.20.
Turkoman {voiceless obstruent} > {voiced} / _ {voiceless obstruent} or {voiceless obstruent}_
Ex.: **aktar-** > **agtar-** 'change', **baʃka** > **baʃga** 'other', **hattā** > **hatdā** 'same'[20]
A rather odd change, the only instance of contact voice dissimilation that we know of. The forms on the left of the arrow are preserved unchanged in Osmanli.

4.1.1.21.
Pre-Old Spanish {**p t k**} > {**b d g**} / V_(**r**)V
Ex.: La *cupa* > *cuba* 'barrell', *rota* > *rueta* 'wheel', *securus* > *seguro* 'sure'[21]
These voiced stops later turned into fricatives, see 4.2.1.1. Voiced stops were not new to the system, they existed already in Latin. As will be seen, intervocalic voicing is highly general in the Romance languages.

4.1.1.22.
Rhaeto-Romance {stops and affricates} > {voiced} / V_V
Ex.: La *rota* > *roda* 'wheel'[22]
The change did not introduce new elements.

4.1.1.23.
Portuguese {**p t k**} > {**b d g**}/ V_V
La *cupa* > *cuba* 'barrell', *rota* > *rueta* 'wheel', *securus* > *seguro* 'sure'[23]
The change did not introduce new elements.

4.1.2. Devoicing

4.1.2.1.
Old or Middle Spanish {**z̺ z**} > {**s̺ s**}
Ex.: *dezir* 'say', *espes̺o* 'spent', *casa* 'house'[24]
This is an unconditioned strengthening whereby an unanchored (**z̺**) and an anchored (**z**) segment disappeared from the system.

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[19] Thordarson (1989:464).
[20] Bazin (1959b:311).
[21] Penny (1991:67–71).
[22] Haiman–Benincà (1992:71–73).
[23] Teyssier (1980:11–20).
[24] Penny (1991:87–88).

4.1.2.2.
Lazio dialect of Italian **d** > **t** / # _ V and V_V
Ex.: *pedem* > *pete* 'foot', (*illa*) *dies* > *la ti* 'the day', *dentes* > *tienti* 'teeth', *decem* > *tieši* 'ten'[25]
This is a conditioned merger bound to an environment that is traditionally not regarded as a devoicing or strengthening environment. Elsewhere, e.g. in gemination, **d** remains voiced: *fice te acqua e dde terra* 'he created (it) from water and earth'.

4.1.2.3.
Old or Middle Spanish **ʒ** > **ʃ**
Ex.: *fijo* 'son'[26]
This is an unconditioned strengthening whereby an unanchored segment disappeared from the system. The postalveolar fricative **ʃ** later turned into **x**.

4.1.2.4.
Khakass **z** > **s** / _#
Ex.: *az* > *as* 'few'[27]

4.1.2.5.
Yakut **z** > **s** / _#
Ex.: **qîz* > *kîs* 'girl'[28]
In Yakut word final **s** can be the reflex of **z**, **ʃ** and **tʃ**. The same segments are affected in other positions by other, partly uniform, changes (see 4.2.1.21, 4.2.2.4, 4.2.2.5).

4.1.2.6.
Yakut **d** (**ð**) > **t**
Ex.: **adaq* > *atax* 'foot', **quduruq* > *kuturuk* 'tail'[29]
This is an unconditioned strengthening whereby a segment disappears from the system.

4.1.2.7.
Chuvash **d** (**ð**) > **t** / {**n l r**}_
Ex.: **qunduz* > *hantar* 'beaver'[30]
In a small number of examples the reflex is **tʃ** instead of **t**. This change did not result in a new segment.

4.1.2.8.
Rhaeto-Romance and northern Italian dialects {obstruent} > {voiceless} /_#
Ex.: La *legit* > ***ledʒ** > RR **letʃ** 'reads', *novus* > **ɲoːf** 'new', *integrum* > **intreg* > *intriek* 'complete', *ovum* > Piedmontese **øf** 'egg', *longus* > Milanese **loŋk**[31]
Word-final devoicing, which is typical of many languages, did not result in new segments.

[25] Rohlfs (1966:203–6).
[26] Penny (1991:87–88).
[27] Pritsak (1959d:608).
[28] Poppe (1959:677).
[29] Poppe (1959:678).
[30] Benzing (1959:710).
[31] Haiman–Benincà (1992:71–73), Rohlfs (1966:422 ff.).

4.1.2.9.
Toda **v** > **f** / V_V
Ex.: *kîfy* ~ Kannada *kivi*, Tamil *cevi* 'ear'[32]
The segment **f** is new to the language.

4.1.2.10.
Toda **v** > **p** / #_
Ex.: Toda *por-* ~ Tamil *varu* 'come', Toda *pel̥* ~ *viral* 'finger'[33]
This change resulted in partial merger, since the segment **p** existed previously in the system. Compare this with the preceding item as well as 4.2.2.15.

4.1.2.11.
Old Indic {obstruent} > {devoiced} /_#
Ex.: **suyug-* > *suyúk* 'well equipped'[34]
This change is a conditioned strengthening, which did not result in previously non-existent segments. It predates 4.1.1.7 and even Old Indic palatalisation.

4.1.3. Other phonation changes

4.1.3.1.
Balto-Slavonic, Celtic and Iranian {**bʱ dʱ gʱ**} > {**b d g**}
Ex.: IE **bʰerō(mi), bʰereti* > OChS *berY*, OIr *berid* 'I carry', **dʰūmus* > *dymᵘ* 'smoke', **gʰostis* > *gostⁱ* 'guest'[35]
This is an unconditioned merger, which resulted in merger with original **b d g**.

4.1.3.2.
Kurukh, Malto **t** > **tʰ** / V_V
Ex.: Ku *bitharna* ~ Ta *vetir* 'blossom', Malto *cithge* ~ Ta *citar* 'raindrop'[36]
In this position stops tend to voice and often turn into fricatives or approximants in the Dravidian languages. On this basis the present aspiration might be classified, though not necessarily, with weakenings.

4.1.3.3.
Latin {**bʱ dʱ**} > {**b d**} except word-initially
Ex.: IE **tibʰej* > La *tibi* 'to you', **medʰjos* > *medius* 'mid'[37]
This change did not result in new segments but, together with 4.2.1.42, it contributed to the disappearance of **bʱ dʱ**. Sihler (1995) assumes intermediate **pʰ tʰ**, which is, to our mind, unfounded.

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[32] Zvelebil (1970).
[33] Zvelebil (1970).
[34] Wackernagel (1896).
[35] Szemerényi (1990:57).
[36] Zvelebil (1970).
[37] Sihler (1995:193 ff.).

4.1.3.4.
Latin $\mathbf{g}^{ɦ}$ > **g** / N_
Ex.: IE *d^hing^ho* > La *fingo* 'I shape'[38]
This change did not result in a new segment but contributed to the disappearance of voiced aspirated segments. See also the previous item and 4.2.1.42.

4.2. Changes in the constriction of obstruents

4.2.1. Fricativisation of stops

4.2.1.1.
Pre-Old-Spanish {**b d g**} > {**β ð ɣ**} (> Ø) / V_(**r**)V
Ex.: La *cibus* 'food' > OSp *cevo* 'bait', *vadus* > *vado* 'ford', *legalis* > *leal* 'legal'[39]
For the dental and the velar the majority development is complete loss, but not for the labial. In this environment original voiceless and voiced stops partly fell together (see 4.1.1.21). Voiced fricatives were new elements in the system, they are in complementary distribution with voiced stops to this day. The fricativisation of **b** probably dates back to (Vulgar) Latin, whereby it coincided with original **w**, and by the end of the Old Spanish period with original **p** as well. Just like the voicing in 4.1.1.21, some form of the present change is also widespread in the Romance languages.

4.2.1.2.
Old–Middle Spanish {**ts dz**} > {**s̺ z̺**}
Ex.: *deçir* 'go down', *dezir* 'say'[40]
This change had no systemic effect in the Praguian sense; it was neither a split nor a merger. Strictly speaking it resulted in an unanchored fricative unless it is anchored by the palatoalveolar affricate and the palatoalveolar fricatives by the velar stops – probably a far-fetched and laboured solution.

4.2.1.3.
Southern Italian dialects {**b d g**} > {**v ð ɣ**} / V _ V and # _
Ex.: *bene* > *vene* 'well', *pedem* > *peðe* 'foot', *decem* > *ðece* 'ten'[41]
This change is a conditioned lenition, which resulted in a new set of segments. The output of the weakening of **d** can also be **r**. This weakening (similarly to the fortition in the same environment in 4.1.2.2) fails to take place after words triggering gemination (*radoppiamento sintattico*). The segment **ɣ** may be replaced by **j**, **v** or zero, e.g. Campanese *u vattə* = *il gatto* 'the cat', *i jattə* = *i gatti* 'the cats'.

4.2.1.4.
Greek (Koine) {$\mathbf{p^h\ t^h\ k^h}$} > {**f θ x**}/ except C[obstr] _
Ex.: *p^hero* 'I bring', *t^helo* 'I want', *k^hairo* 'I rejoice'[42]
This change introduced new segments. After obstruents the aspirated stops lost their aspiration, e.g. *$eleut^heria$* > *$*(e)left^heria$* > **lefteria** 'freedom'.

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[38] Sihler (1995:193 ff.).
[39] Penny (1991:67–71).
[40] Penny (1991:86–87).
[41] Rohlfs (1966:194–6, 203–9).
[42] Browning (1969).

4.2.1.5.
Middle Greek {**p k**} > {**f x**}/ _**t**
Ex.: ClGr *hepta* > MoGr **efta**, ClGr *oktō* > MoGr **oxto**[43]
This change is later than the previous one in all likelihood, thus it contributed to an already existing sound type.

4.2.1.6.
Greek (Koine) {**b d g**} > {**v ð ɣ/j**}
Ex.: ClGr *ballō* > **valo** 'I throw'[44]
This unconditioned change resulted in segments that were new to the language. Voiced stops reappeared later due to borrowed lexical items. Whether the reflex of **g** remained velar or turned palatal depended on the vocalic environment.

4.2.1.7.
Proto-Brittonic and Proto-Gaelic {**b d g**} > {**v ð ɣ**} / V_V
Ex.: Proto-Celtic *sodjo- > OIr **suðʲe** 'seat', **tegesos* > **tiɣʲe** 'house', La *probo* → Welsh *pro*[**v**]*i* 'approve'[45]
This change reulted in completely new segments. Similarly to **b**, **m** also underwent fricativisation, see 4.6.3. In Brittonic **ɣ** diappeared later.

4.2.1.8.
Proto-Brittonic {**p t k**} > {**f θ x**}/ C[liquid]_
Ex.: La *corpus* → Welsh *corff* 'body', **arto-* > *arth* 'bear', **marko-* > *march* 'horse'[46]
This change also led to completely new segments. The simple voiceless stops that resulted from earlier geminates in intervocalic position were fricativised in the same way.

4.2.1.9.
Proto-Gaelic {**t k**} > {**θ x**}/ V_V
Ex.: **katu-* > OIr **kaθ** 'battle', **leuk-* > **loxərn** 'lightning'[47]
This change also led to new segments. The stop **p** did not exist in Proto-Gaelic.

4.2.1.10.
Hungarian **p** > **f** / #_
Ex.: PU **päŋe-* > *fő* 'head'[48]
The segment **f** did not exist in the language prior to this change.

4.2.1.11.
Hungarian **k** > **x** / #_ V[back]
Ex.: PU **kala* > *hal* 'fish'[49]
The segment **x** was also new to the language. The same change took place in certain Ostiak and Vogul dialects independently of Hungarian.

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[43] Browning (1969).
[44] Browning (1969), Moravcsik (1989:53–55).
[45] Russell (1995:236 ff.).
[46] Russell (1995:115–6).
[47] Russell (1995:28–9)
[48] Rédei (1986–89), Sammallahti (1988:515), Bárczi (1962).
[49] Rédei (1986–89), Sammallahti (1988:516), Bárczi (1962).

4.2.1.12.
Proto-Permic **tʃ** > **ʃ** / S_S
Ex.: FP **pečä-* > Vot *pužim*, Zyr *požęm* 'pine'[50]
The segment resulting from this change was generally voiced later, see 4.1.1.6.

4.2.1.13.
Yakut **k** > **x** / #_V [nonhigh] and V [nonhigh]_#
Ex.: **qāz* > *χāz* 'goose'[51]
The segment **x** is new in all the Turkic languages in which it occurs, it did not exist in Proto-Turkic. Intervocalically the reflex of **k** is **g** or **ɣ**, neither of which is new.

4.2.1.14.
Khakass **tʃ** > **s** / #_ and _#; **tʃ** > **z** / V_V
Ex.: *čîn* > *sîn* 'true', *aɣač* > *aɣas* 'tree'[52]
Word-finally all sibilants are neutralised, word-internally only **tʃ** and original **s**. Cf. 4.1.2.4.

4.2.1.15.
Azerbaijani **dʒ** > **ʒ** / except **r**_
Ex.: **uğ* > *už* 'peak'[53]
This change resulted in a new segment. It partly parallels the next item.

4.2.1.16.
Azerbaijani **tʃ** > **ʃ** /_C and at the end of monosyllabic verb stems
Ex.: *sašdan* 'from (the) hair' ← *sač* 'hair', *ač* > *aš* 'open IMPER'[54]
The segment **ʃ** is probably new, its absence from Proto-Turkic is convincingly argued by Doerfer (1976).

4.2.1.17.
Azerbaijani **p** > **f** /_C and at the end of polysyllables
Ex.: *öfdüm* 'I kissed' but *öp* 'kiss IMPER'[55]
Voiceless fricatives except **s** are all new.

4.2.1.18.
Azerbaijani **k** > **x** / word-internally and at the end of monosyllables
Ex.: *baχ* 'look', *yîχar* 'turn up', *vaχt* 'time'[56]
See the comment at the previous change.

4.2.1.19.
Chagatai **k** > **x** / C_ and _C
Ex.: *toqluq* > *toχluq* 'contentedness', *uyqu* > *uyχu* 'sleeping'[57]
See the comment at 4.2.1.17.

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[50] Sammallahti (1988:532).
[51] Poppe (1959:677).
[52] Pritsak (1959d:608).
[53] Caferoğlu–Doerfer (1959).
[54] Caferoğlu–Doerfer (1959).
[55] Caferoğlu–Doerfer (1959).
[56] Caferoğlu–Doerfer (1959). It is possible that *vaχt* is a borrowing and the velar was a fricative already in Persian.
[57] Eckmann (1959b).

4.2.1.20.
Khorezmian (Turkic) **k** > **x** / _C
Ex.: *aqsaq* > *aχsaq* 'lame'[58]
See the comment at 4.2.1.17.

4.2.1.21.
Yakut **tʃ** > **s** / #_
Ex.: *čoq-* > *soχ-* 'crush'[59]
This is a conditioned weakening which did not result in a new segment. It merges original **tʃ** and **j** (cf. 4.6.7).

4.2.1.22.
Proto-Iranian {**p t k**} > {**f θ x**}/ _C
Ex.: Av, OPers *fra-* ~ Ve *prá-*, La *pro* 'before', OPers *afvā-* ~ Ve *apvā́-* 'panic'[60]
The fricatives are all new in Iranian except **s**.

4.2.1.23.
Avestan, Old Persian {**tsʲ dzʲ**} > {**s/θ z/ð**}
Ex.: Av *satəm* 'hundred'[61]
The palatalised affricates are the output of the palatalisation typical of the satem-languages. Their deaffrication is an unconditioned weakening (as in Slavonic, for instance).

4.2.1.24.
Avestan {**b d g**} > {**β ð ɣ**} / except #_, N_, {fricative}_
Ex.: **ugra-* > *uɣra-* 'strong'[62]
Voiced fricatives are new elements in the phonological system of the Iranian languages.

4.2.1.25.
Sogdian {**b d dʒ g**} > {**β ð ʒ ɣ**}
Ex.: OIran *bagāh* > *βaɣa* 'god'[63]
This change is an unconditioned weakening which resulted in partly new segments.

4.2.1.26.
Northern Pashto {**ts dz**} > {**s z**}
Ex.: *calor* 'four'[64]
This is an unconditioned weakening which resulted in merger.

4.2.1.27.
Ossetic **p** > **f** / #_
Ex.: **pāda-* > *fæd* 'foot'[65]
The other two voiceless stops, **k** and **t** remained unchanged. No new segment resulted.

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[58] Eckmann (1959a).
[59] Poppe (1959:679).
[60] Mayrhofer (1989:6–9).
[61] Mayrhofer (1989:6–9).
[62] Kellens (1989:41–42).
[63] Sims-Williams (1989:178–180)
[64] Skjærvø (1989b:384 ff.). The example is from Nyitrai (1999:1185).
[65] Thordarson (1989:464).

4.2.1.28.
Ossetic **g** > **ɣ** / except **ŋ**_
Ex.: **garma-* > *ɣarm* 'warm'[66]
It seems that there was no contrast between the two sounds either before or after the change.

4.2.1.29.
Ossetic **b** > **v** / V_V, C[voiced]_
Ex.: **tāpaya-* > *tavun* 'to warm'[67]
Compare this with 4.1.1.19. This change did not result in a new segment. As opposed to the other two voiced stops, **d** remained unchanged.

4.2.1.30.
Hungarian ({**p t k**} >) {**b d g**} >{**v z v**} / V(**r**)_V
Ex.: FU **orpa(sз)* ~ *orwa(sз)* > *árva* 'orphan', **kätз* > *kéz* 'hand', **(j)ikä* > *év* 'year'[68]
See also 4.1.1.3.

4.2.1.31.
Middle Indic {**b bʱ d dʱ dʒ g gʱ**} > {**β βʱ ð ðʱ ʒ ɣ ɣʱ**}/ V_V
Ex.: *kabha* > *kaβʰa* 'phlegm', *sōga* > *sōɣa* 'sorrow'[69]
This change followed on 4.1.1.8., this is why we give the same examples. Interestingly the retroflex stops were not affected (or turned into liquids, see 4.3.8). The fricatives resulting from this change were partly new but short-lived; they did not survive in Modern Indic.

4.2.1.32.
Vogul and Ostiak dialects {**tʃ tsʲ**} > {**s sʲ**}
Ex.: ObU **ćar* > Vog *sōr* 'flower', FU **čiŋз* > Ost *siw*, Vog *šäk* 'fog'[70]
This is an unconditioned weakening, which resulted in an unanchored fricative (**sʲ**).

4.2.1.33.
Balto-Slavonic {**k̟ g̟**} > {**ʃ ʒ**} (> {**s z**})
Ex.: IE **dek̟m̥t(om)* > Lit *dẽšimt*, OChS *desetь* 'ten', IE **g̟nə-* > Lit *žinaũ*, OChS *znajǫ* 'know'[71]
This change belongs to one of the most important Indo-European isoglosses. The so-called palatal stops (here marked as fronted velars) turned into palatal fricatives, probably via palatal affricates, in all satem languages. It some of these (as in Slavonic) they were later depalatalised.

[66] Thordarson (1989:464).
[67] Thordarson (1989:464).
[68] Rédei (1986–89), Sammallahti (1988:515–6), Kálmán (1965), Bárczi (1962).
[69] Masica (1991:180–1).
[70] Honti (1982).
[71] Schenker (1993:65).

4.2.1.34.
Balto-Slavonic **dʒ** > **ʒ**
Ex.: Proto-Balto-Slavonic **bage* > OChS *bože* 'God Voc', **lugjōm* > *lъzǫ* 'I lie'[72]
The affricate **dʒ** is the output of the First Palatalisation, and is the reflex of **g**. The deaffrication is already an unconditioned change, which created a new segment. The result of the parallel **k** > **tʃ** change is an affricate to this day.

4.2.1.35.
Slavonic **dz** > **z**
Ex.: Early Proto-Sl *gai̯l-* > Late Proto-Sl *dzēla* > Old Czech *zielo* 'very'[73]
The affricate **dz** results from **g** before (**ai̯** >) **e**, the so-called Second Palatalisation. Its deaffrication was unconditioned and did not affect its voiceless counterpart, just like in the previous change. The affricate **dz** merged with original **z**. The Glagolithic script of OChS still distingushed the two sounds, but the Cyrillic script no longer did. This change affected the majority of the Slavonic languages, but not e.g. Polish.

4.2.1.36.
Rhaeto-Romance {(voiced) obstruent} > {(voiced) fricative} / V_V
Ex.: La *bibere* > **bɛjvər** 'to drink', **cocere* > **keʒer** 'to cook'[74]
This change followed intervocalic voicing, thus in this position voiceless obstruents were no longer found when it took place. This change led to partly new segments (e.g. **ʒ**).

4.2.1.37.
Portuguese {**ts dz tʃ dʒ**} > {**s z ʃ ʒ**}
Ex.: *cem* 'hundred', *prezar* 'esteem', *chamar* 'shout', *gente* 'people'[75]
All the affricates result from earlier palatalisations. The deaffrication of **tʃ** is somewhat later than that of the other palato-alveolars. The present change was followed by the merger of its outputs and original **s z ʃ ʒ**, though there appears to have been a short period when **s** and the reflex of earlier **ts** differed.

4.2.1.38.
Biblical Hebrew and Aramaic {**p b t d k g**} > {**f v θ ð x ɣ**} / V_
Ex.: He *dābār* > **daːvaːr** 'word'[76]
This change created new segments with the exception of the dentals. Later changes led to the phonologisation of these.

4.2.1.39.
Southern Semitic **p** > **f**
Ex.: Ar, Eth *fqd* ~ Akk, He, Syr *pqd* 'to search'[77]
This is an unconditioned weakening which resulted in a new, unanchored segment.

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[72] Schenker (1993:69).
[73] Schenker (1993:73), Huntley (1993:133).
[74] Haiman–Benincà (1992:71–73).
[75] Teyssier (1980:11–20, 61–65).
[76] Moscati (1980:26).
[77] Moscati (1980:25).

4.2.1.40.
Dravidian (**k** >) **g** > {**v ɣ**} / V_V
Ex.: Literary Ta **makan** ~ Coll. Ta **maɣɛ̃**, Madras **mavɛ̃** 'boy'[78]
This change affected the majority of Dravidian languages and resulted in a new segment (**ɣ**). On this family see the comment on 4.2.2.15.

4.2.1.41.
Toda **t** > **θ** / V_V
Ex.: Ta **mutu** ~ To **muθ** 'old'[79]
The change created a new segment.

4.2.1.42.
Latin {**b^{ɦ} d^{ɦ}**} > {**f**} / #_
Ex.: IE *b^{h}erō > *fero* 'I carry', *d^{h}ūmos > *fumus* 'smoke'[80]

4.2.1.43.
Old Indic **tʃ** > **ʃ**
Ex.: IE **kṃtom* > Skt *śata* 'hundred'[81]
The original (Pre-)Old Indic affricate was the result of the satem-palatalisation. The voiceless, but not the voiced, affricate then underwent unconditioned deaffrication. This change resulted in a new segment (which may, in fact, have been closer phonetically to **ç** or **ɕ**).

4.2.1.44.
Western Romance languages **k** > **x** (> **j**) / _C
Ex.: La *factum* > Sp *hecho*, Fr *fait* 'fact, deed'[82]
The reflex of **g** also displays a palatalising effect, it probably turned into **j** through a fricative phase. The fricative **x** did nto exist in Latin. See also 4.4.8.

4.2.1.45.
Old French **tʃ dʒ** > **ʃ ʒ**
Ex.: *chose* 'thing', *jeu* 'play'[83]
As always in Romance, the affricates result from earlier palatalisation.

4.2.1.46.
Northern Italian dialects {**ts dz**} > {**s z**}
Ex.: Piedmontese *senre* ~ Standard It *cenere* 'ash' (< La *ciner-*), Ligurian *zeá* ~ Standard It *gelato* 'ice cream'[84]
The original affricates result from earlier palatalisation, they correspond to Standard Italian **tʃ dʒ**. The result of the present change may also be **θ ð**. Compare this with the previous item.

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[78] Zvelebil (1970).
[79] Zvelebil (1970).
[80] Sihler (1995:139 ff.).
[81] Burrow (1955:72–73).
[82] Penny (1991:60–62).
[83] Herman (1967).
[84] Rohlfs (1966:202–212).

4.2.2. Occlusion of fricatives

4.2.2.1.
Pre-Vogul **θ** > **t**
Ex.: ObU ***θ*ō*γəθ*> Vog *towt* 'chew'[85]
This is an unconditioned fortition which resulted in merger.

4.2.2.2.
Proto-Permic **s^j** > **c** / N_
Ex.: PU **kunce* > Proto-Finn-Permic -**ns^j**- > Vot *kiz*, Zyr *kuʒ́* 'urine'[86]
The nasal occluded and voiced (see 4.1.1.5) the fricative and was later lost. Permic *z* and **ʒ́** are voiced affricates.

4.2.2.3.
Yakut **ð** (**d**) > **t**
Ex.: **adaq* > *atax* 'foot', **quduruq* > *kuturuk* 'tail'[87]
This unconditioned strengthening led to the loss of a segment from the system. It is identical to 4.1.2.6; it is listed here as well because it necessarily involves the elimination of the **ð** ~ **d** allophony in favour of **d**.

4.2.2.4.
Yakut {**z ʃ**} > **t** / _# (in polysyllables)
Ex.: **-mîš* > *-bit* NOMEN PRAETERITI, **otuz* > *otut* 'thirty'[88]
This is an unconditioned strengthening resulting in partial merger.

4.2.2.5.
Yakut **s** > **t** / V_V
Ex.: **isig* > *itī* 'warm', **susaq* > *utaχ* 'thirst'[89]
A highly unusual change in phonetic terms. We suspect that **s** turned into **t** word-finally as well (cf. the previous item), though Poppe (1959) does not say anything about that. If it did, this change does not contradict the generalisation that manner changes confined to intervocalic position are always sonority-increasing.

4.2.2.6.
Khotanese and Tumshuqese {**f θ x**} > {**p^h t^h k^h**} / #_, except #_**r**
Ex.: **xara-* > *khara-* 'donkey'[90]
If the voiceless fricatives were followed by **r**, they were voiced and not occluded, cf. 4.1.1.17.

[85] Honti (1982), Sammallahti (1988:511).
[86] Rédei (1986–89), Sammallahti (1988:532).
[87] Poppe (1959:678).
[88] Poppe (1959:679).
[89] Poppe (1959:679).
[90] Emmerick (1989:213–4).

4.2.2.7.
Beluj {f θ x} > {p t k}
Ex.: *kopag* ~ Av *kaofa-* 'shoulder', *metag* ~ Av *maēθa* 'settlement', *kānī* ~ Av *xąniia-* 'fountain'[91]
This unconditioned strengthening led to the loss of voiceless fricatives. As opposed to other Iranian languages, Beluj shows virtually no weakenings.

4.2.2.8.
North-Eastern Pashto **ẓ > g**
This is also an unconditioned strengthening. It affected **ṣ** as well and turned it into **x**.[92]

4.2.2.9
Ossetic **θ > t**
Ex.: **paθana-* > *fætæn* 'wide'[93]
This unconditioned merger parallels fricativising tendencies in Ossetic, cf. 4.2.1.25–27.

4.2.2.10.
Iskashmi–Zebaki–Sanglechi **ð > d**
Ex.: Zebaki *pud* 'foot'[94]
This unconditioned strengthening led to the loss of what was probably an allophony rather than a contrast.

4.2.2.11.
Sanglechi **θ > t**
Ex.: *təv-* ~ Wakhi, Shughni *θaw-* 'burn'[95]
This is also an unconditioned strengthening, but with systemic effect since it led to the merger of contrasting segments.

4.2.2.12.
Macedonian **z > dz** / _C[sonorant]
Ex.: *zver* > *dzver* 'beast'[96]
The **z** in the input of this change is the reflex of an earlier **dz** which itself results from palatalisation. The earlier fricativisation, which is reversed in this change, is typical of most dialects.

4.2.2.13.
Aramaic **{θ ð θˠ} > {t d tˠ}**
Ex.: Proto-Semitic **y̲tb* > Aram *ytb* 'sit', **d̲hb* > *dhb* 'gold', **nṯr* > *nṭr* 'guard'[97]
This change comprises three unconditioned strengthenings, which caused mergers with already existing segments. The sounds transcribed as velarised here are traditionally called emphatic.

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[91] Elfenbein (1989:354).
[92] Skjærvø (1989b:384 ff.). The source gives no example.
[93] Thordarson (1989:464).
[94] Morgenstierne (1938:305), Payne (1989:424–5).
[95] Morgenstierne (1938:305), Payne (1989:424–5).
[96] Friedman (1993:254).
[97] Moscati (1980:28).

4.2.2.14.
Akkadian {ħ ʕ h ʔ} > ʔ
Ex.: Akk *'rb* ~ Ar *ǵrb* 'enter'[98]
This unconditioned strengthening (both devoicing and occlusion) reduced the number of back obstruents by three.

4.2.2.15.
Toda, Kannada **v** > {**b p**} / #_
Ex.: To *por-*, Kan *bar* ~ Tamil *varu* 'come', To *pe̥l*, Kan *beral* ~ *viral* 'finger'[99]
The reflex of word-initial **v** is voiced in Kannada, voiceless in Toda (see 4.1.2.10). Voiced and voiceless stops are in complementary distribution in the Dravidian languages; the voiced ones were originally confined to intervocalic position. Thus this change may have contributed to the phonologisation of **b**. For the development of **v** in Toda see also 4.1.2.9.

4.3. Stop to sonorant changes

4.3.1.
Pashto **t** > **l** / V_V
Ex.: **pitāram* > *plār* 'father'[100]

4.3.2.
Northern Bashkardi **t** > **r** / V_V
Ex.: *karōn* ~ Southern Bashkardi *katam* 'which'[101]

4.3.3.
Altaic Turkic **b** > **m** / #_
Ex.: Northern *mȫri* ~ Southern *bȫrü* 'wolf'[102]
In the languages in which it occurs this change is part of a general levelling whereby intervocalic **m** was replaced by **b**, see 4.5.10.

4.3.4.
Anatolian and Rumelian Turkic dialects **b** > **m** / S_S
Ex.: *gîrmač* ~ Osm *kırbaç* 'whip', *kämrä* ~ Osm *gübre* 'dung'[103]
This change resulted in no new segment. Compare the previous item.

4.3.5.
Karakand and other Turkic languages **b** > **m** / #_VN
Ex.: **baŋa* > *maŋa* 'to me', **beŋiz* > *meŋiz* 'face'[104]
This change resulted in no new segment. Compare the previous two items.

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[98] Moscati (1980:29).
[99] Zvelebil (1970).
[100] Skjærvø (1989b:384 ff.).
[101] Skjærvø (1989a:363 ff.).
[102] Pritsak (1959c:579).
[103] Caferoğlu (1959:251).
[104] Mansuroğlu (1959a:94).

4.3.6.
Slovene **dʲ > j**
Ex.: **medja* > *méja* ‘border’[105]
This change resulted in no new segment.

4.3.7.
Dravidian (**k** >) **g** > **j** / V_V
Ex.: Literary Ta **makan** ~ Ramnad Pallar **majen** ‘boy’[106]
This change resulted in no new segment.

4.3.8.
Pali {**ḍ ḍ̤**} > {**ḷ ḷ̤**}/ V_V
Ex.: Skt *pīḍ̥ā* > Pali *pīḷ̥ā* ‘pain’[107]
Retroflex laterals, which did not exist prior to this change, remained in an allophonic relation with the stops.

4.4. Fricative to sonorant changes

4.4.1.
Pashto **f > w** / V_V
Ex.: **škafa-* > *cəw-* ‘cleave’[108]

4.4.2.
Pashto **θ > l** / #_, V_V
Ex.: **θai̯u̯ar* > *lewar* ‘brother-in-law’, **caθu̯ārah* > *calor* ‘four’[109]

4.4.3.
Northern Bashkardi **f > w** /_**t**
Ex.: *hōwtar* ~ Southern *haptōr* ‘hyena’[110]

4.4.4.
Chuvash **z** and **ð > r**
Ex.: **adaq* > *ura* ‘foot’[111]
After sonorants **z** turned into **t** instead of **r**, see 4.1.2.7.

4.4.5.
Chagatai **ð > j** / V_V, _#
Ex.: *uð* > *uy* ‘cow’, *bäðük* > *biyik* ‘big’[112]

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[105] Priestley (1993:396).
[106] Zvelebil (1970).
[107] Masica (1991:170).
[108] Skjærvø (1989b:384 ff.).
[109] Skjærvø (1989b:384 ff.).
[110] Skjærvø (1989a).
[111] Benzing (1959:710).
[112] Eckmann (1959b:147).

4.4.6.
Ob-Ugric **ð** > **l**
Ex.: **pid̵e-* > Ost *pǎl* 'high', Vog *pǟlt* 'length'[113]
This unconditioned weakening resulted in merger. The distribution of **ð** had been very small even before its disappearance.

4.4.7.
Latin **z** > **r** / V_V
Ex.: **genes-es* > *generis* 'kind GEN'[114]
The segment **z** was the variant of **s** intervocalically and before voiced consonants. In the latter environment it was dropped.

4.4.8.
Western Romance languages **k** > **x** (> **j**) / _C
Ex.: La *factum* > Sp *hecho*, Fr *fait* 'fact, deed'[115]
Cf. 4.2.1.44. If this change is interpreted as the weakening of **x**, it is unconditioned. If it is interpreted as the weakening of **k**, it is conditioned.

4.5. Sonorant to stop changes

4.5.1.
Rhaeto-Romance dialects {**j w**} > **g** or **k** / _C
Ex.: La *durus* > **dykr̥**, **dɛkr̥** 'hard', *lupus* > **lukf** 'wolf', *laborat* > **ləvogrə** '(he) works', G *Bauer* → **pokr̥** (MASC), **pogra** (FEM) 'peasant'[116]
In *durus, lupus, laborat* the strengthening glide is the excrescence of the stressed vowel, which diphthongised in early Romance. The stop appears as **k** when followed by a voiceless consonant.

4.5.2.
New Indo-Aryan **w** > **b** / #_
Ex.: Skt *vivāha* > Hi *byāh*, Be *biyā* 'wedding'[117]
This change, which did not result in a new segment, affected the majority of the Indo-Aryan languages.

4.5.3.
Middle Indic {**r l**} > **b** / **m**_
Ex.: Skt *tāmra* > Pali *tamba* 'copper', *amla* > *amba* 'sour'[118]
This change did not result in a new segment. What probably happened here is that an epenthetic **b** was inserted between **m** and the liquid and the resulting **bl, br** clusters were simplified in harmony with the general Middle Indic tendency through loss of the liquid.

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[113] Rédei (1986–89), Sammallahti (1988:518).
[114] Sihler (1995).
[115] Penny (1991:60–62).
[116] Haiman–Benincà (1992:44–47), and Kaisse (1992), who takes data from Kamprath (1986) and (1987).
[117] Masica (1991:202–3).
[118] Masica (1991:175–6).

4.5.4.
Hungarian **j** > **ɟ** / _V[low]
Ex.: FU **jalka* > *gyalog* 'on foot'[119]
This change has been one of the sources of **ɟ** besides 4.1.1.4.

4.5.5.
Classical Greek **j** > **c** (> **t**) / {**p** $\mathbf{p^h}$}_
Ex.: **tupjō* > *typtō* 'I hit'[120]
The segment **c** did not exist originally in the ancestor of Classical Greek, but this change was not its only source.

4.5.6.
Romance **j** > **dʒ** / #_
Ex.: La *januarius* > It *gennaio* 'January', *jocus* > Fr *jeu* 'game, play'[121]
In **dʒ** original **j** and **g** coincided, the latter when before a palatal vowel. This change is typical of the overwhelming majority of Romance languages; in some of them (e.g. French, Portuguese), **dʒ** was later deaffricated to **ʒ** (see 4.2.1.37 and 4.2.1.45).

4.5.7.
Kazan Tatar and West Siberian Turkic **j** > **dʒ** / #_**i** and #_V**j**
Ex.: **yer* > *ǧir* 'place', **yay* > *ǧäy* 'summer'[122]
On **dʒ** see 4.1.1.12.

4.5.8.
Azerbaijani dialects **m** > **b̥** / **p**_
Ex.: **öpm-* > *öpbäχ́* 'kiss'[123]

4.5.9.
Khakass **j** > **tʃ** or **dʒ** / #_
Ex.: **yoq* > *čoχ* 'no', **yäl* > *čil* 'wind'[124]
This change resulted in no new segment. Its output is sometimes **ʃ**.

4.5.10.
Altaic Turkic **m** > **b** / V_V
Ex.: Northern *tuban* ~ Southern *tuman* 'fog', *täbir* ~ *tämir* 'iron'[125]
Cf. 4.3.3.

4.5.11.
Middle Indic **j** > **dʒ** / #_
Ex.: Skt *yama* > Prkt *jama* 'death god'[126]

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[119] Rédei (1986–89), Sammallahti (1988:519).
[120] Sihler (1995).
[121] Herman (1967), Penny (1991).
[122] Thomsen (1959:413).
[123] Caferoğlu–Doerfer (1959).
[124] Pritsak (1959d:609).
[125] Pritsak (1959c:579).
[126] Masica (1991:169).

4.5.12.
Italian **w** > **bb** / _ **j**
Ex.: La *cavea* > *gabbia* ‘cage’[127]
In this environment **w** and **b** merged, cf. *rabia* > *rabbia* ‘anger’.

4.6. Sonorant to fricative changes

4.6.1.
Old Spanish **ʎ** > **ʒ**
Ex.: La *mulier* > *mugier/mujer* ‘woman’[128]
The segment **ʒ** did not exist in Latin, but it could emerge due to other changes as well, primarily syntagmatic fusions.

4.6.2.
Greek (Koine) **w** > **v** or **f**
Ex.: *eleut*^{h}*eria* > **lefteria** ‘freedom’[129]
The fricative emerged as voiceless only before voiceless consonants. This change led to the loss of **w**. The labial fricatives did not exist in Classical Greek, but were introduced by changes that are at least contemporaneous with, or prior to, the present change (cf. 4.2.1.4 and 4.2.1.6).

4.6.3.
Proto-Brittonic and Proto-Gaelic **m** > **ṽ** / V_V
Ex.: La *similis* → OIr **saṽal**^{j} ‘similar’[130]
This change introduced a new segment, which later denasalised and fell in with the **v** that resulted from the lenition of **b**. The other nasals remain unchanged. Cf. 4.2.1.7.

4.6.4.
Hungarian **m** > **v** / V_V
Ex.: FU **kumɜ-* ‘frost’ > *hó/hav-* ‘snow’[131]
Phonetically this change is probably the same as the previous Celtic one, and Hungarian **v** in these words developed through a nasalised labial or labiodental approximant. Bárczi (1962) suggests an intermediate **b** stage, which is, to our mind, an unfounded hypothesis. The actual output of this change is in several respects closer to an approximant even today than to a fricative. See also the next change.

4.6.5.
Hungarian **ŋ** > **j** or **v** (or ∅) / V_V
Ex.: FU * *aŋe* > *aj(ak)* ‘lips’[132]
This change parallels the previous one. Bárczi (1962) suggests an intermediate **g** stage, but we find a velar (originally nasalised) approximant phonetically much more likely.

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[127] Rohlfs (1966:386–7).
[128] Penny (1991:55, 61).
[129] Browning (1969), Moravcsik (1989:53–55).
[130] Russell (1995:30, 236 ff.).
[131] Rédei (1986–89), Sammallahti (1988:517), Bárczi (1962).
[132] Rédei (1986–89), Sammallahti (1988:518), Bárczi (1962).

4.6.6.
Uyghur **j** > **ʒ** / #_V[high]
Ex.: *yïl* > *žil* 'year', *yüräk* > *žüräk* 'heart'[133]

4.6.7.
Yakut **j** > **s** / #_
Ex.: **yōq* > *suoχ* 'no'[134]
Word-initial **j** thus coincided with original **tʃ**, cf. 4.2.1.21.

4.7. Systemic aspects of the changes

4.7.1. The data

What conclusions can be drawn from this set of data? The first and most important one is that sonority-increasing changes (4.1.1, 4.2.1, 4.3 and 4.4) are virtually always conditioned, whereas sonority-decreasing ones (4.1.2, 4.2.2, 4.5 and 4.6) are often unconditioned. In terms of numbers this means the following for lenitions. In 4.1.1 there is no exception, there is not a single unconditioned change. In 4.2.1 thirteen out of the 46 are unconditioned. It is significant that ten out of the thirteen affect affricates that are palatal or result from palatalisation. In 6.2. we shall discuss the palatal phenomenon in detail and propose an explanation for the exceptional behaviour of this class of segments. The remaining three changes in 4.2.1 are Koine spirantisation (4.2.1.6), Sogdian spirantisation (4.2.1.25) and the **p** > **f** change typical of Southern Semitic (4.2.1.39). In 4.3 there is only one, in 4.4 two unconditioned changes.

As for fortitions, what we can see is this. In 4.1.2 three out of the eleven changes are unconditioned; in 4.2.2 nine out of the fifteen; in 4.5 there is not a single unconditioned change among the twelve, in 4.6 only two out of the seven are unconditioned.

This has the following consequences for the implicational hierarchy. Because of the correlation we demonstrated between sonority and the implicational structure of consonant systems weakenings often result in segments that did not exist in the phonological system prior to the change, but this is not typical of strengthenings. If a strengthening is conditioned, it does not affect the phonological system, only the distribution of some of its members. Unconditioned strengthenings, by contrast, can shrink the system by causing mergers. Of the fourteen unconditioned strengthenings above there is not one that introduced a new segment into the phonological inventory. Of the 31 conditioned strengthenings there are only four that definitely introduced a new member (4.1.2.9, 4.2.2.12, 4.5.8 and 4.6.6) and two are likely to have done so (4.2.2.6, 4.5.7). Item 4.2.2.15 did not introduce a new segment but contributed to the phonologisation of an allophone. Items 4.5.4, 4.5.5 and 4.5.6 had outputs that were new with respect to some earlier stage of the language, and their chronological relation to other changes resulting in the same segments is not always entirely unambiguous, but it is clear that they were not the primary sources of those new segments.

[133] Pritsak (1959b:541).
[134] Poppe (1959:679).

Let us finally turn to those changes where sonority relations are unclear. Item 4.1.3.1, a change that affected a large number of languages, obviously erases an implicationally dependent series of stops (voiced aspirates) through merging them with a more basic series (plain voiced), on which the former immediately depended. Items 4.1.3.3 and 4.1.3.4 get rid of the same stops in Latin through conditioned mergers (4.2.1.42 turns the same Pre-Latin stops into fricatives in other environments). The change in 4.1.3.2 is a riddle from our point of view. We are unable to determine with certainty the status of aspirated stops in the implicational hierarchy, but from what we have gathered about the comparative phonology of Dravidian we suspect that they are more likely to be secondary as opposed to unaspirated stops.

4.7.2. The interpretation of the data

Our main findings can be summarised as follows. *Lenition often results in segments that first appear in the sound system because of the lenition and the output of the change is often implicationally dependent on its input. This is why lenitions are practically always conditioned* (with the exception of palatals, to be discussed later), *and, on the basis of what we have seen, do not tend to end up unconditioned even in the long run: if their input completely disappeared from the system, their output would be unanchored.* The input and the output of such changes are not related implicationally if the input is a fricative and the output is a sonorant. As we will see when discussing Germanic, this is why the unconditioned **z** > **r** change does not contradict the generalisation we have put forward – and it also does not enlarge the phonological system. Changes from obstruents to sonorants probably have to be interpreted differently in the typological framework, but this does not belong to the topic of this work.

In the case of fortitions too, there is an implicational relation between the input and the output – at least when both are obstruents. This is related to the fact that fortitions can be both conditioned and unconditioned, but they typically do not have outputs that previously did not exist in the language. If a fortition had an output that is new to the system, then that output would be the one that should have anchored the input of the change earlier (as in a hypothetical case of a **f** > **p** strengthening in a **p**-less language). *Consequently fortitions can freely shrink phonological systems, which lenitions typically cannot.*

It is important to stress at this point what does not follow from our hypothesis. We do not claim that it is the function of lenitions in any sense to enlarge the phonological system or that it is the function of fortitions to shrink it. This would only be compatible with a teleological concept of sound change to which we do not subscribe. What we do claim is that in the phonologisation, i.e. the emergence as base variants, of the outputs of sound changes systemic pressures play some channelling role. These pressures can be empirically verified on a typological basis and can be conceptualised in the form of an implicational hierarchy. These systemic pressures only define the limiting conditions of changes and do not cause or trigger them in any sense.

4.7.3. The environments of the changes

When making generalisations about the environments of lenitions and fortitions, we have to be much more cautious than is usual. It is clear, but verges on the tautological, that for the voicing of voiceless segments at least one voiced segment has to be next to the affected segment. More generally lenitions often happen in an intervocalic or intersonorant environment – again a time-honoured observation.[135] But one must always keep in mind cases like Old Indic, in which the voicing of word-final obstruents far predates the voicing of intervocalic ones (4.1.1.7), or those Turkic languages (e.g. Chagatai in 4.1.1.10) in which word-initial, but not intervocalic **t** was voiced. These show that intervocalic position is not necessarily a preferred position for weakening: language-specific cases may single out other environments. One must also consider cases when (as in Chuvash, 4.1.2.7) the vicinity of sonorants results in strengthening rather than weakening. A comparison of 4.2.1.3 and 4.1.2.2 shows that even in two dialects of the same language, which generally have the same segmental inventory and the same phonotactic pattern, one and the same segment may undergo weakening in one dialect and strengthening in the other in exactly the same environment.

The effects of word-initial position are similarly ambiguous in terms of conditioning lenition; generalisations are virtually impossible to make. In Chagatai (see above) it triggered weakening, in Avestan (4.2.1.14) it prevented one. In Khotanese and Tumshuqese initial weakening takes place if the segment is followed by **r**, but strengthening if it is followed by a vowel (see 4.1.1.17 and 4.2.2.6). Weakening can be conditioned by an adjacent obstruent or consonant in general (see 4.2.1.5, 4.2.1.17, 4.2.1.19, 4.2.1.20, 4.2.1.22, 4.4.5, 4.4.3, 4.4.8). What we see in Greek is perhaps the manifestation of an overall syntagmatic pattern, namely a preference for [+continuant][–continuant] consonant clusters (much like in Germanic, see Chapter 5). Proto-Iranian is superficially similar (4.2.1.22), but the fact that weakening takes place word-initially too shows that there is no such principle behind it.

The environments of fortition are similarly varied. They happen word-initially, word-finally, before consonants (e.g. 4.5.1) and post-nasal position apparently favours the formation of stops (4.5.3, 4.2.2.2). One finds intervocalic strengthening in Toda (4.1.2.9), in Italian (4.1.2.2) and in Yakut (4.2.2.5). In Toda strengthening is not confined to intervocalic position, that is only one of its environments. What all this shows is that generalisations about the environments of weakening and strengthening must be made with the utmost care; they may be much more elusive than the cursory or non-chalant treatment this question tends to receive would imply. We have been able to make only one generalisation based on the material we have collected. This is that if a manner change is confined to intervocalic position, then that change is a weakening. This generalisation does not mean that strengthening does not happen intrevocalically: the facts obviously show the opposite. What it means is that strengthenings are not confined to intervocalic position. The Yakut change in 4.2.2.5 may contradict even this weak and rather obvious generalisation, though we suspect that a thorough study of the history of that language may reveal the counterexample not to be a counterexample after all. *In sum, it seems to us that while certain weak generalisations can be made about the environments conducive to lenition, it is not possible to assign typical environments to fortition.*

[135] Among others, Westbury and Keating (1986) seek a phonetic answer to the question what conditions are conducive to the voicing of stops – having criticised markedness theory for not giving phonetic content to its central notion. In particular they investigate the environments in which it is easier to articulate voiced rather than voiceless stops. Not surprisingly they come to the conclusion that at the beginning and at the end of an utterance voiceless stops, medially voiced stops are easier to pronounce.

5. A SURVEY OF THE HISTORY OF THE GERMANIC OBSTRUENT SYSTEM(S)

In this chapter we give a systematic presentation of the development of the system of obstruents from Proto-Indo-European through Proto-Germanic to the individual Germanic languages. Our chief concern in doing so will be the verification of the hypothesis we put forward at the end of the previous chapter, i.e. to see if Germanic shows conditioned lenitions that enlarge the consonant system and unconditioned fortitions that may reduce it. The discussion in this chapter is divided into the following parts: Proto-Germanic; Gothic; West Germanic and within that English, High German, Low German and Dutch; finally, Scandinavian.

5.1. Proto-Indo-European and the Proto-Germanic innovations

The reconstructed PIE obstruent system consisted of one fricative (**s**) and more than ten stops.[1] Places of articulation for these were labial, dental, palatal, velar and labiovelar, but each language preserved four of these at most. In the western (or centum) IE languages, among them in Germanic, palatals and velars merged in a velar series. In the eastern (or satem) IE languages velars and labiovelars merged in a velar series and palatals developed into sibilant fricatives or affricates. Consequently the obstruent system of each IE language taken separately can be deduced from four places of articulation instead of five.[2] As for the manner classes of stops the overwhelming majority of Indo-Europeanists agrees that there were three: plain voiceless, plain voiced and voiced aspirated. The last of these has also been called breathy voiced recently.

Some assume a further class, that of voiceless aspirated stops (see Szemerényi 1990:69–70, 152–3). These sounds have reflexes separate from the other manner classes only in Indic, but there voiceless aspirated stops can be explained with reference to morphological as well as areal factors. This debate will not be pursued in this work any further because even if we agreed with those who assume a fourth class, this would make no difference for Germanic, since in all the proposed cases these stops show the same reflexes as plain voiceless stops. The difference between plain voiceless and putative voiceless aspirated stops is just as immaterial as that between palatal and velar stops. The conclu-

[1] The immense literature on this topic will not be surveyed and listed here. We will confine ourselves to what is essential for our purposes. The classic comprehensive work in the Indo-European proto-language is Szemerényi (1990), in a shorter version Szemerényi (1972). The most thorough and most up-to-date work on the segmental phonology of PIE is Mayrhofer (1986:73–177). On the problem of PIE **θ**, assumed by eminent scholars in the past, see Mayrhofer (1986:151–8).

[2] Though certain details in the development of vowels in the satem languages point to a difference between velar and labiovelar consonants in their vicinity, see Mayrhofer (1986:104–5).

sions of this chapter would not be affected, no matter how we take sides on this issue, so we will assume the smaller (and more probable) system without voiceless aspirated stops.

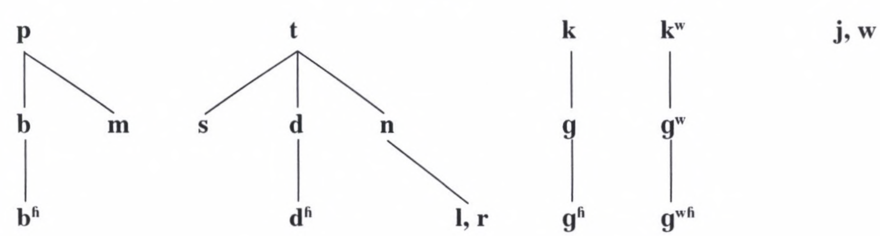
The entire stop system of PIE was reconstructed in a radically different way by a group of linguists who proposed what is now customarily referred to as the 'glottalic theory'. From the 1970's on Gamkrelidze, Ivanov and Hopper have argued that PIE stops had phonation types rather different from what had been assumed since the nineteenth century. The traditional plain voiceless series is for them voiceless aspirated, traditional voiced aspirated is breathy voiced (i.e. the same), traditional plain voiced is for them ejective. It is this last claim that caused most uproar among Indo-Europeanists. We will not survey the arguments, since this has been done by more knowledgeable linguists, see Collinge (1985:259 ff.), Szemerényi (1990:159–163) and Mayrhofer (1986:92–96 and passim). We take it – as the great majority of linguists does – that the three phonation types were as is traditional, plain voiceless, plain voiced and voiced aspirated.

We will not discuss the question of laryngeals at all. Laryngeals were fricatives which are documented as such only in the oldest attested language of the family, Hittite, in all other languages they appear as vowels or as anomalies in vowel alternation patterns (called ablaut). This is an even older and even more extensively discussed problem, though hardly anyone nowadays doubts the necessity of their reconstruction.[3] Given, however, the general uncertainty surrounding their phonetic nature and given the fact that with the exception of Hittite they emerge as vowels of some kind in all IE languages, we have decided that it is wiser to leave them out of this discussion.

Considering all these, we shall take the following to be the PIE obstruent system:

(25)	**p**	**t**	**k**	**k**^{w}
	b	**d**	**g**	**g**^{w}
	b^{ɦ}	**d**^{ɦ}	**g**^{ɦ}	**g**^{wɦ}
		s		

On a typological basis, the hierarchy of phonation types coincides with the order in which we have tabulated the three classes here: primary phonation is voicelessness, secondary phonation is voice, tertiary phonation is breathy voice. The implicational structure of the entire consonant system (excluding laryngeals) may be set out as follows:

(26)


[3] The literature on laryngeals is huge; for a conspectus one is advised to consult Szemerényi (1973) for earlier, Bammesberger (1988), Szemerényi (1990:127–137) and Mayrhofer (1986:121–150) for more recent developments.

In Proto-Germanic, the obstruent system was reshuffled in three steps collectively called Grimm's Law. The three steps were these:

(27a) All voiceless stops were replaced by voiceless fricatives unless preceded by an obstruent.
(27b) All voiced stops were replaced by voiceless stops.
(27c) All voiced aspirated stops were replaced by voiced fricatives intervocalically and word-finally, by voiced stops elsewhere.

The English data in the following three columns correspond to (27 a, b, c) respectively:[4]

(28)			
	p: **pēd-/pōd- > foot*	**b**: **abl- > apple*[5]	**b**^{ɦ}: **b*^{h}*er- > bear*
	t: **trejes > three*	**d**: **duo > two*	**d**^{ɦ}: **d*^{h}*ō- > do*
	k: **kap(j)- > have*	**g**: **genos > kin*	**g**^{ɦ}: **g*^{h}*ostis > guest*
	k^{w}: **k*^{w}*od > what*	**g**^{w}: **g*^{w}*ēn- > queen*	**g**^{wɦ}: **seng*^{wh}*- > sing*[6]

The first change (27a), as indicated, does not take place if another obstruent precedes the stop, e.g. PIE **stə-* > E *stand*, **oktōw* > *eight*. The third step (27c) requires some explanation. The two kinds of obstruents (voiced fricatives and voiced stops) that replaced voiced aspirated stops remained in an allophonic relation for a long time. The Proto-Germanic distribution of the two kinds of allophones has been determined by Moulton (1954, 1972) on the basis of their distribution in the oldest documented Germanic languages and through reconstruction of the phonetic content of the letters denoting them. Moulton, who worked with the greatest philological precision, arrived at the following:[7]

(29)		/b/	/d/	/g/
	gemination	**bb**	**dd**	**gg**
	N_	**mb**	**nd**	**ŋg**
	#_	**#b**	**#d**	**#ɣ**
	l_	**lv**	**ld**	**lɣ**
	r_, _#, V_V	**v**	**ð**	**ɣ**

[4] We have chosen English because it has a conservative consonant system from this point of view. We are aware that reconstructed Proto-Germanic examples would have been more in style and certainly more decorative, but not necessarily more useful.

[5] Stems containing PIE **b** are very few and are not generally accepted. Some linguists have argued that PIE actually lacked such a sound.

[6] The reflexes of PIE **g**^{wɦ} are notoriously varied and irregular in Germanic (as indeed in several other IE languages), which makes it exceptional among the PIE stops. It only appears as a stop in post-nasal position. For other reflexes see Prokosch (1939:71–74).

[7] Moulton regards **β** instead of **v** as the fricative variant of **b** and this is a tradition followed by many linguists. We will use the symbol **v** throughout for three reasons. (i) The difference between **β** and **v** is irrelevant to our concerns. (ii) This sound is almost certainly **v** is the documented periods of all the Germanic languages. (iii) We are not at all convinced of the phonetic reality of the reconstruction of **β** instead of **v** for Proto-Germanic.

These three (or six) segments never occurred next to a voiceless sound for phonotactic reasons, mainly inherited from Proto-Indo-European. There are two points of detail in Moulton's phonotactic reconstructions that do not appear well-founded to us. (i) Moulton claims that the set of phonotactically permitted consonant clusters includes **ɣð**, even though there is only one example of it (Go *gahugd*, OE *hygd*, OHG *huct*, OS *gihugd* 'thought'). In this cluster there is no evidence that the second obstruent was a fricative rather than a stop and given that it is a suffix (cf. OE *hycgan* < **hugjan* 'to think') the phonotactic properties of the whole cluster are less relevant anyhow. (ii) Moulton suggests **ð** instead of **d** after **z** (**mizðō* 'reward'), but here again he has no evidence whatsoever.

The relative chronology of the three steps is a matter of debate. What is clear is only that stops of the three different manners of articulation did not merge with each other.[8] What follows from this is that step two (**b** > **p** etc.) cannot have preceded step one (**p** > **f**), since in that case the reflexes of PIE voiced stops would be Gmc voiceless fricatives. Similarly, step three (**b**^{ɦ} > **b/v**) cannot have preceded step two (**b** > **p**), since in that case there would be no voiced stops at all in Germanic, only fricatives and voiceless stops.[9] If the three steps happened consecutively, the most probable order is that given above. But they may also have happened more or less simultaneously (as suggested by Fourquet 1948),[10] in which case the three steps do not separate real temporal phases and diachronic stages. This question is ultimately not a very important one; for us the chronology of Grimm's Law is a primarily a "virtual" chronology that reflects structural relations.

The first of the three steps (27a) is a conditioned sonority-increasing change.[11] It introduced new segments into the phonological system, for whose existence before Grimm's Law, even as positional variants, there is no evidence whatsoever (contrary to what Streitberg 1896:113 claims). These new segments (voiceless fricatives) are typologically secondary to their sources (voiceless stops). This change is thus fully in harmony with our hypothesis.

The second step (27b), by contrast, is a typical fortition. It was an unconditioned change, we know of no environments or lexical items that it skipped. Being a sonority-decreasing change it involved upward movement on the implicational hierarchy and its outputs were segments that existed in the (post-27a) system, even if only as variants. In step one (27a) PIE voiceless stops did not turn into fricatives precisely in those environments in which they did not contrast with voiced stops since the latter could not occur after (voiceless) obstruents. This means in particular the clusters **sp, st, sk, pt, kt**. These were neutralising environments already in Proto-Indo-European for two reasons: (i) word-initial **s** could only be followed by voiceless stops (a sort of progressive assimilation); (ii) word-internally regressive voicing assimilation (or identity) was compulsory, consequently in the

[8] For a survey of the different chronologies proposed for Grimm's Law see Collinge (1985:69), Cser (1994:65–67).

[9] *Pace* Kluge and Twaddell, whose chronologies are quoted and discussed in Martinet (1937) and Abrahams (1949). They hypothesise that voiced aspirated stops first turned into voiced fricatives in all environments, and the occlusion of these fricatives in the appropriate contexts is a later phenomenon independent of Grimm's (as well as Verner's) Law. The precise chronologies they assume are these: **b**^{h} > **β**, **p** > **f**, **b** > **p** (Kluge), **p** > **f**, **b**^{h} > **β**, **b** > **p** (Twaddell). We agree with Moulton that in the absence of any evidence for the lack of voiced stops in early Proto-Germanic no such phase should be assumed.

[10] Though Fourquet proposes that voiceless stops were only aspirated in the course of Grimm's Law, the fricativisation **p**^{h} > **f** is a later "weakening" (*relâchement*) independent of and later than the Law itself.

[11] It is actually a classic case of "negative conditioning", on which see 0.2.

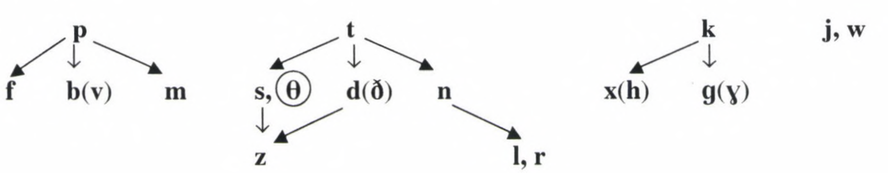
static phonotactic pattern **s**, **p** and **k** could only be followed by **t**, never **d** (even if it was the **t** that actually caused the voicelessness of **p** or **k**).[12] What this means in terms of phonological contrasts is that in the "phase" between (27a) and (27b) voiceless stops were in complementary distribution with both voiceless fricatives and voiced stops, since in the second slot of the five (rather frequent) consonant clusters listed above only voiceless stops were permitted, the other two kinds of obstruents were not.

The interpretation of step three (27c) is not as straightforward from our point of view as that of the other two. It resulted in an allophony that was phonologised in the daughter languages only a millennium or two later. Since the distribution of voiced stops appears wider and phonetically less motivated than that of voiced fricatives, we shall take the former to be the base variants. If we took voiced fricatives to be the base variants (as for instance Lass 1994 does), they would be unanchored. The change (27c) is definitely conditioned and it turns stops of tertiary phonation into stops of secondary phonation or fricatives of secondary phonation depending on the context. Thus it can be interpreted as movement up the implicational hierarchy only in part.

The last important change that contributed to the formation of the Germanic consonant system is Verner's Law. It involved the voicing of those voiceless fricatives that were (i) not word-initial; (ii) not adjacent to a voiceless sound; (iii) preceded by an unstressed syllable nucleus.[13] The voiceless fricatives that satisfied these three criteria turned into voiced fricatives or stops (except **z**) depending on the allophonic rule. Strictly speaking this change did not alter the structure of the consonant system, it only made the choice between voiced and voiceless fricatives predictable in one direction. It further introduced a new segment, the voiced allophone (**z**) of **s**. Verner's Law did not result in total redundancy as far as the voicing of fricatives was concerned, since word-internal voiced fricatives were not devoiced after stress, so the presence of a voiceless instead of a voiced fricative in a given context became predictable, but not the other way round. Even this limited redundancy disappeared not much later, when word stress became fixed on stem-initial syllables. With this shift voiced and voiceless fricatives came into contrast again and **s** and **z** also became separate base variants since their choice no longer depended on the environment.

After all these formative changes the consonant system of Proto-Germanic looked as follows:

(30)



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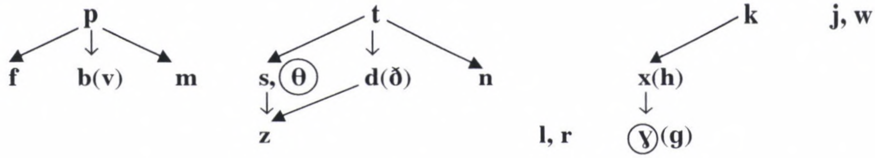
[12] The first of these two phenomena is called Sieb's Law (see Collinge 1985:155–8). Word-internally both **st** and **zd** can be reconstructed for PIE. Grimm's Law turns both into **st** in Germanic, see La *nīdus* ~ E *nest* (< PIE **nizdos*) and the superlative suffix, e.g. ClGr *(még)istos* 'largest' and E *-est* (< **-istos*). The syntagmatic and paradigmatic aspects of Grimm's Law are discussed in detail in Cser (1995:9–13).

[13] See PIE **pətḗr* > Gmc **faðḗr* > OE *fæder* (> *father*), G *Vater* 'father' but PIE **bhrā́ter* > Gmc **brṓθar* > OE *brōðor* (> *brother*), G *Bruder* 'brother' (the reflexes coincide in Modern English for reasons unrelated to Verner's Law). Stress was phonologically, though not morphologically and lexically, free in PIE.

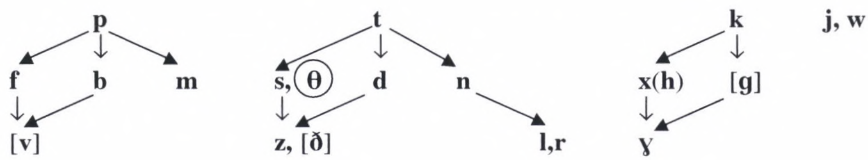
We have argued above that voiced stops instead of the voiced fricatives should be taken as base variants where the two are in complementary distribution. The opposite may be considered only in the velar series because **ɣ** instead of **g** seems to have been the word-initial variant. If we take the voiced velar fricative to be the base variant, the system will be modified like this:

(31)



Thus there are two unanchored segments instead of just one. As a matter of detail it may be noted that **x** probably developed a word-initial and intervocalic allophone **h** very early. If we include in the chart every segment regardless of their contrastivity, i.e. we include the major allophones as well as the base variants, it will be completed as follows:

(32)



5.2. Gothic developments

Gothic is the earliest extensively documented Germanic language: the text found in the Codex Argenteus dates from the fourth century AD. This is one of the reasons why it is the most conservative language in the whole group in many respects, its consonant system included. Practically its only innovation is the devoicing of voiced fricatives word-finally and before **s**, **t** – changes that are by no means unique to Gothic. Thurneysen's Law, which captures the voicing dissimilation of fricatives in certain environments is a minor change on a systemic level and affects only the distribution of fricatives. Holtzmann's Law, which describes the fortition of PIE glides in a handful of Gothic and Scandinavian words is laden with so much uncertainty that we found it better to leave out any discussion of it in this book. We would definitely not be able to move the numerous vexing problems that surround it towards any solution, but without that we also cannot draw any conclusions that would be of interest particularly for this work. The few changes that are specific to Gothic had no paradigmatic effect, so it is a reasonable conclusion that the Gothic consonant system in its structure as well as in terms of the syntagmatic properties of its elements is virtually identical to that of Proto-Germanic.[14]

[14] There are several classic descriptions and histories of Gothic, e.g. Braune–Ebbinghaus (1981), Kieckers (1960), Krause (1953). Moulton (1954) and (1972) are structuralist discussions of its phonology, both synchronic and diachronic. The former is the most detailed study on the distribution of different types of obstruents. Voyles (1981) is an early generative description of the whole of Gothic phonology. Voyles suggests (contrary to Moulton) that **ɣ** did not devoice before **s** and **t**.

5.3. West Germanic developments

West Germanic is differentiated from Proto-Germanic by two unconditioned changes. The first is this:

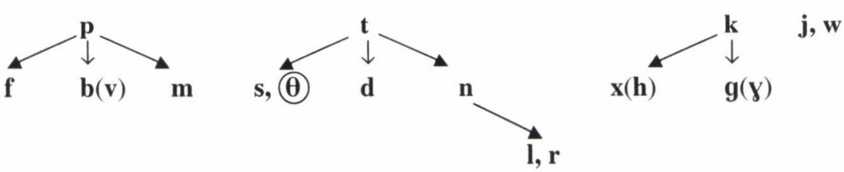
(33) **ð > d**

This change is the elimination of an allophony, whereby the more sonorous and typologically more dependent variant is absorbed by the less sonorous and typologically more basic variant which would have anchored it if their difference was ever phonologised. The other change is rhotacism:

(34) **z > r**

Rhotacism, which is common to West and North Germanic, involves turning a fricative of secondary phonation into a liquid of primary phonation. Thus the West Germanic consonant system is identical to that of Proto-Germanic except for the absence of **ð** and **z**:

(35)



Typologically Proto-Germanic (including Gothic) and West Germanic show at most two kinds of anomalies: contrast between **s–θ**, which are both dependent on a single stop that anchors the entire dental series, and unanchored **ɣ** inasmuch as that is regarded as the base variant rather than **g**. We described both anomalies earlier from a typological point of view (3.4.5 and 3.4.7).

5.4. English developments

5.4.1. From West Germanic to Late Old English

In this period several significant changes affected the obstruent system. Some of these changes are typical of several Germanic languages (e.g. the devoicing of word-final fricatives), others are more or less specific to Old English (e.g. the palatalisation of velars).[15]

[15] Some minor changes (e.g. the **fs** > **ps** and **xs** > **ks** dissimilations) will be left entirely out of consideration due to their lack of paradigmatic importance.

5.4.1.1. Palatalisation

Velar obstruents were palatalised before and sometimes after palatal vowels. This overall process involves the following particular changes:[16]

(36) (a) **k > c > tʃ**
(b) **g > ɟ > dʒ**
(c) **ɣ > ʝ > j**
(d) **sk > ʃ**

The various velar consonants were not palatalised in exactly the same environments and the various palatal vowels did not palatalise the velars in exactly the same way. The precise description of the individual environments and processes would be superfluous at this point, but let us indicate the complexity of the details.

All the four changes took place before **i** and **j** both word-initially and word-internally, and they also happened before stressed **e**. Before the more open palatal vowel (generally written <e>), which resulted from the merger of unstressed **e** and **æ**, only the fricative was palatalised (36c). The fricative **ɣ** was palatalised after all palatal vowels provided that it was not immediately followed by a velar vowel. The stop **k** was palatalised only after **i** and only if it was not immediately followed by a velar vowel.[17] Changes (36a, b, c) happened word-finally as well if the velar was preceded by a sequence of **i**+sonorant. Change (36d) probably started in the vicinity of palatal vowels but it gradually spread to other environments and ended up as an unconditioned change. This is why the sequence **sk** is still not found in native English words.[18]

By "Classical" Old English times the difference of palatals and velars was phonologised (though still not indicated in spelling). This is partly due to umlaut, which involved the fronting of velar vowels in certain environments, and which happened later than the palatalisation of velar consonants. Because of umlaut, new palatal vowels were found in positions following velar consonants. Another event that contributed to the phonologisation of the palatal–velar contrast was the disappearance or merger of palatal vocalic elements (including **j**) in unstressed syllables.

It is not known how the palatalisation of velars and their phonetic drift (i.e. the **c > tʃ**, **ɟ > dʒ**, **ʝ > j** processes) relate to each other chronologically. It must also be added that the morphological alternations introduced by the changes in (36) started levelling under paradigmatic pressures very early. Moreover, the fact that the various Old English dialects did not participate in the process to the same extent and that there was massive linguistic interference from Old Scandinavian, which did not undergo palatalisation at all at that

[16] Hogg (1992) includes the **x > ç** shift here too, which took place only between a palatal vowel and a consonant, because of the limited distribution of **x**. Even if this change happened at the same time as the others, its output remained allophonic, but we suspect that this allophony was typical already of Proto-Germanic. Given that it has no structural significance of any kind, we will simply include the variant **ç** under **x** throughout this work.

[17] This is how Hogg (1992:258–260) presents word-internal palatalisation, but he admits that this particular question is fraught with uncertainties and disagreements among scholars.

[18] Except when it results from metathesis, as in *ask*.

time, makes the whole picture extremely complicated. It is of course not our task to disentangle all the threads, we are only interested in the effect palatalisation had on the consonant system.

The changes in (36a, b) only affected place of articulation. The changes called assibilation by Hogg (those mentioned in the previous paragraph as phonetic drift) are not interesting from our point of view, since affricates belong to the class of stops typologically. The first step within (36c), palatalisation in the strict sense also affected place of articulation only, and remained allophonic, but the second step was an unconditioned weakening, whereby a fricative turned into a glide. This did not lead to the appearance of a new segment, since this **j** coincided with original (ultimately Indo-European) **j** (see OE *gear* **jæːɑr** > *year* = G *Jahr*; OE *gellan* **jellɑn** > *yell* = G *gellen*). The interpretation of **sk** > **ʃ** is difficult, it being a change in a combination of segments rather than a single segment, but it is clear that it introduced a new segment in an anchored position within the newly created palatal series.[19]

5.4.1.2. The redistribution of fricative voice

Two processes are included under this title: the devoicing of word-final voiceless fricatives and the voicing of intersonorant voiceless fricatives. Hogg (1992:277–281) also includes the disappearance of intersonorant **x** (=**h**?) here.[20]

Word-final devoicing only affected **v** and **ɣ**, since original **z** had by then turned into **r**, and **ð** into **d** (see above). The devoicing of **v** and **ɣ** resulted in **f** and **x**, respectively, which coincided with original word-final **f** and **x**, thus this change was a conditioned merger. Devoicing is sporadically attested in word-internal syllable codas as well, but this never became general like in German.

Voicing affected all intersonorant fricatives, which no longer included **x** and did not yet include **ʃ**. The reflex of intersonorant **f** coincided with the intersonorant allophone of **b**.[21] By contrast, the intersonorant reflexes of **θ** and **s** (**ð** and **z**, respectively) had nothing to coincide with because of the West Germanic changes mentioned above. These particular lenitions thus created new segments, which had the possibility, along with **v**, of being phonologised later.

In sum then, the net result of the redistribution of fricative voicing was that the contrast between voiced and voiceless fricatives disappeared, since their distribution became predictable. The contrast between word-initial **ɣ** and **x** also disappeared, but for another reason: initial **ɣ** strengthened into **ɡ**. (This change was certainly later than palatalisation because the voiced velar obstruent is always palatalised into **j** initially, never into **dʒ**.) By late Old English times only voiceless fricatives are found word-initially, word-finally and in voiceless surroundings, whereas only voiced fricatives are found in intersonorant position.

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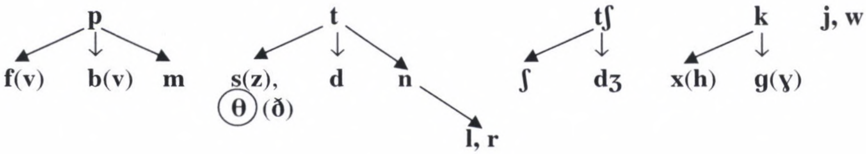
[19] The most detailed discussion of (Pre-)Old English palatalisation is Hogg 1992:257–276). See also Cser (1995:38–42).

[20] It is because of the identity of such environments that changes of the kind **x** > **h** > ∅, i.e. turning into a purely glottal element and disappearing, are subsumed under lenition. We discussed this in 1.1–1.4.

[21] Hogg (1992:283) suggests that early Old English documents display a graphic distinction between **v** and **β**, where **v** is an allophone of **f**, whereas **β** of **b**. This we do not find entirely convincing.

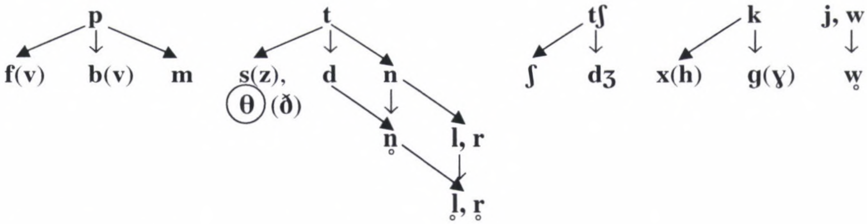
After these changes, including the occlusion of initial **ɣ** (after which **g** must be regarded as the base variant rather than the fricative), the consonant system of late Old English can be represented as follows:

(37)



Though strictly speaking irrelevant from the point of view of the present work, it is an interesting question whether one should interpret word-initial voiceless sonorants as unitary segments rather than clusters of **h**+sonorant (e.g. *hlūd* **l̥uːd** instead of **hluːd** [> *loud*]). If we accepted that voiceless sonorants are monophonematic entities, the above chart would be modified like this:

(38)



Typologically speaking, after the elimination of the **ɣ**-anomaly through a conditioned fortition, the only anomaly that the Old English obstruent system preserved is the contrast between **s** and **θ**.[22]

5.4.2. The formation of the Middle English obstruent system

In the period between late Old English and late Middle English one important restructuring took place in the obstruent system, the phonologisation of voiced fricatives, but this happened through a number of independent changes.

Because of the general simplification of geminates – which naturally affected voiceless fricatives as well –, a contrast was established between voiced fricatives and voiceless fricatives in intervocalic position, e.g. OE *cyssan* **kyssan** > EME *kissen* **kissən** > LME **kisən** (> MoE *kiss*) as opposed to *risen* **rizən**. With the loss of word-final **ə** the voicing contrast between fricatives appeared word-finally too: OE *nosu* **nozu** > EME *nose* **nɔːzə** > LME **nɔːz** as opposed to *loos(e)* **loːs**, or OE *baðian* **-ð-** > EME *bathe(n)* **-ð-** > LME *bathe* **baːð** as opposed to OE *bæð* **-θ** > ME *bath* **baθ**. French loan words begin-

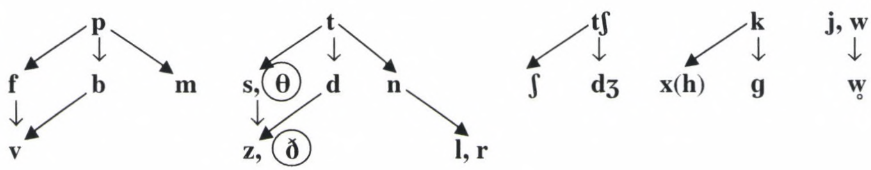
[22] The best and most complete historical and synchronic phonology of Old English is Hogg (1992), which also gives a good survey of the literature. This book has replaced Campbell's classic grammar (1959) at least as far as phonology is concerned. Lass–Anderson (1975) is an interesting reading on the same topic. Cser (1995) is a detailed history specifically of the Old English obstruent system. The best structural(ist) analysis of the Old English obstruent system in terms of contrasts and redundancies is Anderson (1985).

ning with **v** helped establish the contrast word-initially as well: *val(e)* **vaːl** 'valley' as opposed to native English *fal* **fal** (> *fall* NOUN). Thus by the end of the Middle English period voiced fricatives were all phonologised. This was made possible by the fact that they could each be integrated into the phonological system as base variants because voiced stops as well as voiceless fricatives were there to anchor them.[23]

The voiced OE fricative **ɣ**, which was of a very limited distribution already in Old English, was not phonologised because by the end of the period it was replaced by an approximant. This segment only occurred in (Late) Old English word-internally after back vowels, but in Middle English it soon coincided with original **w** and then formed a diphthong with the preceding vowel, e.g. OE *dragan* > ME *drawen* (> MoE *draw*). Thus the voiced velar fricative is no longer of interest from the point of view of the development of the obstruent system.

Of the voiceless sonorants only **w̥** remained (or, to put it differently, **x** disappeared from all initial non-pre-vocalic positions), all the other voiceless sonorants fell in with their voiced counterparts. In sum, we arrive at the following system:[24]

(39)



5.4.3. Modern English

Between the fifteenth century and the present day the consonant system of English acquired two phonemes. One is **ʒ**, which results from the contraction of **zj** sequences (*measure* ME **mezjuːr** > MoE **meʒə**), and whose incidence has been increased by recent French borrowings (e.g. *beige* **beɪʒ**). The other is **ŋ**, which was phonologised with the loss of post-nasal **g** (e.g. ME *sing* **siŋg** > MoE **sɪŋ**). With the exception of Scottish dialects the fricative **x** was systematically lost from syllable codas, its only possible environment, with accompanying compensatory lengthening (ME *right* **rixt** > **riːt** > MoE **raɪt**), but in some words it was replaced by **f** (*rough* ME **ruːx** > MoE **rʌf**). This phoneme remains in one single realisation, prevocalic (and pre-stress) **h**. The voiceless sonorant **w̥**, however, has remained to this day in several dialects – probably because it is not as low in the implicational hierarchy as the other voiceless sonorants. The Modern English consonant system is the following:

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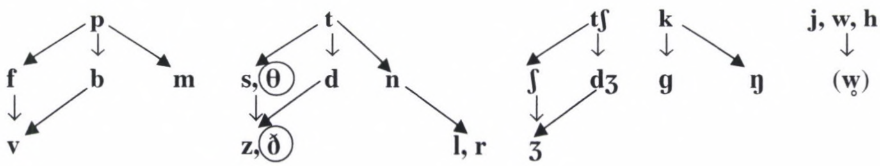
[23] Lass (1992) suggests that word-initial voiced fricatives in borrowings were tolerated in Middle English as opposed to Old English (cf. La *versus* → OE *fers*), because the voicing of initial **s** and **f** was general in the South-West dialects of Old English. We do not find this argument convincing, since these dialects have always been marginal within English and, apart from a couple of lexical items they did not contribute to other dialects or "mainstream" developments.

It may also be noted that since **θ** was voiced at the beginning of unstressed words, towards the end of the Middle English period an initial **θ** – **ð** contrast appeared too, though the number of actual or near-minimal pairs (*thigh* vs. *thy*) is very low.

[24] We relegate to a footnote the relatively unimportant changes whereby **ð** > **d** before sonorants and **d** > **ð** before V**r** (OE *spīðra* > ME *spider*, OE *mōdor* > ME *mother*).

(40)



5.5. High German developments

It is the consonant system of High German that is the farthest removed from that of Germanic due to a radical restructuring in the first centuries of the Middle Ages known as the Old High German Consonant Shift. This is predated by another change specific to High German, the total elimination of voiced fricatives. The change **z** > **r** is common to West and North Germanic, the change **ð** > **d** is typical of West Germanic in general, but it is only in Pre-Old High German that **v** is replaced by **b** and **ɣ** by **g** in all environments. In these dialects two allophones underwent unconditioned merger with those variants that had anchored them typologically.

5.5.1. The Old High German Consonant Shift

This thorough reshuffling of the Old High German obstruent system and contemporaneous obstruent changes in the same period can be captured in the following points:

(41) (a) Voiceless stops are replaced by affricates word-initially, after nasal and partly after liquids as well: **p** > **pf**, **t** > **ts**, **k** > **kx**;
(b) Voiceless geminated stops, which only occur between vowels, are replaced by (originally long but soon shortened) affricates: **pp** > **pf**, **tt** > **ts**, **kk** > **kx**;
(c) Voiceless stops are replaced by long fricatives after short vowels, of which fricatives **ff** and **xx** merge with the corresponding original voiceless long fricatives: **p** > **ff**, **t** > **ζζ**,[25] **k** > **xx**;
(d) Voiceless stops are replaced by fricatives after long vowels and partly after fricatives: **p** > **f**, **t** > **ζ**, **k** > **x**;[26]
(e) Voiceless stops remain unchanged after fricatives and **t** remains unchanged before **r**;
(f) Voiced stops are devoiced to various degrees in the various dialects, but this did not lead to systemic change apart from the **d** > **t** change. The voiceless stops occurring in later borrowings as well as those voiceless stops that failed to be affricated because of their environments continued to differ from the

[25] The phonetic identity of the fricative resulting from **t** is a matter of debate to this day. It is sure to have been a voiceless coronal fricative, which differed from **s** and **ss** in most positions until about the middle of the thirteenth century but has merged with them by modern times. The paleographic symbol <ʒ> as well as <z> are commonly used in Germanic studies to denote this sound, but we do not wish to continue this practice because both of these symbols are used in the IPA with a well-defined phonetic value which is definitely not that of the sound in question.

[26] But **r** is not affected after **k**.

reflexes of the original voiced stops, except original voiced geminate stops, which were completely devoiced. Word-final and syllable-final devoicing is not yet general in Old High German, but it is frequently attested, so we included it in the chart below.

(g) Mostly in the vicinity of vowels, but not word-finally, voiceless fricatives turned into (probably) voiceless lenis fricatives, and so did **ss**[27] as opposed to **ff** and **xx**: **f** > **v̥**, **s** > **z̥**, **θ** > **ð̥**.[28]

(h) The fricative **ð** resulting from (g) above turns in all environments into **d**. This stop does not coincide with the reflex of original **d** (which is **t**).[29]

In the examples below we compare Modern English and Modern High German cognates:

(42)	(a)	*pound*	*Pfund*
		ten	*zehn*
		mint	*Minze*
		cold	*chalt* (Swiss German)
	(b)	*apple*	*Apfel*
		set (< OE *settan*)	*setzen*
		wake	*wecken* (OHG *-ch-*; < **wakkjan*)
	(c)	*ship*	*Schiff*
		that	*daß*
		break (< OE *brecan*)	*brechen*
	(d)	*sleep*	*schlafen*
		white	*weiß*
		reek	*Rauch*
	(e)	*spare*	*sparen*
		right	*recht*
		bitter	*bitter* (< **bitr-*)
	(f)	*sib(ling)*	*Sippe*
		do	*tun*
		edge	*Ecke* (< **aggjō*)

[27] At least if the contrast between **ss** and **ζζ** is a lenis–fortis contrast. Braune–Eggers (1987), Joos (1952) and Esau (1976) argue against this, claiming that the contrast was in place of articulation. For Braune–Eggers (1987) **ζ** was dental and **s** palatal, but they also assume the general lenition of **s**. For Joos (1952) and Esau (1976) **ζ** was dorsal and **s** was apical, but there was also a subphonemic strength difference between them. The contrast between the two coronal fricatives remained quite stable throughout the Old High German period even word-finally and in gemination. In this they differ from the other fricatives, since the contrast between old and new **f** and the contrast between old and new **x** was neutralised very early in word-final position. This is Joos's and Esau's strongest argument against the interpretation of this contrast as fortis–lenis. Penzl (1968), on the contrary, argues that wherever it exists, the contrast is still a fortis–lenis one (which in practice means a voiceless–voiced contrast in intervocalic position).

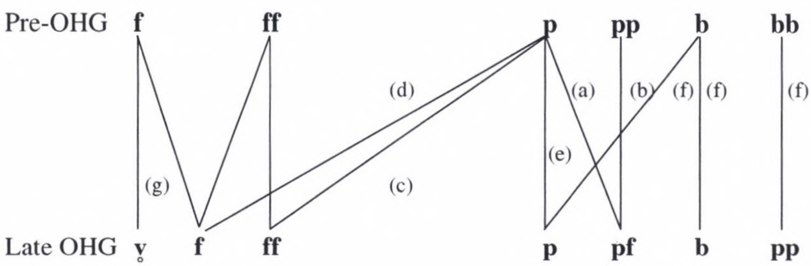
[28] The last of these changes, **θ** > **ð̥**, happened in all environments. The spelling <v> for **v** in German orthography is a trace of the same lenition. I will not discuss the detailed phonetics of the fortis–lenis contrast; functionally and from the point of view of the implicational hierarchy it can be described in a fashion parallel to the voiceless–voiced contrast. I use the terms fortis and lenis because they are customary in German linguistic tradition, and I did not wish to change that for the sake of marginal concerns.

[29] Strictly speaking this statement needs to be qualified for Standard (High) German, where **nd** and **nθ** are both continued by **nd**.

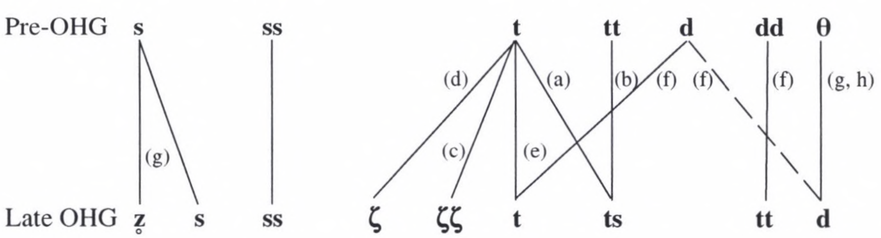
(g–h)	*see*	[**z**]*ehen*
	thing	*Ding*
	father	*Vater* (OHG **v̥**-)

These changes can be tabulated in the following way:[30]

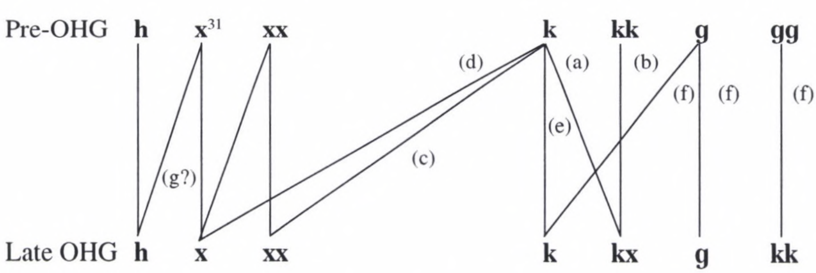
(43) labial series



(44) coronal series



(45) velar series



Let us then interpret the Old High German Consonant Shift typologically.

Ad (a, b): Note that the formation of affricates is different from a systemic point of view from that of Old English affricates. Old English affricates are highly typical in that they occur at places where stops do not. This is the normal pattern for affricates and this is why we maintain that typologically affricates belong to the class of stops. In Old En-

[30] I include here geminates or long consonants, though they are biphonemic.

[31] Penzl claims that intervocalic **x** > **h** took place in the OHG period; if we accept this, it may be included under (g) above.

glish affricates came into being in such a way that velar stops changed their place of articulation in the vicinity of palatal vowels, and assibilation, i.e. their turning into affricates proper, was a secondary development. In Old High German what we see is the opposite. An affricate develops from each voiceless stop and its place of articulation remains the same. The formation of affricates is part of a general tendency of fricativisation, it is nothing else than fricativisation arrested in mid-course for phonetic reasons (e.g. preceding nasal). It is possible, though not at all certain, that it could be regarded as weakening, since it is part of fricativisation, a sonority-increasing change. Still, we do not think affricates should be taken as dependent on stops in the implicational hierarchy. What is clear is that they contributed significantly to the enlargement of the consonant inventory.

Ad (c, d): These are conditioned lenitions. The change **t** > **ζζ** introduces a new segment, the other two fricatives introduce a contrast that did not exist previously in intervocalic position (regarded as a fortis–lenis contrast), i.e. it enlarges the phoneme inventory.

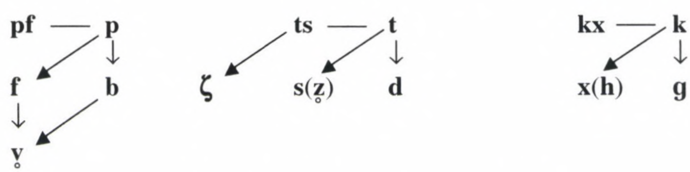
Ad (e, f): The devoicing of voiced stops only has systemic effects in the case of total, i.e. neutralising devoicing. This happens clearly to **d**, which is strengthened to **t** through an unconditioned fortition and whose outcome coincides with the unchanged reflexes of Pre-Old High German **t**. The devoicing of syllable- and word-final voiced stops, and the devoicing of **bb** and **gg** are conditioned strengthenings, which partly fill the distributional slots left empty by the affrication of voiceless geminates. It remains true that the typical geminates are those in the higher regions of the implicational hierarchy.[32]

Ad (g): The lenition of **f** and **s** is conditioned and results in new segment types. Since in gemination and word-finally original and new **f** coincided, the difference between **f** and **v̥** was phonologised, but the difference between **s** and **z̥** was not (yet). The lenition of **θ** is unconditioned, which results in a new segment, but that difference remains allophonic and so the change does not enlarge the phonological system.

Ad (h): The unconditioned fortition of **ð** is a unique development of the obstruent system, at least in this period, since previously all voiced fricatives had turned into stops (except **z**, which turned into **r**). Typologically it can be argued that in want of a voiced stop **ð** would have become an unanchored phoneme, if it was ever phonologised, but due to strengthening it acquired an anchored position.

The obstruent system of Late Old High German can be represented as follows:

(46)



As can be seen, there are no unanchored segments in the system at all.[33]

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[32] The upward movement of geminates in the hierarchy can be traced well throughout Germanic, especially West Germanic. This issue is discussed in detail in Cser (1994).

[33] We admit to some uncertainty as regards the placement of affricates on the same level as voiceless stops. What we must note is that a coherent picture of the coronal region emerges if we consider that Middle High German **ʃ** takes the place of Old High German **ζ** in the implicational hierarchy (according to some, **ζ** itself was originally a fricative close to the palatal place of articulation), so it is not an unwarranted assumption that it is dependent on **ts**, but this is only possible if **ts** and **t** are on the same level. But those (extremely rare) languages in which affricates form a parallel series at the same places of articulation as stops certainly remain a problem for our analysis. We will return to affricates in 6.1.4.

5.5.2. Middle and New High German developments

We discuss the period following Old High German under one title because of the paucity of changes affecting the consonant system. They are the following:

(47) (a) Glides strengthened into stops after liquids, in particular: **rw** > **rb**, **lw** > **lb**, **rj** > **rɡ**. This is a conditioned fortition, which reassigns glides to existing segment types. Examples: *gärwen* > *gerben* 'to tan', *swalwe* > *Schwalbe* 'swallow', *verje* > *Ferge* 'ferryman'.

(b) The lenis fricative **ɣ̥** merges with its fortis counterpart, which anchored it, through an unconditioned fortition, thus **ɣ̥** > **f**. Example: *verje* (see above).

(c) The coronal fricatives **s** and **ζ** merge in **s**. Given the environments of the sibilants there remains one possible context for contrast, and that is the intervocalic position: V**z**V < V**z̥**V < V**s**V (*Riese* 'giant'), but V**s**V < V**ζ**V < V**t**V (*gießen* 'pour') or V**s**V < V**ss**V (*missen* 'miss'). In this merger implicationally independent segments coincide; its result is the phonologisation of the **s** – **z̥** difference.

(d) All geminates are degeminated, see *missen, Sippe* in previous points.

(e) **w** > **v** in all environments. This unconditioned strengthening fills the slot left empty by the **ɣ̥** > **f** change, but no segment would have remained unanchored without it. Similarly to the merger in (c), here again implicationally independent segments coincide.

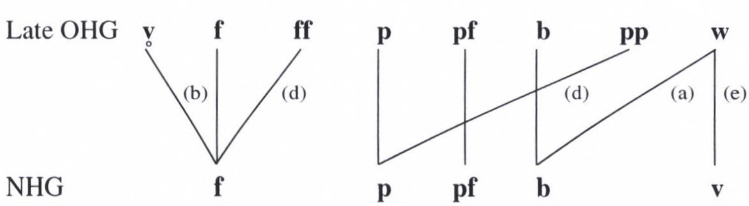
(f) **j** > ∅ between vowels, as in *blüejen* > *blühen* 'blossom'.

(g) **sk** > **ʃ** in all environments, which may be connected to the mergers of coronal fricatives. Example: *scuo* > *Schuh* 'shoe'. Word-initially **s** > **ʃ** before all vowels, as in *swalwe* > *Schwalbe* 'swallow', *sparēn* > [ʃ]*paren* 'to spare'.

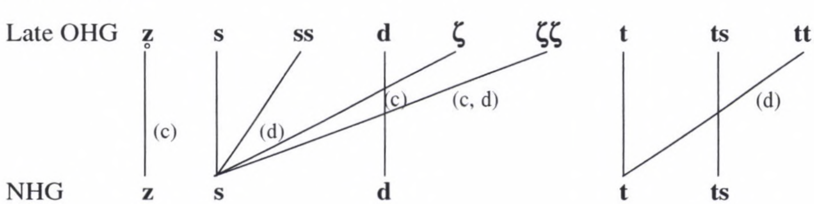
(h) **kx** does not remain an affricate but simplifies to a stop.[34] Example: *chalt* > *kalt* 'cold'.

In a tabular fashion:

(48) labial series

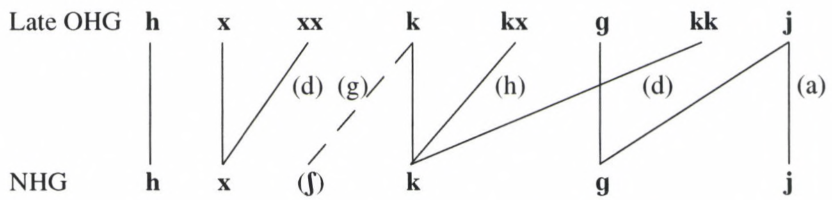


(49) coronal series



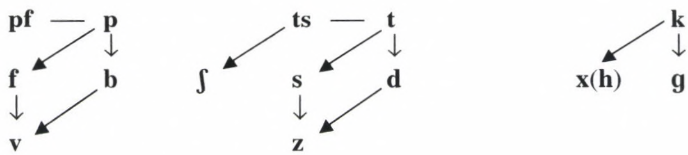
[34] Except for the Alemannian dialect.

(50) velar series



We have evaluated the individual changes from a typological point of view above, so nothing remains but to summarise the New High German obstruent system:

(51)



As can be seen, the system differs from that of Late OHG in that **z** is now phonologised and **ʃ** has taken the place of **ʒ**. No anomalies can be found.[35]

5.6. Low German developments

5.6.1. The consonant system of Old Saxon

Old Saxon underwent the following changes with respect to West Germanic:

(1) In voiced environments the fricatives **f**, **s**, **θ** were lenited just like in the other continental languages/dialects. In word-internal **v** the lenited reflex of **f** and the old (Germanic) allophone of **b** coincided. Because of the general word-final devoicing of fricatives the opposite is found in that position, i.e. **f** as the local variant of both segments. Consequently the net result is the same as in Old English: **v** is in complementary distribution with both **f** and **b**. In the dental series, again like in Old English, **ð** is the positional variant of **θ** and is in contrast with **d**. The literature is divided on the question of velars. Klein (1984) does not mention **x** among the leniting fricatives, whereas Voyles (1970) does. Given the written forms *fehu* 'cattle' *sehan* 'see' etc., we are tempted to believe that the former is right. Word-final **ɣ** may well have devoiced already in this period.

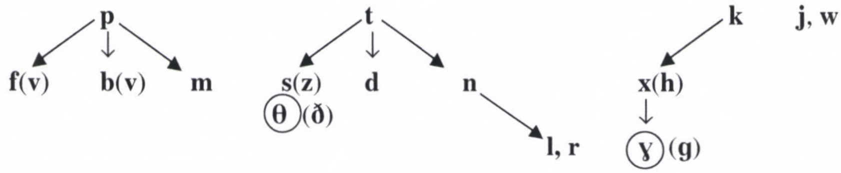
The general voicing of word-initial fricatives is supposed by Klein (1984) to have taken place also in this period, though the *Heliand*, one of the most important documents in Old Saxon, does not yet show traces of it. It appears conspicuously in Middle Low German (*vrolich* 'happy').

[35] The Old High German Consonant Shift is one of the most frequented topics of historical linguistics. Braune–Eggers (1987), esp. (81–110, 119–169) is a classic, detailed philological description, very useful to this day. Penzl (1975), Moulton (1987), Keller (1978) and Voyles (1976) are good overviews and phonemic analyses. Prokosch (1939) and Streitberg (1896) belong to the time-honoured classics. For Middle and New High German we used mostly Penzl (1975) and Mettke (1989).

(2) Velar obstruents palatalised but to a lesser extent than in Old English. This only happened before, not after, palatal vowels, and the outcomes of the process were phonologised much later (in the thirteenth century, i.e. Middle Low German, according to Klein). The stop **k** palatalised to **ts**, **ɣ** to **j**.

Considering all this, the Old Saxon consonant system can be represented as follows:

(52)



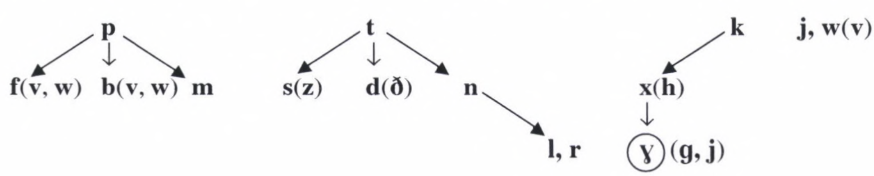
There are two anomalies: first, the contrast of **s** and **θ**, second, since **ɣ** has a wider distribution than **g**, the former has to be taken to be the base variant, but it is consequently left unanchored.

5.6.2. Middle and New Low German

In this context it will not be possible to give a comprehensive survey; what we can attempt here is to highlight a few general tendencies that characterise Low German. This is true especially with respect to the extremely varied kinds of lenitions that occur.[36]

Word-final devoicing is widespread in Low German dialects just like almost everywhere among the Germanic languages. The lenition of intervocalic **p** and **k**, even as geminates, is less general but by no means infrequent. In a handful of dialects lenition affects voiceless stops word-finally and in consonantal contexts. Voiced stops also show a variety of developments. The reflex of **d** (which merges with **θ**) is usually a stop, word-finally always voiceless. In some dialects it weakens intervocalically to a fricative (**ð**), a liquid (**r**), or it may even disappear. The reflex of **b** is **f** word-finally in all varieties of Low German, intervocalically **v**, which is also the reflex of Germanic **w** – though it would, of course, require a great deal of instrumental research to tell whether this is a fricative or an approximant in the different dialects. The reflex of **g** can be a velar fricative not only intervocalically but also word-initially. In some varieties it is a voiceless palatal fortis, though this is rarer than its lenis counterpart. The variants **g** and **j** are found both intervocalically and word-initially. Between vowels this segment may totally disappear. Niebaum (1984) suggests that the segment **s** had a voiced intervocalic variant. Considering all these the consonant system of Middle Low German is the following:

(53)



[36] Our sources are Niebaum (1984) and Simmler (1982).

The loss of Old Saxon **θ** is important because this unconditioned merger leads to the loss of an unanchored segment. At the same time unanchored **ɣ** remains – though here again the qualification has to be made that it can probably only be decided separately in each dialect whether the fricative is really the base variant.

5.7. Dutch (Netherlandic) developments

The Old Netherlandic consonant system faithfully continues that of West Germanic.[37] Its most significant innovations consist in the devoicing of final consonants, stops and fricatives alike, the continuing reduction of the distribution of **h** through its loss in intervocalic and initial preconsonantal position and the turning of the cluster **hs** into **ss**. The clusters **ft** and **xt** coincide in **xt** (**luft* > *lucht*).

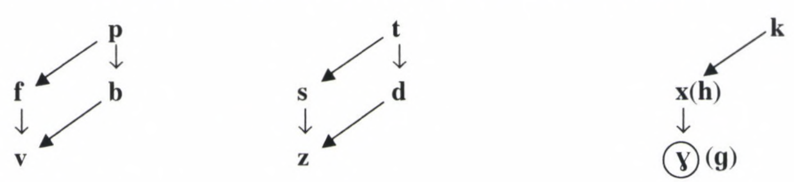
In Middle Dutch degemination is general. The **θ** > **d** change so typical of the continental Germanic languages happens here as well,[38] in all likelihood through **ð**, since voiceless fricatives all lenite (more precisely voice) in vocalic environments (but not word-finally), much like in German. Goossens (1974) claims that the voicing did not take place after short vowels; his example is *heffen* 'to lift'. We are not sure if this interpretation of data like this is correct, but on the testimony of the other Germanic languages it seems to us a more natural explanation that since degemination did not predate voicing, original geminates simply did not voice. Word-initial **fr**, **fl** turned into **vr**, **vl** (**fleugan* > *vliegen* 'fly'). The voicing distinction between **v–f** and **z–s** was phonologised on account of the French loanwords beginning with voiceless fricatives.[39] It is possible that this contrast developed somewhat later in time, but this is irrelevant here. The fricative **x** was not affected by the voicing because by the time it happened it had already disappeared precisely from the triggering environments. The cluster **sk** did not remain unchanged – a common development in Germanic – but turned into **sx**.

The voicing of **f** and **s** is typologically very similar to the same voicing in High German, though there new voiceless (or fortis, as seems more suitable for High German) fricatives reappeared due to language-internal innovations and pressed the lenited fricatives lower in the implicational hierarchy. In Dutch, by contrast, voiceless fricatives were supplied by loan-words, since – voicing being a conditioned change – voiced fricatives were in complementary distribution with the unchanged voiceless ones.

It is also important that **θ**, which first voiced in all environments and then strengthened to a stop, merged with original **d**.

The Middle Dutch obstruent system thus acquired the following shape:

(54)



[37] Our discussion of Dutch is based on data from Goossens (1974).

[38] The reflex of **θθ** is perhaps **s**, but this is uncertain because **θθ** is not documented in Old Netherlandic. The examples in Goossens (1974) all arise as results of suffixation.

[39] This is the exact opposite of what happened in Middle English, where the contrast between **v–f** and **z–s** emerged as a result of French borrowings beginning with the voiced, not the voiceless fricatives (among others, see 5.4.2).

The only unanchored element is **ɣ**, which has to be regarded as the base variant because it has a wider distribution than its stop counterpart.

In the Modern Dutch period peripheral voiced stops were lost in post-nasal position: **mb** > **m**, **ŋg** > **ŋ**. The most important obstruent change in this period is the second word-final devoicing. This affected those voiced obstruents which came into final position due to the loss of word-final **ə**; practically this means original (Old Netherlandic) **bb**, **dd**, **gg** and **nd**. Final **gg** is continued by **x**,[40] the others by **p**, **t** and **nt**, respectively. All other instances of **g** (which can only result from original geminates, since post-nasal **g** had been lost by this time) are continued by a (voiceless) fricative and all instances of **ɣ** (i.e. word-initial, intervocalic single and, of course, final) also devoice to **x**, at least in the majority of dialects.

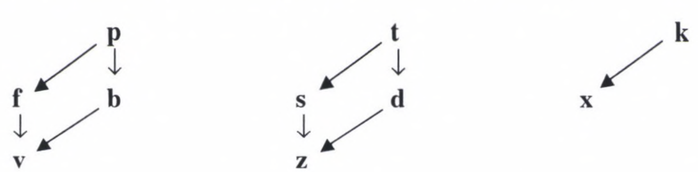
As can be seen, the velar region underwent a major restructuring in this period. This can be explained on the basis that this was the most unstable place of articulation within the whole consonant system on account of the unanchored voiced fricative. This segment was replaced by anchored ones in all Germanic languages, but Dutch differs from e.g. English and German in that it did not replace **ɣ** with a stop or an approximant but with a voiceless fricative – in all environments, including intervocalic, as in *regen* **reːxə** 'rain'. Typologically speaking the **ɣ** > **x** change is an unconditioned strengthening, which eliminated an unanchored segment.

The fact that original **gg** is continued by a fricative does not necessarily mean that an unconditioned lenition has taken place, since geminates at this time no longer occurred elsewhere but between vowels, thus the fricativisation can simply be interpreted as the continued operation of the phonotactic rule inherited from Proto-Germanic that does not allow **g** in this position.

One further change has to be mentioned here, the loss of intervocalic **d**. This change has not operated in a strict manner in many cases and has thus led to several optional or stylistically different variants (e.g. *vader* ~ *vaar* 'father'). This phenomenon casts doubt on the generally accepted claim that Proto-Germanic **ð** developed into a stop in all positions. Is it the case that the dialects underlying Netherlandic were exceptions to this? Goossens (1974:97) claims that they were not and despite the loss of **d** (probably via a fricative) it had been a stop in all environments in Old Netherlandic. His argument is simply that the result of the word-final devoicing of this segment is **t**, not **θ**, so the variant in that position was obviously a stop rather than a fricative. We doubt, however, that this argument carries over automatically to intervocalic position.

The Modern Dutch obstruent system thus looks as follows:

(55)



Minor changes that may be mentioned here include **sx** > **s** word-internally and finally as well as **wr** > **vr**. It is also noteworthy that in Dutch, as opposed to most other West Germanic languages, it is phonetically voicing rather than aspiration that differentiates be-

[40] In certain dialects **k**.

tween stops of primary and secondary phonation (and, naturally, between fricatives too). Not unrelated to this, contact voicing assimilation operates between obstruents. It is regressive if the second segment is a stop (**sb** > **zb**), but progressive if it is a fricative (**pv** > **pf**), and also when the second segment is the initial **d** of a function word (**sd** > **st**).

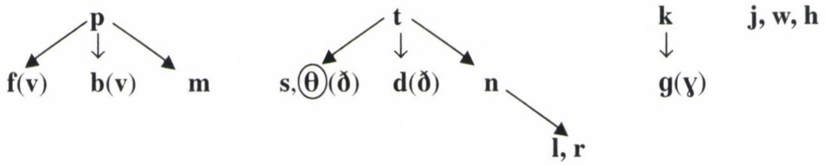
5.8. Scandinavian developments

In the period of the earliest written documents in Scandinavian several changes are discernible that affected the consonant system.[41] Much like in Old English, voiced and voiceless fricatives were redistributed through the voicing of voiceless ones in intersonorant position as well as word-finally following a voiced segment, and the occlusion of word-initial voiced fricatives. To this a few minor changes can be added, such as **Vθl** > **V:l** and the loss of intervocalic and preconsonantal **x** (*slaxan* > *slāa* 'kill', *rextaʀ* > *rēttʀ* 'right'). This segment thus remained only in word-initial position where it had, in all likelihood, turned into a purely laryngeal segment much earlier.

As a result of these changes voiced fricatives entered into complementary distribution with their voiceless counterparts. It appears to us from the data that they remained in complementary distribution with voiced stops as well, though our sources (Haugen 1976:154–5 in the first place) do not explicitly say so. The loss of **z** is significant, this being the only voiced fricative that was a base variant in Germanic. It turned into a (probably) voiced apico-palatal fricative (written *ʀ* in the tradition of Scandinavian studies), but this proved to be a transient segment. If preceded by a consonant, it assimilated to it: **stainaz* > *stainaʀ* > *stainʀ* > *steinn* 'stone'. It turned into **r** in all other environments – this rhotacism is much like that in West Germanic.

The Common Scandinavian consonant system thus looks as follows:

(56)



The only anomaly is the **s**–**θ** contrast inherited from Proto-Germanic.

In the Middle-Scandinavian period two changes bear significantly on the consonant system from a typological point of view. Both dental fricatives underwent unconditioned strengthening to the corresponding stops, so **θ** > **t** and **ð** > **d** (*þank* > *tack* 'thank', *faðir* > *fader* 'father'). Icelandic already constitutes an exception; there the dental fricatives remained intact. Original **θ** had been voiced previously in unstressed vocalic contexts, i.e. largely in function words. The **ð** resulting from this change naturally underwent the strengthening just like original **ð** (*þu* > **ðu** > *du* 'thou'). The second of these two fortitions is the

[41] For this group we relied mostly on Haugen (1976), a survey of the history of Scandinavian languages with a strongly structuralist slant in internal history, Seip–Saltveit (1971) and Noreen (1970), which are slightly dated works by now aiming at a virtually unrestricted and unstructured presentation of palaeographic and historical facts and data. For Icelandic we also used Kress (1982).

same as that seen in West Germanic, as are its typological aspects: through an unconditioned strengthening a segment merges with that segment which would have anchored it if their distinction had ever been phonologised. By contrast, the other strengthening (**θ > t**), which is common to Scandinavian and only Frisian, reduces the system through merging a fricative, which did not anchor any other segment, with the stop that anchored the fricative in question. The voicing of **θ** in unstressed vocalic contexts, which predates the strengthening, seems to be the same change in all respects as the contemporaneous voicing in Middle English.

It was in this period that a separate palatal series of obstruents developed in Scandinavian (again excluding Icelandic, in which there are only palatalised obstruents). This happened partly via the palatalisation of velar stops (or clusters containing velar stops) before front vowels, partly via the syntagmatic fusion of the dental obstruents (**t**, **d**, **s**) and **j**. It is important to note that this change almost only happened word-initially, in internal position velars and palatals hardly ever seem to have been affected. It is immaterial to us whether the outcome of palatalisation is a set of stops or affricates; what is not immaterial, however, is that in the overwhelming majority of Scandinavian languages and dialects these palatal consonants all lost their occlusion and developed into unanchored fricatives (and **j**) through unconditioned weakenings. The particular processes subsumed under palatalisation can be schematically represented like this:[42]

(57) **dj** —— **dj** —— **j** *bøygja* > Middle Sc *bøya* 'bend'
g(j) ↗

tj —— **tç** —— **ç** *stykke* > North Sw [**styççe**] 'piece'
k(j) ↗

stj —— **stç** —— **sç** —— **ʃ** *skjǫldʀ* > Far **ʃøldur** 'shield'
sk(j) ↗ **sj** ↗

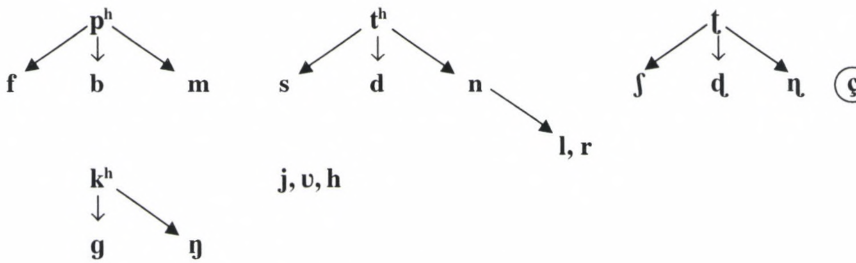
The significance of palatalisation for the consonant system is that it led to the appearance of a new place of articulation. The new stops emerging at this place gradually and in varying degrees, but typically turned into fricatives. Palatalisation took place in Old English as well, but there what appeared was a set of segments arranged into a wholly anchored series, which has proved highly stable. Scandinavian palatalisation and its aftermath resembles the (more or less contemporaneous) behaviour of French palatals; they both show that the implicational relations that hold at other places of articulation do not apply with the same stringency to palatal obstruents.

A further development to be mentioned here is the increasing of the sonority of intervocalic stops. This happened in almost every Scandinavian dialect and resulted in voiced fricatives or approximants. These changes did not have any systemic effect since either they only resulted in positional variants or only altered the distributional regulari-

[42] Based on Haugen (1976:270).

ties of segments. Certain consonant clusters (e.g. **r** + coronal obstruent) developed into retroflex obstruents. Of these the voiceless stop was capable of anchoring palato-alveolar **ʃ**. As a specimen of modern continental Scandinavian let us take the consonant system of Norwegian:

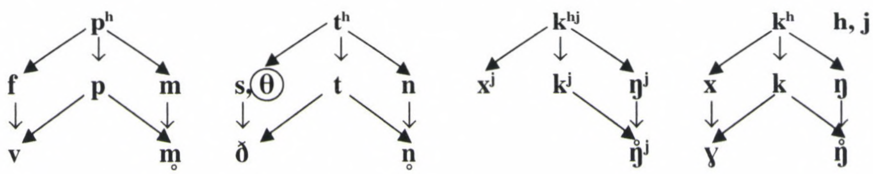
(58)



As can be seen, the only unanchored obstruent is **ç**.

The more conservative consonant system of Modern Icelandic is the following:

(59)



The only unanchored segment is either the dental or the alveolar fricative: Icelandic is the only Germanic language besides English that has preserved the ancient (and, from our point of view, anomalous) Germanic **s–θ** contrast. Kress (1982) lists **j** among the voiced fricatives; we are not sure if this is correct but suspect that **j** may be an approximant rather than a fricative. If it is a fricative, however, it is naturally anchored by **xʲ** and **kʲ**. It is also possible that **v** is closer to an approximant articulation.

6. PHONOLOGICAL INTERPRETATION

6.0. Introductory

In this chapter we recapitulate some of our findings and outline a phonological model that can explain them in a coherent fashion. We develop a system of representations for phonological segments that mirrors the relative complexity of phonological systems that allow or do not allow segment types in harmony with typological dependencies. We will tackle the issue of palatals, which behave unlike segments at other places of articulation. Their eccentricity was revealed both synchronically (3.4.4) in that they defy implicational relations, and diachronically (4.7.1) in that they often undergo lenition in all environments. To illustrate both sides of the coin once again, let us see the obstruent system of Modern French and the unconditioned fricativisation of the Old French palatoalveolar affricates (the latter is the same as change 4.2.1.45):

(60) French

p	**t**		**k**
b	**d**		**g**
f	**s**	**ʃ**	
v	**z**	**ʒ**	

(61) Early OFr **tʃ dʒ** > Late OFr **ʃ ʒ** (c. 13th century)
Ex.: Latin **kaːrus** > Ga-Ro **k**$^{(j)}$**æːr** > EOFr **tʃeːr** > LOFr/MoFr **ʃɛːr** 'dear'
Latin **gamba** > Ga-Ro **g**$^{(j)}$**æmbə**> EOFr **dʒambə** > LOFr/MoFr **ʒɑ̃b**(ə) 'leg'

In what follows we will argue that the behaviour of palatal consonants can be explained if we assume that the position of the feature carrying palatality in feature geometry is different from that of other place features.

6.1. Segment structure

In the infrasegmental structure we assume that there are three classes of elements, which are normally represented by at least one element each in every segment. Source elements are the exponents of pulmonic and laryngeal activity (or, in other words, initiation and phonation). Filter elements describe the nature of constriction in the vocal tract above the glottis; place elements describe the location of the constriction.

The internal structural traits of segments are twofold, i.e. two kinds of relations exist between elements. One pertains to their relative timing. It seems reasonable to assume that timing normally allows only a binary opposition, that is, two elements can be synchronous or consecutive (with possible overlap on the phonetic level) within a segment. This is probably related to the observation that "intrasegmental contours never exceed two articulatory phases" (Steriade 1993a).

The other structural relation is dependency: this means that an element is linked to another element instead of the Root node. Dependencies increase the complexity of a segment. The representation of these relations is this:

(62)

6.1.1. Source elements

Source elements can be ranked on the basis of their cross-linguistic patterning. Voicelessness is primary with respect to voicing in obstruents, but the opposite holds within the class of sonorants. Aspiration may or may not be primary for obstruents, but there seem to be arguments for aspiration being the primary phonation type in many languages, e.g. Icelandic. There are also arguments that voicelessness of sonorants is equivalent to aspiration. These hinge on the interpretation of aspiration and make reference to facts like the pattern of causative formation in Burmese, which involves aspiration for obstruents but voicelessness for sonorants:[1]

(63)

páuʔ	'be pierced'	**pʰáuʔ**	'pierce'
céʔ	'be cooked'	**cʰéʔ**	'cook'
kwà	'peel off'	**kʰwà**	'separate'
mjô	'be floating'	**m̥jô**	'set afloat'
nôu	'be awake'	**n̥ôu**	'waken'
láʔ	be bare'	**l̥áʔ**	'uncover'

Other source elements (laryngealisation as in Jalapa Mazatec **n̰à** 'shiny' or breathy voice as in Hindi **kum̤ar** 'potter') are so rare for sonorants that it would be difficult to make general claims about their relation to the source elements of obstruents.

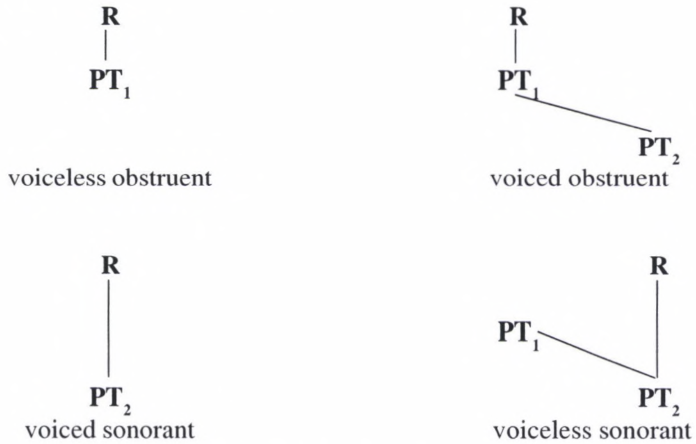
We suggest that combinations of Phonation Type (**PT**) elements express these relations in feature geometry. These we use instead of labels expressing some more particular content like [voiced], [voiceless] etc. for two reasons. One is that a cross-linguistic generalisation is missed with labels of the letter kind: we fail to capture the fact that, for instance, in many respects the voiceless–voiced contrast in Dutch is very much like the aspirated–unaspirated contrast in German or Icelandic. The other is that we erroneously imply that within one language the voicing of an obstruent is equivalent to the voicing of a sonorant.

Thus, for obstruents, primary phonation is carried by $\mathbf{PT_1}$, secondary phonation by $\mathbf{PT_1}$ with a dependent $\mathbf{PT_2}$ element. For sonorants, primary phonation is carried by $\mathbf{PT_2}$, se-

[1] This question is discussed in Ladefoged and Maddieson (1996:68–69), from where the Burmese examples were also taken.

condary phonation by $\mathbf{PT}_2$ with a dependent $\mathbf{PT}_1$ element.[2] The representation of the most common types will be as follows:[3]

(64)



These representations capture the fact that voiced obstruents and voiceless sonorants are marked, i.e. more complex, than voiceless obstruents and voiced sonorants, respectively.[4] They also make it possible to express the fact that the voicing of an obstruent requires the vicinity of at least one other voiced segment (because $\mathbf{PT}_2$ must come from somewhere), whereas the devoicing of a voiced obstruent does not require the presence of a voiceless segment because in such processes $\mathbf{PT}_2$ is simply delinked and the voicelessness of the obstruent is “laid bare”. *Mutatis mutandis* the same is expressed with respect to sonorants.

6.1.2. Filter elements

We assume three kinds of filter elements: **No** (noise) is found in obstruents, **Na** (nasality) in nasals and **Re** (resonance) in non-nasal sonorants. **No** expresses the predominantly aperiodic acoustic energy resulting from extreme narrowing or closure of the vocal tract, **Re** the opposite, while **Na** is required as a third filter element because of the unique manner of the articulation of nasals (and the resulting characteristic acoustic shape) and the cross-linguistic and historical stability of nasals segments as well as the early appearance of the nasal vs. non-nasal contrast in language acquisition. As opposed to source elements, the three filter elements are assumed to be incompatible.[5] We have not found examples that suggest that they should be dependent on some other element, so, by default, they are linked immediately to the Root node.

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[2] If a language distinguishes more than two phonation types, the number of **PT** elements will increase.

[3] The arrangement of the charts shows that $\mathbf{PT}_1$ and $\mathbf{PT}_2$ are on different tiers. More on this will be said later.

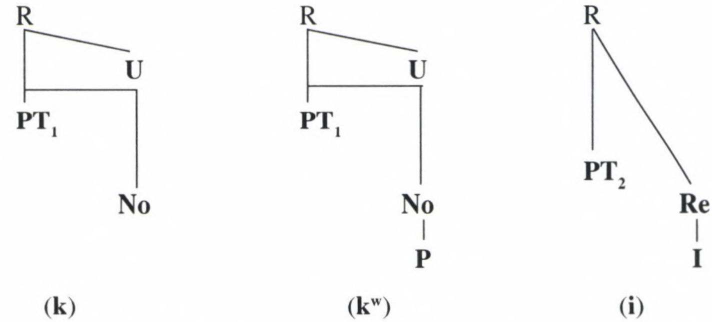
[4] For simplicity, obstruents of primary phonation type will again be referred to as voiceless, those of secondary phonation type as voiced and vice versa for sonorants.

[5] At least in general. It is possible that their compatibility is required in certain cases, e.g. for languages like Waffa, which distinguish occluded nasals from nasal approximants (Ladefoged–Maddieson 1996:134).

6.1.3. Place elements

As regards the number and the "content" of place elements (**I** for palatality, **U** for velarity, **P** for labiality etc.) not much in particular will be proposed here. The default is for consonant place elements to be linked to the Root node. By contrast, vowel place elements are linked to **Re**. When a consonant has two places of articulation, the secondary articulation is also a dependent of the filter element (i.e. it is located where place elements are in vowels):

(65)



Arguments for this will be given in section 6.4. We will also argue that **I** behaves differently than other place elements. The number of place elements that need to be assumed for a given language depends on how many contrasting places of articulation are found in it. Since we are concerned specifically with the relation of palatality and manner, we will not take sides in questions like how the unmarked nature of coronals is to be incorporated into a theory of phonological representations.[6]

6.1.4. The structure of stops, affricates and fricatives

Stops, the most unmarked consonants, consist of **PT** and a consecutively ordered **No** element. If unreleased, they lack burst and hence have no **No** element.[7] Fricatives consist of the same elements, but in their structure source elements and **No** are synchronous. Affricates have the same structure at this level as released stops. The difference between the two categories is here assumed to be one of place of articulation primarily:[8] palatal or

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[6] It seems likely that the **Re** element of vowels must be able to support more than one vowel element, e.g. **I** and **A** or their equivalents in the case of **e** etc., depending on what elements exactly one adopts.

[7] As Steriade (1993a) and (1993b) suggest, released stops are here regarded as contour segments. Our opinion differs from hers in that release does not involve maximum aperture but actual noise (and we also do not believe released and unreleased nasals should be represented differently, since – as opposed to stops – they carry the same sort and amount of acoustic information). It is also possible that glottal stops consist of a single **PT** element, but this question will not be discussed here.

[8] In the UPSID, 222 languages are listed that have affricates. In 117 (i.e. slightly more than half) of these, affricates are found at places of articulation where stops are not (mostly palatal or palato-alveolar), as in English or Italian. In some exceptional languages they form a series of their own, parallel to that of stops, as in German. In the remaining languages there is a small overlap between the stop series and the affricate(s), usually in the coronal region (i.e. there is a **t** – **ts** contrast, as in Hungarian). The idea pursued here is thus correct for the majority pattern, but of course we do not wish to give the impression that we regard the analysis of affricates an unproblematic issue.

palato-alveolar stops tend to be affricates rather than pure stops.[9] Alternatively, affricates could also be assumed to differ from released stops in that they have two Root nodes.[10] The structure of stops and fricatives will be displayed in charts in the following section.

6.2. Obstruent system types

6.2.1. One series

The simplest obstruent systems in natural languages consist of one series of stops and nothing else. The UPSID has 14 such languages in it.[11] For instance, the obstruent system of Tiwi is as follows:

(66) **p t̪ t ʈ k**

In such languages only one tier is available for the single source element and the filter element of obstruents. The single tier explains why there are no fricatives (because **PT** and **No** cannot be synchronous). Thus the only possible structure for obstruents is the following:

(67)

As can be seen, unreleased stops differ from their released counterparts in not having a **No** element. The broken lines in the representation of the released stop indicate consecutive relation – which is, of course, the only possibility if only one tier is available.

6.2.2. Two series

The next level of complexity characterises systems including one series of stops and one series of fricatives of identical phonation type. A case in point is the Indo-Pacific language Fasu, whose obstruent system is the following:

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[9] The phonetic explanation of the preponderance of palatal fricatives and affricates vs. pure stops is that the area of contact between the active and the passive articulator is much larger for palatals than for other places of articulation, and hence the release takes longer, which is conducive to the appearance of noise.

[10] This is another highly problematic issue which we will not attempt to resolve here. Both single-root and double-root analyses of affricates present problems, though different ones (see the discussion in Lombardi 1990). It must be considered that the analysis of affricates is a function of several aspects of the phonological systems, ranging from the structure of the segment-inventory to prosodic morphology (for the latter see McCarthy and Prince 1990).

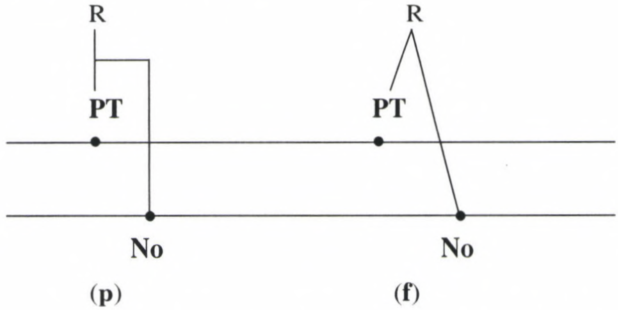
[11] Tiwi, Nunggubuyu, Burera, Alawa, Maranungku, Malakmalak, Bardi, Wik-Munkan, Western Desert, Kariera-Ngarluma, Gugu-Yalanji, Arabana-Wanganura, Bandjalang, Hawaiian. All except the last are spoken in Australia: the absence of fricatives is clearly an areal trait.

(68)

p	**t**	**k**	
ɸ	**s**		**h**

In such languages, obstruents are composed of the same two elements as in one-series languages, but they are located on two different tiers, which makes it possible for them to be either consecutive or synchronous:[12]

(69)



Why two-series languages do not normally have two series of stops instead of one of stops and one of fricatives is a question we will explain in the following section.

6.2.3. Three series

Languages with three series of obstruents have two series of stops (primary and secondary phonation) and one series of fricatives (primary phonation). Latin is a good example of this type:

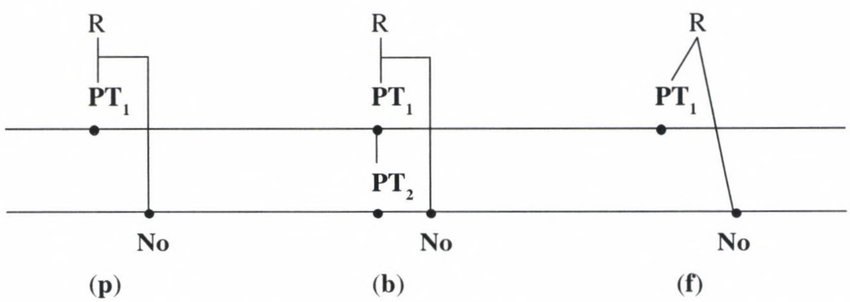
(70)

p	**t**	**k**	**k**^{w}	
b	**d**	**g**		
f	**s**			**h**

In such languages there are two **PT** elements but only two tiers available, one for $\mathbf{PT}_1$, the other for $\mathbf{PT}_2$ and for **No**. Thus **No** may stand in a consecutive relation with both **PT** elements, but it can only be synchronous with $\mathbf{PT}_1$, so there can only be fricatives of primary phonation.

The resulting representations are the following:

(71)



[12] From now on I do not include the representation of unreleased stops, since it can be easily derived from that of released stops.

It appears that the unmarked case is for $\mathbf{PT_1}$ to stand alone on its tier. If it shared its tier with $\mathbf{PT_2}$, the consequence would be phonatory contour segments – a phenomenon to our knowledge unattested in the phonology of the world's languages.[13] If $\mathbf{PT_1}$ shares its tier with **No**, the consequence is two series of stops but no fricatives. Such languages exist but are highly untypical: in the entire UPSID there are only four of them (Diyari, Andamanese, Nasioi and Auca). In these it is safe to assume that **No** is found on the $\mathbf{PT_1}$ tier instead of the $\mathbf{PT_2}$ tier. Nevertheless, the tendency clearly is that if it is possible for $\mathbf{PT_1}$ not to share its tier with other elements (i.e. if there are at least two tiers available for obstruent source and filter elements), it will not share it.

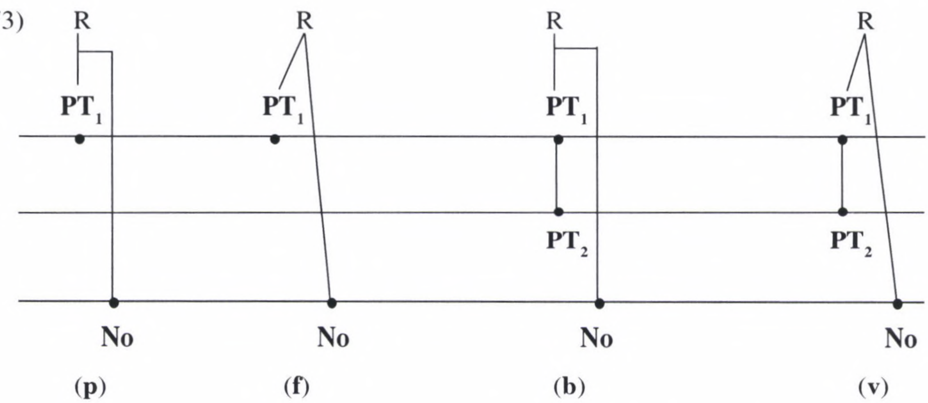
6.2.4. Four series

The most usual pattern for languages that have four series of obstruents is to have two series of stops and two series of fricatives (primary and secondary phonation for both). French is a language like that; its obstruent system is repeated here for convenience:

(72) = (60)				
	p	**t**		**k**
	b	**d**		**g**
	f	**s**	**ʃ**	
	v	**z**	**ʒ**	

Such languages have the same inventory of elements as three-series languages, but they have a third tier on which **No** is found "divorced" from $\mathbf{PT_2}$. The structure of the four kinds of obstruents will then be as follows:

(73)



Further possible ramifications of obstruent systems will not be investigated here, but we assume other systems can be modelled along the same lines.

It is clear that the richer a system is in manner distinctions the more complicated its infrasegmental representations are. In the simplest system only **PT** and **No** exist and they

[13] Phonetically, of course, there exist phonatory contour segments, as in English, but they do not presuppose that the two **PT** elements be on the same tier.

are found on the same tier (67). This is the minimal structure any language must have. On the next level, the same two elements are on two tiers, which makes it possible for them to enter into synchronous, and not only consecutive, combination. A system becomes more complicated if the two tiers host two **PT** elements besides the **No** element (71); even more complicated systems have three tiers for these three elements (73).

The same is true for individual segment types. Voiceless stops consist of nothing else but $\mathbf{PT}_{(1)}$ and **No** (the latter only if it is released). Fricatives consist of the same elements but they are more complex in that the synchronous relation of the two elements requires that they be on two tiers. In systems including fricatives, stops are also represented on two tiers, but in their case this is coincidental and not a necessity: consecutive relation could also be established on one tier (cf. the structure of **p** in 67 vs. 69). This is why stops are simpler than fricatives of the same phonation type. Voiced stops are more complex than both because they are composed of three elements, but in the implicational hierarchy of segments they are on the same level as voiceless fricatives (i.e. in the stricter sense of the word they only imply voiceless stops, and not voiced stops, at their own place of articulation, but in the weaker sense of implication they are dependent on voiced stops in that a language that has no fricatives at all does not normally have secondary phonation stops; see 2.3). Voiced fricatives are more complex than voiced stops for the reason explained above with reference to voiceless segments: they need three tiers, whereas voiced stops do not, although if there are three tiers available in the phonological representations of the language, stops will make use of them (cf. the structure of **b** in 71 vs. 73).

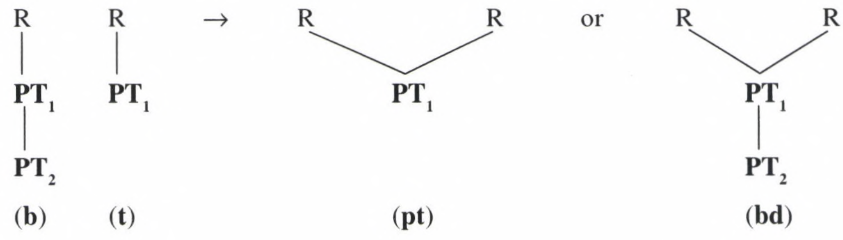
6.3. Some typical processes affecting obstruents

Let us now turn to the question of how those processes that most typically affect obstruent manner can be captured in the model developed so far. Four generally attested processes will be analysed here: contact voice assimilation, voicing induced by a sonorant, fricativisation of the first of two stops, and fricativisation in other positions.

6.3.1. Contact voice assimilation

Assimilation or identity of the voicing value of adjacent obstruents is universal morpheme-internally and very frequent across morpheme boundaries. This follows automatically from the infrasegmental structures advocated above combined with the Obligatory Contour Principle:[14]

(74)

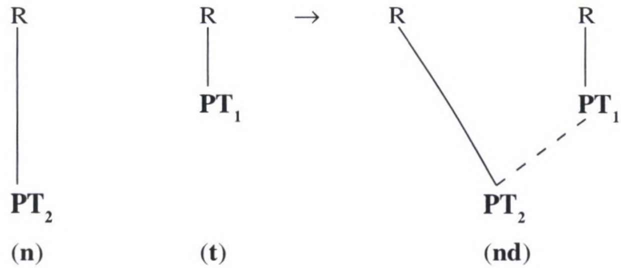


[14] **No** is left out of (74) and (75) for ease of exposition; it would not add anything of substance at this point.

When two obstruents are adjacent, their $\mathbf{PT_1}$ elements would be adjacent – but this is forbidden by OCP. The two Root nodes will then have a common $\mathbf{PT_1}$ linked to them, which consequently either has a dependent $\mathbf{PT_2}$ element or not, but the two Root nodes cannot differ in one having $\mathbf{PT_2}$, the other not. This is because $\mathbf{PT_2}$ is always a dependent of $\mathbf{PT_1}$.

6.3.2. Voicing induced by sonorants

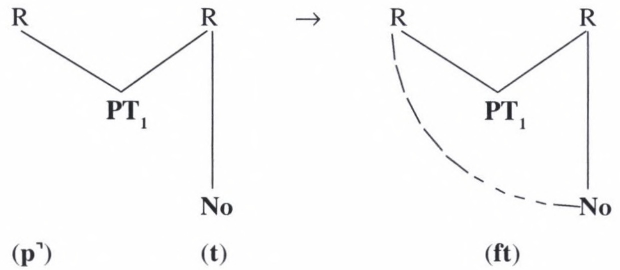
Voicing of an obstruent induced by an adjacent sonorant can be modelled as the simple spreading of $\mathbf{PT_2}$:

(75)


This is in harmony with two general observations: (i) the voicing of a voiceless obstruent requires the adjacency of at least one voiced segment (even if it may not be a sufficient conditioning factor); (ii) the voicing of a voiceless obstruent by an adjacent sonorant is far not so general as voice assimilation on contact between obstruents. The first of these observations is catered for by the interpretation of voicing as spreading of $\mathbf{PT_2}$; the second by the automatism of OCP in one case, as opposed to the possibility, but not the requirement, of spreading in the other.

6.3.3. Fricativisation induced by a following stop

This kind of process is exemplified by Greek. Sequences of two stops always turn into fricative + stop sequences, as in Classical Greek **hepta** 'seven', **okto:** 'eight' > Modern Greek **efta, oxto** (identical to 4.2.1.5).[15] It can be very simply modelled as the spreading of **No** from the second stop on the first:

(76)


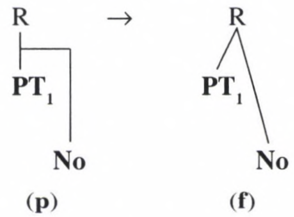
[15] Such processes are described in more detail in Cser (1999).

Interestingly, this process is phonologically a case of spreading, whereas its traditional (surface) label is dissimilation. This shows that spreading and assimilation on the one hand, and delinking and dissimilation on the other, are not to be automatically equated.

6.3.4. Fricativisation in other positions

Other cases of fricativisation, i.e. those not induced by a following stop, are changes in the internal timing of the segments: the consecutive relation of **PT** and **No** turns into a synchronous relation. This is shown in the following figure:

(77)

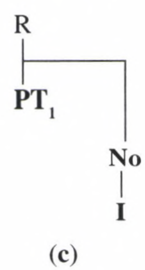


This way of modelling such processes is in harmony with the observation that they have no characteristic environments cross-linguistically. In Iranian, fricativisation occurs before all consonants in all positions (4.2.1.22; Mayrhofer 1989:6–9), in Hebrew after all vowels (4.2.1.38; Moscati 1980:26), in Pre-Hungarian word-initial **p** was always replaced by **f**, **k** was replaced by **x** only before back vowels, **t** remained unchanged (4.2.1.10–11; Sammallahti 1988:515–6).[16]

6.4. The question of palatals

Recall that palatals behave idiosyncratically in certain respects, two of which we pointed out earlier: (i) palatal fricatives quite freely occur in languages that lack homorganic stops, which is not true of other places of articulation and (ii) palatal stops often turn into fricatives in context-free changes, which is again unique to this place of articulation. To explain this we suggest that **I**, the place element for palatals, always attaches to the filter element instead of the Root node. What this means is that palatality is inherently a secondary place of articulation, which is sometimes not accompanied by a primary place. The representation of a palatal stop will then be as follows:

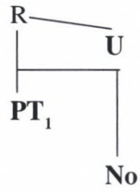
(78)



[16] In Pre-Hungarian, there is a complex history of word-internal fricativisations as well.

By contrast, a velar stop has the element **U** attached to the Root node:

(79) = (65)



(k)

The credibility of this claim depends on whether the consequences that follow from it match the facts observed in human languages. The first two – interrelated – observations mentioned above clearly indicate a preference for fricatives as opposed to stops at the palatal place of articulation, one synchronically, the other diachronically. Its explanation, we claim, is that palatality has a tendency to enhance the filter element of segments, because that is what it depends on: without a filter element there can be no palatality. Since the only segments whose filter element is jeopardised by their position in the phonological sequence are stops, it is clear that palatal stops will be at a disadvantage in comparison with fricatives. This also explains the curious fact that the only nasals in the UPSID that lack a homorganic stop are palatal. Furthermore, there are a number of other facts that the model we propose and the place of palatality in it explain simply and naturally.

(i) If palatal stops are in a coda position and thus lose noise, they may lose palatality as well. This is what happens in Korean, for instance. In that language, coda stops neutralise in the following way:

(80)	**p**	**b**	$\mathbf{p^h}$	→	**p˺**
	k	**g**	$\mathbf{k^h}$	→	**k˺**
	t	**d**	$\mathbf{t^h}$	→	**t˺**
	c	**ɟ**	$\mathbf{c^h}$	→	**t˺**

In the case of peripheral and dental stops, the neutralisations only affect the source element. It is significant, however, that palatals neutralise to **t˺** instead of **c˺**. What this shows is precisely that the general loss of release (i.e. loss of noise) does not affect any place of articulation except palatality, which is lost along with noise. This supports the idea that **I** is a dependent of **No**.[17]

It must be mentioned at this point that some languages show more complicated patterns. In Hungarian, for one, palatal stops may be unreleased but remain palatal in preconsonantal position:[18]

(81) *hagyta* **hɑc˺tɑ** '(he) left it'
hagyma **hɑɟ˺mɑ** 'onion'

[17] The idea that coda position bars certain elements that are connected to release is discussed in Steriade (1993a). However, she does not say anything about palatality there because it is not related to the issue of contour segments.

[18] See Siptár (1995:33), also Siptár and Törkenczy (2000).

It is still true, however, that released stops in preconsonantal position are definitely possible in Hungarian and probably more frequent than unreleased stops. The affricates **tʃ** and **ts** are always released and have no unreleased variants:

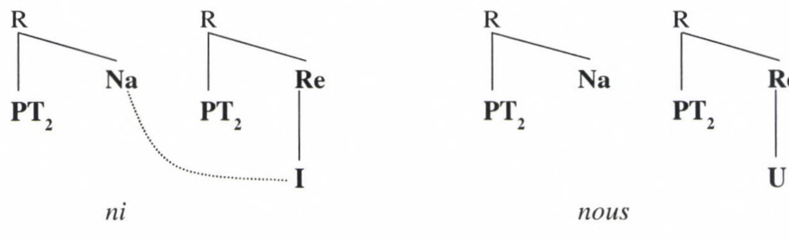
(82) *macska* **mɑtʃkɑ** 'cat'
pöcköl **pøtskøl** 'flip'.

(ii) In several languages, the other manifestation of the same underlying structure is that palatal stops or affricates do not occur in positions that regularly block the burst. In English, for instance, **tʃ** and **dʒ** do not normally occur in preconsonantal position, where all other stops are unreleased. The only forms in which an affricate is followed by a consonant have a strong boundary in the critical position (as in *matched, fudged*). This phonotactic principle appears to be valid in a large number of languages, though we have not made surveys specifically about it.

Spanish preserves the vestiges of a sound change that was conditioned by the same principle. The sequence **ult** turned into **utʃ** in a release-position, but into **uj** in a non-release-position: **multu* > *mucho* 'much ADJ' but **mult* > *muy* 'much ADV' and **vultre* > *buitre* 'vulture'. To take another diachronic example, it is no accident that French is one of the two Romance languages (next to Portuguese) in which affricates underwent complete fricativisation (see 61). The history of French is exceptionally rich in vowel losses and concomitant large-scale phonotactic restructuring. What this means is that affricates in French were much more likely to find themselves in preconsonantal position than affricates in Italian, Spanish or any other related language (cf. **accapitare* 'try to catch' > *acheter* **aʃte** 'buy'). It is likely that this is what explains the exceptional disappearance of affricates.

(iii) Among consonants, palatals are rare with respect to other places of articulation, but the same is not true of vowels. According to the statistics in Maddieson (1984:35), **p** is found in 263 languages in the UPSID, dental or alveolar **t** in 309, **k** in 283. At the same time, **c** is only indicated in 39, **tʃ** in 136. This is because palatal consonants have a more layered structure due to a dependency not found in consonants with other place elements. In vowels, however, all place elements are dependents of the **Re** element and there are thus no differences in complexity among them.[19]

(iv) Palatality spreads easily from vowels to consonants, whereas velarity does not. This is because **I** is on the same tier in vowels as in consonants, but **U** is not. Compare the representation of French *ni* **ni** ~ **ɲi** 'neither' vs. *nous* **nu** 'we':[20]

(83)


[19] This may of course not be true of those vowels that have long been argued to be more "marked", e.g. **y**, **ø**.

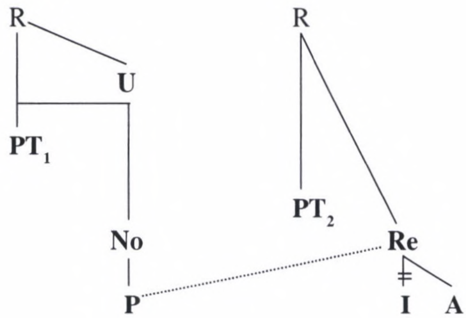
[20] For the sake of legibility, we have not indicated the contraction of the **PT**$_2$ elements as required by OCP. We also do not indicate any element that would account for the (underlying) coronality of **n**, mainly because we are not quite certain how coronality should be represented (perhaps, being a default place, by no specific element at all), but we also do not believe it would affect the point made here in any way.

(v) Non-palatal consonants can have a secondary (i.e. vocalic) place of articulation.[21] This is again borne out by typological facts: in the UPSID only three languages have labialised palatal affricates (no stops at all), but 38 have **k**^{w}. (This might perhaps be an argument for a two-root analysis of affricates: two secondary places of articulation, as in Akan **cç**^{w}, can only be supported by two Root nodes.)

(vi) Secondary place spreads from consonants to vowels more easily than primary place. This is because the secondary, but not the primary, place elements of consonants occupy the same slot in element geometry as the place elements of vowels. Evidence of the tendency for secondary place to spread more easily than primary comes from several languages, among them Latin, where labiovelars, but neither labials, nor velars, turn a vowel into rounded:

(84) La ***k**^{w}**ek**^{w}**o:** > *coquo* 'to cook' but *pello* 'beat', *celsus* 'high' with unchanged vowel.

(85)



k^{w}**e** > **k**^{w}**o** (> **ko**)[22]

(vii) If secondary place is vocalic place in consonants and is generally a dependent of the filter element, it follows that unreleased stops lose their secondary place element. This is again borne out by facts like those of Latin, where **k**^{w} alternates with **k** in exactly that fashion: when released, it is **k**^{w}, when unreleased, it is **k**:

(86) *coqu-ere* 'to cook' ~ *coc-tus* 'cooked'
relinqu-ere 'to leave' ~ *relic-tus* 'left'.

(viii) Given that primary and secondary place is located differently, there is no reason why the same element could not occur in both positions within a single segment. This means that primary and secondary place of articulation can be identical – but they cannot be palatal, since **I** can only be a secondary place. This appears to be a theoretical possibility: labialised labials or velarised velars are very hard to find in the world's languages,

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[21] The idea that secondary place is vocalic place in consonants occurs in Clements and Hume (1995). There it is part of a model of infrasegmental structure that is, to our mind, complicated beyond necessity.

[22] The vowel system of Latin is such that all rounded vowels are velarised by a default mechanism. The change **k**^{w}**o** > **ko** is independent of the process discussed here.

and indeed no such segment occurs at all in the UPSID. Yet there are indications that they exist, though only marginally. Hudson (1995:789 and 794) cites the following Chaha data:

(87) **bənər** 'demolish' vs. **b^{w}ənər** 'demolish IMPERS'
bitəbət 'dissolve' vs. **b^{w}itʃəb^{w}ətʃ** 'dissolve IMPERS'

Labialisation as well as palatalisation here function as exponents of a grammatical category, but this does not affect the point that labialised labials are indeed single segments.

7. GENERAL SUMMARY

This work has sought to establish a crucial link between two theoretical constructs of phonology. One is the implicational hierarchy of consonant systems, which we worked out on the basis of the available phonetic and typological literature in more detail, to our knowledge, than has been done previously. The other is the notion of lenition or weakening, involving its inverse, fortition or strengthening. Lenition is one of the most widely used categories in diachronic phonology, but a detailed analysis of how it is treated in the literature shows that it is ill-defined and poorly understood and consequently capable of causing confusion in scientific discussion.

It seems to us that a link between the implicational hierarchy of consonant systems and lenition/fortition can be established through a third theoretical construct, that of sonority. This apparently plays a crucial role in the implicational hierarchy as its basic organising principle, though the two do not coincide. Significant deviations can be seen in e.g. the relation between fricatives and nasals. In discussing lenition and fortition we decided to refer only to sonority as a decisive factor for two reasons. One is that by this narrowing of the meaning of the terms we were able to make them operationally useful in the categorisation and analysis of linguistic data; the other is that in the literature on changes regarded as lenitions or fortitions sonority generally functions as an important (though by no means exclusive) organising principle and thus the way we categorise changes frequently coincides with how others would categorise them.

The diachronic analysis of sonority changes (i.e. lenitions and fortitions) led to a generalisation which we formulated in 4.7. This generalisation holds of obstruents and claims that lenitions are overwhelmingly context-dependent (with the exception of the lenition of palatal and palatalised obstruents), whereas fortitions are either conditioned or unconditioned, with no apparent preference for either of the two. This phenomenon can be explained with reference to the link between sonority changes and the implicational hierarchy: lenitions are downward movements in the latter and thus, if they were unconditioned, they would lead to the emergence of unanchored segments in the system. The same is not true of fortitions, since they are upward movements within the implicational hierarchy and so it does not matter whether they are conditioned or unconditioned, since they cannot result in unanchored segments. The detailed diachronic analysis of the obstruent system of Germanic languages fully bears out the generalisation.

In order to establish a phonological basis for our typological findings we worked out a model of infrasegmental structure, whose primary goal was to describe manner of articulation properties of obstruents, but it had certain consequences with respect to place of articulation as well, since the exceptional behaviour of palatals had to be accounted for. The model led to several predictions that did not originally belong to the phenomena to be explained in this work but which appear to be largely correct. It is in these three questions: the implicational hierarchy of consonant systems, lenitions and fortitions, and the phonological modelling of the manner of articulation of consonants that we hope to have shown new results as well as new paths of research.

7.1. Unanswered questions

There are several issues that belong broadly to the topics discussed in this work but which have not been specifically addressed here. As we see it, they are the following:

(i) The suprasegmental properties of the environments of lenitions and fortitions (stress, syllable structure etc.). It seems that not all widely accepted generalisations are valid in this question either: syllable-final strengthening is found in, for instance, Rhaeto-Romance (4.5.1); post-tonic position can lead to strengthening and pre-tonic position can lead to weakening (see Verner's Law in Chapter 5). The typological analysis of these factors would have exponentially increased the amount of data to be analysed.

(ii) The relation between lenition and loss or, more broadly, between lenition and the reductive nature of sound change. This is a central concern of historical linguistics and much valuable work has been done on it, but we still lack a generally accepted, comprehensive model of explanatory value.

(iii) The relation between lenition and the sound changes resulting in purely laryngeal segments (primarily **h** and **ʔ**). Most of those who discuss this question take it more or less for granted that the changes resulting in laryngeals are lenitions. Such changes need to be looked into more deeply so that we will be able to decide on this issue.

(iv) The question of geminates and (de)geminations. This may be crucially related to the matters of lenition and fortition.[1]

(v) The highly intimate and problematic relation between voiced nonsibilant fricatives and approximants. The frequency of changes leading from one to the other and the phonetic indeterminacy of the borderline between them has been the source of much descriptive confusion. This issue is clearly not alien to that of lenitions and fortitions.

We are sure that detailed discussion of these five points would have significantly contributed to the results of this work and perhaps would have modified them. Nevertheless, we were forced to disregard them in order not to get bogged down in writing a book that may never be finished.

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[1] We argued for a link on the basis of Germanic data in Cser (1994).

APPENDICES

Appendix 1: The UPSID languages referred to in this book

Language	Number	Family (total number of languages of the family in UPSID)
German	004	Indo-European (21)
Lithuanian	007	
Russian	008	
French	010	
Spanish	011	
Pashto	014	
Armenian (Eastern)	022	
Ostyak	050	Ural-Altaic (22)
Cheremis	051	
Finnish	053	
Azerbaijani	059	
Khalaj	064	
Mongolian	066	
Evenki	067	
Goldi	068	
Kpelle	103	Niger–Kordofanian (31)
Igbo	116	
Zulu	126	
Songhai	200	Nilo-Saharan (21)
Maba	202	
Fur	203	
Nubian	206	
Nyangi	207	
Ik	208	
Tama	210	
Temein	211	
Nera	212	
Tabi	213	
Kunama	219	
Arabic	250	Afro-Asiatic (21)
Tigre	251	
Amharic	252	
Hebrew	253	
Socotri	254	
Shilha	256	
Tuareg	257	
Somali	258	
Iraqw	260	
Beja	261	
Kullo	262	
Dizi	263	
Hausa	266	

Language	Number	Family (total number of languages of the family in UPSID)
Ngizim	269	
Kanakuru	270	
Vietnamese	303	Austro-Asiatic (6)
Maung	350	Australian (19)
Tiwi	351	
Burera	352	
Nunggubuyu	353	
Alawa	354	
Malakmalak	356	
Bardi	357	
Wik-Munkan	358	
Kunjen	359	
Western Desert	360	
Nyangumata	361	
Aranda	362	
Kariera-Ngarluma	363	
Gugu-Yalanji	364	
Arabana-Wanganura	366	
Diyari	367	
Bandjalang	368	
Lakkia	401	Austro-Tai (25)
Yay	402	
Sui	403	
Saek	404	
Po-ai	405	
Lungchow	406	
Atayal	407	
Rukai	417	
Roro	420	
Kaliai	421	
Iai	422	
Hawaiian	424	
Taishan	501	Sino-Tibetan (18)
Burmese	509	
Lahu	510	
Ao	512	
Tiddim Chin	513	
Andamanese	600	Indo-Pacific (26)
Asmat	601	
Washkuk	602	
Telefol	606	
Gadsup	608	
Yagaria	609	

Language	Number	Family (total number of languages of the family in UPSID)
Kewa	610	
Chuave	611	
Dera	619	
Kunimaipa	620	
Yareba	621	
Koiari	622	
Nasioi	624	
Rotokas	625	
Nambakaengo	626	
Haida	700	Amerindian (Northern) (51)
Tlingit	701	
Navaho	702	
Chpewyan	703	
Tolowa	704	
Hupa	705	
Nez Perce	706	
Wintu	709	
Mixe	715	
Mazatec	727	
Mixtec	728	
Chatino	729	
Nootka	730	
Kwakw'ala	731	
Quileute	732	
Squamish	733	
Puget Sound	734	
Luiseño	737	
Hopi	738	
Diegueño	743	
Achumawi	744	
Tarascan	747	
Zuni	748	
Acoma	749	
Wiyot	753	
Yuchi	757	
Alabama	759	
Paez	804	Amerindian (Southern) (37)
Ocaina	805	
Amahuaca	810	
Chacobo	811	
Tacana	812	
Arabela	817	
Auca	818	

Language	Number	Family (total number of languages of the family in UPSID)
Amuesha	824	
Campa	825	
Moxo	827	
Guarani	828	
Cofan	836	
Greenlandic	900	Other (17)
Aleut	901	
Kota	903	
Yukaghir	907	
Chukchi	908	
Georgian	910	
Kabardian	911	
Lak	912	

Appendix 2: Languages with anomalous obstruent systems (cf. 3.4)

	v/β	–p	Later	ɣ	ð	Palat	Phar	Uvul	Retr	θ–s	other
004						+					
007	+										
008						+					
010						+					
014			+								
022									+		
050				+							
051	+				+						
053	+										
059											+
064						+					
066		+									+
067	+										
068	+					+					
103				+							
116				+							
126			+								
200		+									
202		+				+					
203				+		+					
206		+									
207			+								
208			+								
210		+				+					
211						+					
212		+									
213										+	
219		+									
250		+									
251		+									
252		+									
253						+					
254		+	+			+					
255								+			
256		+				+	+				
257		+				+		+			
258		+									
260						+					
261		+				+					
262		+									

	v/β	–p	Later	ɣ	ð	Palat	Phar	Uvul	Retr	θ–s	other
263		+									
266		+									
269			+								
270			+	+		+					
303		+									+
350				+							
359				+							
401			+								
402										+	
403								+			
404	+			+							
405			+								
406			+								
407	+						+				
417										+	
421	+										
422											+
501			+								
509										+	
510				+							
512			+								
513	+										
601						+					
602		+									
606		+									
608	+										
609	+										
610		+									+
611		+									
620								+			
621		+									+
622		+			+						
625	+										
626	+										
704			+								+
705			+								
706			+								
709										+	
715	+					+					
727	+										
728	+										

	v/β	–p	Later	ɣ	ð	Palat	Phar	Uvul	Retr	θ–s	other
729						+					
737	+										
738	+										
743	+		+								
744						+					
747									+		
748			+								
749											+
753			+								
757			+								
759			+								
804				+							
805						+					
810										+	
811	+										
812	+										+
817						+					
824	+										
825	+										
827	+										
828	+										
836				+							
837									+		
900			+			+					
901						+					
903	+										
907								+			
908				+					+		
910	+							+			
911						+	+				
912							+				
Sum	**27**	**25**	**21**	**12**	**2**	**25**	**4**	**6**	**4**	**6**	**9**

ABBREVIATIONS OF LANGUAGES

Akk	Akkadian
Ar	Arabic
Aram	Aramaic
Av	Avestan
Be	Bengali
ClGr	Classical Greek
E	English
EME	Early Middle English
EOFr	Early Old French
Eth	Ethiopian
Far	Faroese
FP	Finno-Permic
Fr	French
FU	Finno-Ugric
G	German
Ga-Ro	Gallo-Romance
Go	Gothic
Gr	Greek
He	Hebrew
HG	High German
Hi	Hindi
Hu	Hungarian
IE	Indo-European
It	Italian
Kan	Kannada
Ku	Kurukh
La	Latin
Lit	Lithuanian
LME	Late Middle English
LOFr	Late Old French
ME	Middle English
MI	Middle Indic
MIA	Middle Indo-Aryan
MGr	Middle Greek
MoE	Modern English
MoFr	Modern French
MoGr	Modern Greek
NHG	New High German

ObU	Ob-Ugric
OChS	Old Church Slavonic
OE	Old English
OFr	Old French
OHG	Old High German
OIr	Old Irish
OIran	Old Iranian
OPers	Old Persian
OS	Old Saxon
Osm	Osmanli
OSp	Old Spanish
Ost	Ostiak
PGmc	Proto-Germanic
PIE	Proto-Indo-European
Prkt	Prakrit
PU	Proto-Uralic
RR	Rhaeto-Romance
Sc	Scandinavian
Sl	Slavonic
Skt	Sanskrit
Sp	Spanish
Sw	Swedish
Syr	Syrian
Ta	Tamil
To	Toda
Ve	Vedic Sanskrit
Vog	Vogul
Vot	Votiak
WGmc	West Germanic
Zyr	Zyrien

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The author of this volume attempts to establish a link between the notions of lenition and fortition on the one hand, and the implicational hierarchy of obstruents on the other, through the property of sonority. Earlier theories of lenition and fortition are critically assessed and the typological patterning of obstruent systems is given thorough treatment. Crucial links between these two fields of phonological phenomena are discovered, empirically verified and phonologically explained. The hypothesis is tested against a corpus of diachronic phonological changes from a large number of languages and is further demonstrated through the detailed historical discussion of the obstruent systems of the Germanic languages. In the last chapter the author proposes a model for the representation of manner and place of phonological segments which explains the idiosyncratic behaviour of palatal obstruents and correctly predicts a range of phenomena that originally fall outside the intended scope of the investigation.

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