

Beats-and-Binding Phonology

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PREFACE

This book constitutes a refinement and further development of the model of Beats-and-Binding Phonology originated in my post-doctoral dissertation (Habilitationsschrift) (Dziubalska-Kołodziej 1995). The present shape of the model is a result of new research, in which parts of the previous data and materials were used. Primarily, it is the result of feedback from numerous discussions and new publications in phonology and phonetics, new data collected by myself and others, new developments in Natural Linguistics and their new applications. I would like to thank all colleagues whose remarks and comments during conferences and on various other scholarly occasions contributed to modifications and improvements of the Beats-and-Binding model of phonology.

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PART I.

THE FOUNDATIONS OF THE MODEL

CHAPTER ONE

The aim of the book

In this monograph I will present a model of phonology which originates in the assumption that a phonology has a larger scope and more explanatory power if it is not limited by syllable-oriented explanations. Thus, the model presented here characteristically lacks reference to the syllable: at best, it relegates the syllable to the status of an epiphenomenon. The model derives from the framework of Natural Linguistics, in particular the theories of Natural Phonology and Natural Morphology. In accordance with the Natural Linguistics assumptions, the present model seriously considers and accounts for both internal and external linguistic evidence in the area of phonology.

Natural Linguistics is functionalist (Dressler 1984, 1993, Dressler and Dziubalska-Kořaczyk 1994) and semiotic (Dressler 1985) in nature. Generalizations formulated within its framework have the status of universal or language-specific preferences and not absolute rules or laws (cf. Dressler 1988b, 1996, 1999a). Contrary to purely formalist frameworks, it draws heavily from external linguistic evidence (Dressler 1979c, 1996) which for a naturalist model becomes substantive. *Chapter Two* of this book will introduce the reader into the naturalist framework, primarily as applied to the study of phonology, i.e. Natural Phonology, and, secondarily¹, to the study of morphology, i.e. Natural Morphology. Natural Phonology will be traced back to the seminal works by Stampe and Donegan (cf., among others, Stampe 1969, 1979, Donegan and Stampe 1979), which in turn may be traced back to the original ideas of Baudouin de Courtenay and Sapir. Most emphasis will be placed on modern advancements in Natural Phonology, inseparable from those in Natural Morphology and naturalist linguistic thinking in general, which are primarily due to the vast conceptual and methodological input by Dressler (cf., e.g., Dressler 1984, 1985, 1996, 1999a,b) and his followers.

A conspicuous feature of the model of phonology I present here is its syllable-less structure. Therefore, the role of the syllable in phonology will be carefully studied and evaluated to form a background for confrontation with a syllable-less phonology and to demonstrate that the latter outweighs the syllable-based models. *Chapter Three* will include a historical overview of approaches to the syllable as well as their critical evaluation. I will start with the etymology of the term “syllable”, discuss the central vs. peripheral vs. no role of this unit in phonology and finish the chapter with an evaluation of the role of the syllable in Natural Phonology.

Chapter Four will introduce the principles of the Beats-and-Binding model (B&B). It will be proposed that the notions of a *beat* and *non-beat* make it possible for the functions of the syllable to be taken over without maintaining it as a unit. A basic rhythmic speech skeleton consists of regularly recurring beats. Beats are primary rhythmic entities realised preferably by vocalic figures against the consonantal ground (non-beats). They do not possess any inherent

¹ Or, as much as it is necessary for a good understanding of the functioning of phonology, which is not independent of morphology.

articulatory characteristics since they are functions rather than units, i.e. they are intentional (in the sense of Baudouin de Courtenay 1895) and perceptual rather than articulatorily actual in nature. Their realisation is preferably vocalic due to the saliency potential inherent to vowels, although consonants may take over a beat function in a number of circumstances (to be discussed in *Chapter Seventeen*). Interrelationships between beats and non-beats consist in bindings which are binary and whose strength relates to sonority. On the basis of B&B principles, a probable synchronic scenario of structure creation in phonology will be proposed.

A stand will be taken on the issue of the epistemological compatibility between preferences and constraints. Both these generalisation tools are used, apparently very differently, by Natural Linguistics and Optimality Theory (cf. Prince & Smolensky 1993, Archangeli & Langendoen 1997, Kager 1999). The latter theory deserves attention not only due to its serious impact on phonological thinking in recent years, but also because it may potentially have much more in common with naturalist thinking than any other formalist framework thus far.

Importantly, it will be argued that the formal devices employed by B&B do not contradict and are not harmful to natural linguistic ideology, primarily due to their expository rather than self-generating nature. In other words, B&B models natural linguistic reality.

B&B phonology assumes the minimal units of a beat and a non-beat, prototypically realised by, respectively, a vowel and a consonant. Sequences of non-beats, realised by consonant clusters, result from reorganisation of the basic beat/non-beat structure of sequences. The resulting clusters are subject to phonotactic preferences specified for all positions within a word, i.e., a given cluster qualifies best to function as word-initial, -medial or -final on the basis of the preference it obeys. The phonotactic preferences specify the universally required relationships between distances in sonority within clusters which guarantee, if respected, preservation of clusters. If not respected, phonotactic preferences guide the changes (e.g. in acquisition and phonostylistics) leading to the improvement of structure. The model of phonotactics in the B&B phonology will be the topic of *Chapter Five*.

The initial five chapters constitute the first of four parts of the book, THE FOUNDATIONS OF THE MODEL. The second part is devoted to the INTERNAL LINGUISTIC EVIDENCE FOR THE MODEL, the third to the HISTORICAL LINGUISTIC EVIDENCE FOR THE MODEL, and the fourth to the EXTERNAL LINGUISTIC EVIDENCE FOR THE MODEL. In the latter three parts an attempt will be made to justify the B&B model through critical reviews of the existing areas of evidence usually involving the syllable. In all cases, a B&B treatment of a problem will be proposed. The evidence concerning the syllable as a unit, its composition, its boundaries and its weight traditionally comes from two major types of sources, referred to as internal and external. The three chapters of *Part II* will discuss evidence from phonotactics (*Chapter Six*), phonological processes (*Chapter Seven*) and the phonology-morphology interface (*Chapter Eight*) as well as provide, respectively, B&B accounts of the discussed phenomena.

Part III (Chapter Nine) is devoted exclusively to the analysis of diachronic evidence within the B&B model. Diachrony has been separated from the other types of evidence, both internal and external, due to its ambivalent nature which permits it to evade a clear-cut classification into *either* internal *or* external type.

Part IV (Chapter Ten through Seventeen) will be devoted to a detailed treatment of a number of areas of external evidence from the point of view of both syllable theories and Beats-and-Binding Phonology. The areas are: first language acquisition, second language acquisition, aphasia, writing systems, phonostylistics, psycholinguistics and metaphonology and phonetics. Each area will be equipped with a bridge theory (Botha 1979, Dressler 1985), which relates the substance of a given type of evidence to the theory of phonological representation and process. I shall demonstrate that what one actually finds in aphasia or in orthography or in child language is evidence to support preferences such as for **n**→**B** binding, the Optimal Sonority Distance

Principle (OSDP), trochaic feet and superiority of morphology over phonology, rather than for the epiphenomenon “syllable”. Additionally, I shall try to uncover a variety of ways in which linguists have allowed themselves to be deceived while interpreting phenomena as proofs for the syllable.

Consonantal beats will be discussed in *Chapter Seventeen*. The feature *syllabic* has traditionally been assigned not only to vocalics, but also to consonants. Although there is a universal preference not to have consonantal beats in a language, this preference may be overridden in a language-specific fashion either on a pre-lexical level, or post-lexically. The circumstances in which consonantal beats can occur will be examined.

Concluding remarks will close the book. The advantages of Beats-and-Binding Phonology will be specified. I shall try to assess the value of applying B&B rather than syllable theories to the explanation of phonological phenomena. As Alan Bell put it:

'Defining the syllable' and 'proving the existence of the syllable' are pseudo-problems. If assumption of a syllabic unit leads to explanation of regularities of segment organization, so much the better. If not, we will be awaiting a more general theory of organization, and the syllable may enter the museum's Hall of Scientific Constructs, taking its place beside ether, the noble savage, and the like. (Bell 1976: 261)

Even if reader of this volume does not feel the syllable to be a museum piece, it is hoped that the present work takes a worthwhile step towards "a more general theory of organisation".

CHAPTER TWO

The Natural Linguistic framework as a prologue to the Beats-and-Binding model

The aim of this chapter is to introduce the reader into the conceptual framework of Natural Linguistics and, in particular, to its two manifestations: Natural Phonology and Natural Morphology. Naturalness in linguistics can be traced back to Baudouin de Courtenay and Sapir. Some of their ideas were taken up by Stampe and Donegan, the founders of Natural Phonology. Naturalness as the ideology behind linguistic explanations received deeper conceptualization and was operationalized in terms of principles by Dressler. This led to the widening of the scope of the framework's explanatory potential to other components of language, i.e. morphonology, morphology, syntax and text, as well as to such areas of language study as pragmatics and sociolinguistics. It also gave new impetus to and provided new insights into Natural Phonology.

In order to do justice to major founding contributions to natural linguistics², this chapter is partly historiographic, partly expository. It is of primary importance for further chapters of this book to gain a clear understanding of the naturalist framework. Needless to say, this understanding is filtered through my own views on the presented issues. The presentation will be divided into three major parts, devoted, respectively, to: the foundation work by Stampe and Donegan (2.1.), Dressler's contribution to the framework (2.2.), and the solutions to the problem of acquisition proposed in the framework (2.3.). Certain fundamental theoretical issues³ will be returned to and elaborated on in Chapter 4 entitled *The Beats-and-Binding model: principles* mainly from the present author's perspective.

² At this point, I would like to emphasize that this book is not an introduction to natural linguistics, which entails that full justice to the framework cannot be done due to the limits of space. Furthermore, I take responsibility for potential subjectivity of interpretation of other authors' views.

³ For instance, the epistemological status of such notions as representation, preference, process vs. constraint or absolute vs. hierarchic constraint.

2.1. Classical Natural Phonology as originated by Stampe and Donegan⁴

An initiating assumption of Natural Phonology, first formulated by Stampe (1969) in his *Acquisition of phonetic representation*⁵ paper is that the phonological system of a language is the residue of universal phonological processes which are available to children and which are revised (restricted and inhibited) by children during language acquisition. Phonological processes are distinct from morphonological or morphological rules, which have to be learned.

2.1.1. Naturalness. Representations.

Natural Phonology is a natural theory of language. Language is not simply a conventional institution. Rather, it is "a natural reflection of the needs, capacities, and world of its users" (Donegan and Stampe 1979: 127) and the theory is designed to explain this natural phenomenon. The basic explanatory principle⁶ in Natural Phonology is the tension between clarity of perception and ease of articulation (Donegan and Stampe 1979: 130). The tension is manifested by the workings of processes of contradictory teleologies (which I will also simply call "listener-friendly" and "speaker-friendly" ones further in the book). The speaker and listener share the aim of either encoding or decoding the underlying intention of speech. The idea of the intention or "Lautabsicht" goes back to the tradition of the mental phoneme (Baudouin de Courtenay 1895, Sapir 1933). According to Stampe, the underlying segments possess the same status ontologically as the surface segments: "they are mental representations of sounds which are, at least in principle, pronounceable" (Stampe 1979: 35). Phonological representation is understood as a kind of representation rather than as a level of representation. The principle of naturalness allows one to establish a possible phonological representation: "if a given utterance is naturally pronounceable as the result of a certain intention, then that intention is a natural perception of the utterance" (Donegan and Stampe 1979: 163).

2.1.2. Processes.

Phonological processes reflect a dialectal relationship between phonetic capacity and phonetic restrictions on this capacity. They are inborn, natural, universal and mental. "[T]he phonological system of a language is largely the residue of an innate system of phonological processes, revised in certain ways by linguistic experience" (Stampe 1969: vii). Since processes reflect conflicting phonetic restrictions (e.g. an obstruent intervocalically cannot be both voiceless - cf. a paradigmatic restriction due to which voiceless stops are preferred to voiced ones - and voiced - cf. a syntagmatic restriction due to which voiced stops are preferred in an intervocalic position), they fall into contradictory sets. The conflicts are resolved by means of suppression, limitation or ordering of the processes. The contradictory sets are manifested by lenitions on the one hand and fortitions on the other. Lenitions (in the literature referred to also as centripetal, weakening, syntagmatic processes), e.g. assimilation, reduction, deletion or monophthongization, are context-sensitive processes which apply especially in weak positions and in casual speech. Their teleology is to minimize articulatory difficulties of speech. Fortitions (centrifugal, strengthening, paradigmatic processes), on the other hand, e.g.

⁴ The foundations of Natural Phonology were laid in the following (published) works of David Stampe and/or Patricia J. Donegan (see the references for details): Stampe (1968), Stampe (1969), Donegan (1978), Stampe (1979), Donegan and Stampe (1979). Other works by the two authors will be mentioned later in this chapter and in Chapter Three.

⁵ Already formulated in Stampe (1968).

⁶ Distinctivity served as the explanatory principle in structuralism. Simplicity used to be the basis of grammar construction in orthodox Generative Phonology.

dissimilation, onset strengthening or insertion, are context-free but expected to apply in strong positions and more formal styles. Their teleology is to maximize the perceptual characteristics of speech.

2.1.3. Processes vs. rules.

Stampe and Donegan's Natural Phonology has a clear-cut distinction between processes (as characterized in 2.1.2. above) and rules. While processes are natural, rules are conventions (though they basically originate from processes). Although both operate on phonological material and produce phonological output, only processes are sensitive to phonological environment: rules must be conditioned outside of phonology. Thus, though both processes and rules have to do with phonology, they have different ontological status. The following differences obtain between processes and rules:

<i>processes</i>	<i>rules</i>
1. possess synchronic phonetic motivation	1. have no synchronic motivation, but possess a grammatical function
2. are inborn	2. have to be learned
3. apply subconsciously (only their absence is noticeable)	3. are formulated through observation
4. are exceptionless	4. tolerate exceptions
5. apply to slips of the tongue, loan words etc.	5. are not productive
6. may be obligatory or optional	6. are obligatory, style-independent (since conventional)

Due to their nature, rules are ordered before processes in derivation, while among the processes fortitions are ordered before lenitions. In other words, the dependence on phonological context increases: starting from rules, which are context-independent, through fortitive processes, which are in most cases independent, to lenitive processes, which are predominantly context-dependent.

2.2. Development of the naturalist framework by W. U. Dressler⁷

2.2.1. Process types and processes.

What Dressler calls *processes* are language-specific phonological processes derived from universal natural *process types*. Prelexical processes are responsible for segment structure and phonotactics while postlexical processes derive phonetic outputs from phonemes.

Fortitions are called foregrounding or clarification (*Verdeutlichung*) processes; lenitions are called backgrounding or obscuration (*Entdeutlichung*) processes. The names reflect the

⁷ From Dressler's numerous publications on Natural Phonology as well as those within the vast area of Natural Linguistics the reader is referred especially to Dressler (1984, 1985, 1990, and 1996) for the outline of the Naturalness Theory of Phonology and its relation to other components of grammar. This section relies basically on these four works and personal communication: the quotes will appear only if a further work of Dressler is referred to.

functions of the processes: "foregrounding and backgrounding", since the processes operate according to the figure-and-ground principle (see below), i.e. they foreground the figure and background the ground; "clarification and obscuration" since the processes either maximize clarity of perception or minimize effort of articulation.

Rules in Dressler's terminology correspond to either morphonological rules or allomorphic morphological rules. The distinction between processes and rules is, according to Dressler, not an absolute one (cf. Stampe) but a gradual one. Processes and rules or, rather, phonological, morphonological and morphological rules (or processes⁸) form a continuum without clear-cut boundaries between particular kinds of processes. Whether a given process is a prototypical representative of one of the categories (e.g. phonological or morphological) depends on a whole set of criteria (cf. especially Dressler 1985).

2.2.2. Acquisition hypotheses⁹.

While it remains unquestioned that morphonological and morphological rules have to be learned in first language acquisition, the availability of process types from the very start of acquisition is disputable. They either are available, or become available through maturation. The former claim, represented by classical Natural Phonology, can be referred to as a strong innateness hypothesis (Stampe 1969). The latter, in recent years supported by Dressler (cf. e.g. Dressler 1996) and applied especially in the area of Natural Morphology (cf. e.g. Dressler and Karpf 1995) can be called a weak innateness hypothesis. What inclines one to opt rather for the "weak" hypothesis? The reasons are at least threefold: 1. The evidence and counter-evidence concerning universal processes in L1 acquisition and latent processes in L2 acquisition tend to be balanced and as such unconvincing either way (cf. e.g. Stampe 1969, Hurch 1983, 1988a, Major 1987, Dziubalska-Kolaczyk 1990, Donegan 1985, Dressler 1996). 2. One could not claim the strong hypothesis for the other (than phonology) components of grammar. 3. There exists a model of self-organizing processes (Karpf 1989, 1990, 1991, Dressler and Karpf 1995) which can integrate the "weak" claim and, thus, serve as a bridge-theory (cf. below 2.2.6. for the explanation of the concept) relating acquisition on the physiological, psychological and neurological level to phonological acquisition.

The concept of self-organizing processes in language acquisition assumes an interplay of genetic preprogramming and of selecting and evaluating postnatal information within and among preferentially coupled neuronal assemblies (which develop into interacting modular systems). In contrast to Chomskyan innatism, much less genetic preprogramming is assumed and it is viewed as being not necessarily of an autonomously grammatical nature. A radical version of this approach assumes, for phonology, only the preprogramming of phonetic processors and of general cognitive and rhythmic principles, and the emergence of (non-innate!) modules of segmental and prosodic phonology as the outcome of the organization and reorganization of the processing of phonetic information.

2.2.3. Naturalness.

Beside the phonetic motivation of naturalness in phonology, emphasized by the classical model, there exist numerous other factors contributing to naturalness. Illuminating these factors allows us to elucidate the notion of naturalness itself. The following general principles of cognitive, psychological and sociopragmatic origin are of relevance: 1. rhythmicity as a principle of the organization of activity (biology, music, speech). 2. The psychological and semiotic principle of figure and ground (cf. Holenstein 1976; Scherer 1984; see below section 2.2.5.). 3. The

⁸ The Stampean terminological distinction rule vs. process loses its conceptual value in Dressler's work.

⁹ Cf. section 2.3. below for a more elaborate discussion of the problem of acquisition.

topological proximity law which states that "near stimuli tend to be grouped together" (López-García 1990: 124-128). 4. The "Renschburgsche Hemmung" which blocks the reapplication of the same operation within too close a distance in time. 5. The neurologically based preference for binary contrasts. 6. A principle of cognitive economy which guarantees a constant flow of information (cf. Fenk-Oczlon 1989). 7. The notion of prototype, central to cognitive linguistics, which groups universal preferences together. 8. The sociopragmatic basis of communication which is to be traced to speaker-hearer interaction.

These as well as the functional and semiotic principles (cf. below) will form the foundation of the Beats-and-Binding model of phonology.

2.2.4. Functionalism¹⁰.

The explanatory model of non-conventionalist, natural linguistics is functional. The model assumes two basic functions of language, the communicative one and the cognitive one, and subsumes two main functions of phonology, i.e. perceptibility and pronounceability, under the communicative function. The functionalist science theory is an important aspect of similarity between naturalist linguistics and cognitive linguistics (Langacker 1988; cf. the discussion of converging features of both approaches in Dressler 1990).

Functional explanation in Natural Phonology relies on:

1. Goal conflict.

A clear example is a conflict between the tendency towards ease of articulation on the part of the speaker (reflected in the generalization of lenitions) and the need to facilitate perception and processing for the sake of the listener (reflected in the generalization of fortitions).

2. Multi/plurifunctionality.

One function can be served by several operations (multiple strategies), and one operation can serve several functions simultaneously. A phonological example is the problem of L₂-specific consonant clusters which may be difficult for the learner to pronounce or even perceive. An obvious facilitation in interlanguage is cluster-simplification. This may be brought about both by the process of vowel epenthesis (a fortition) and consonant deletion (a lenition). The process of vowel epenthesis can serve both better perceptibility and pronounceability, whereas the process of consonant deletion can only serve better pronounceability.

3. A hierarchy of functions.

The two highest functions of language are its communicative function and its cognitive function. Subordinated to these two main functions are other general functions such as that of distinctiveness, as well as the specific functions of the various components of the language system.

4. The assumption that "Form follows function to some extent".

Language functions are served by linguistic operations; in phonology, they are served by phonological processes. The operations may serve their functions in more or less efficient ways while the more efficient ways are preferred (cf. e.g. the minimax principle: the speaker uses the most efficient means to achieve the highest effectivity).

5. Dysfunctions and functional deficiencies i.e. the incompatibility of a form with a function.

The main purpose of functional analysis is to link forms (linguistic devices or operations) to the functions they fulfil. Sometimes, however, an incompatibility of form and function may arise.

6. Alternative explanations.

¹⁰ Apart from the works already mentioned (see Note 6), the reader is referred e.g. to Dressler 1993, Dressler and Dziubalska-Kolaczyk 1994 specifically for the discussion of functional explanation and dysfunctions.

A possibility of coexistence and non-exclusiveness of alternative explanations is a result of the multicausality of human actions and is an outcome of the features of functional explanation discussed above.

7. Preferences.

Due to the factors mentioned above, functional predictions have the form of preferences. This means that naturalist linguistic universals, founded on functional and semiotic principles (cf. below section 2.2.5.), have the form of preferences, and not of absolute statements¹¹.

To explain functionally in Natural Phonology thus means that any time one identifies a function of a given form, one must take into consideration the above seven aspects of functional explanation. In other words, one must remember that a function proposed to justify a form may: 1. conflict with another function; 2. be accompanied by another function; 3. be subordinate to another function; 4. not fully determine the form, or, in other words, there may be forms which would serve this function more efficiently; 5. not be compatible with the form at all, i.e. the form could be dysfunctional. Therefore, the proposed explanation 6. may not constitute the only explanation of the form and 7. must have preferential nature, i.e. must allow for a margin of other factors which may influence the form.

2.2.5. Semiotics¹².

Dressler employed Peircean semiotics (Peirce 1965) as a metatheory of linguistics. From semiotics and other bases of naturalness (phonetic, cognitive, psychological, sociopragmatic), e.g. in phonology, universal preferences for particular semiotic parameters can be deduced and applied, in turn, to explain crosslinguistic tendencies in phonology. The basic semiotic preferences are those for iconicity, indexicality, (bi)uniqueness and for the satisfying of the figure-and-ground principle. Thanks to the semiotic foundations of phonology, Donegan's (1978: 143) "rich-get-richer principle"¹³ is no longer ad hoc and receives its semiotic foundation in the figure-and-ground principle¹⁴. The latter is a general and basic principle of perception which predicts that figures, i.e. the perceptually more salient elements, tend to be further foregrounded, while the less salient elements in the background tend to be further backgrounded. I will rely heavily on this principle in my model (see Chapter 4). The reader is referred to Dressler's publications (see Note 11) for a rich and detailed discussion of these and other semiotic principles and their workings in phonology and other components of grammar.

2.2.6. The universals-to-performance quintuple.

The way from phonological universals to their realization in performance is indirect and leads through: language types, language-specific competence and system adequacy, and sociolinguistic norms. This is illustrated by means of the quintuple (originally established by Hjelmslev and Coseriu, and adapted by Dressler, cf. Dressler 1985: 292) consisting of: (I) universals, (II) type, (III) language-specific competence, (IV) sociolinguistic norms and (V)

¹¹ The notion of preference will be discussed in more detail in Chapter Four and will be employed throughout the book.

¹² Apart from Dressler's works already mentioned (see Notes 6 & 9), the reader is referred to Dressler 1989 for the semiotic foundations of a naturalist linguistic theory.

¹³ The "rich-get-richer principle" applies to fortitions: e.g., talking about vowels (as Donegan does in her 1978 work), rather [I] (more chromatic) than [E] is expected to tense. To quote Donegan (1978: 143): "the vowel which is more susceptible to increase of a given property is the one which already possesses that property to a higher degree."

¹⁴ The notion of figure/ground segregation was first introduced into psychology by the Danish psychologist Rubin and later integrated into the framework of perceptual organization by gestalt psychology (Ungerer and Schmid 1996: 156ff).

performance. The quintuple has been adapted by Dressler to replace Chomskyan triple (I, III and V) and Saussurean quadruple (I, III, IV and V), since it shows the path from universal properties of language to individual performance in steps compatible with the naturalist framework. Each of the five elements is simultaneously the basis of and is filtered by the next one. One needs to consider the whole quintuple when attempting to account for performance¹⁵.

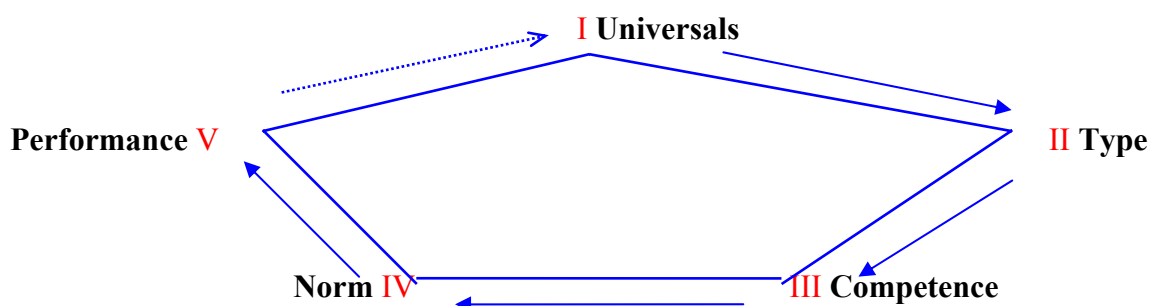


Figure 1. The universals-to-performance quintuple (Dressler 1985: 292).

Let us interpret the diagram: we distinguish three subtheories of naturalness, i.e. (I) the theory of universals (which can also be understood as the theory of markedness), (II) the theory of type adequacy and (III) the theory of language-specific system adequacy, which decide the outcome in performance. Still, more factors contribute to the final shape of performance; these are: (IV) normative, i.e. sociolinguistic factors and (V) psycholinguistic factors, i.e. the ones directly connected with language use. Performance, in turn, has the potential to modify universals.

Universals of human language (I) are properties (e.g., phonological processes) which can be scaled along parameters of naturalness from most to least natural. Accordingly, some of them appear in all languages, some of them enter implicational scales of applicability and, finally, some of them are totally suppressible. A selection of universal properties constitutes a language type (II) (e.g., iso-accentual languages, quantity-sensitive languages). Properties (I) and (II) are filtered by the system of an individual language in order to make them comply with the properties defining this system (III). The choices within an individual system undergo further specification via sociolinguistic norms (IV) and conditions of usage (V). Performance itself feeds back into the universals.

2.2.7. Internal vs. external evidence.¹⁶

The issue of internal vs. external evidence has a long history in linguistics. Discussion usually concentrates on either refuting or defending the role of external evidence as opposed to internal evidence. Already the choice of terms suggests a bias towards internal evidence which has been understood as either THE evidence or at least the more important evidence. Evidence in

¹⁵ In fact, although Chomsky (1965) proclaimed the strict dichotomy between competence and performance (“knowledge” vs. “behaviour”), some of his formulations allow, under closer inspection, for a different interpretation: competence understood as INCLUDED in performance. See, e.g., Chomsky and Halle (1968:3): “One fundamental factor involved in the speaker-hearer’s performance is his knowledge of the grammar that determines an intrinsic connection of sound and meaning for each sentence.”

¹⁶ Further publications by Dressler arguing for the role of external/substantive evidence are, for instance: Dressler 1979a, 1984, 1996. Others taking up the issue of internal vs. external evidence are, e.g., Zwicky ms, Ohala 1986.

linguistics in general serves to choose among competing hypotheses and theories. Some among linguists believe that internal evidence, i.e. evidence from alternation and distribution of linguistic units, suffices to prove (or at least not falsify) a theory. Sometimes, however, they encounter a problem in accounting for a phenomenon which is not liable to explanation exclusively on the basis of internal evidence. Such would be the case, for instance, with a phonological process which applies to a set of segments which do not form a natural class in any sense definable by the assumed theory. Such a problem is easily solved if one inspects external evidence (i.e. evidence from first and second language acquisition, sociophonology (phonostylistics), aphasia, loan word phonology, psychophonology (slips of the tongue, speech play, clippings), writing systems, metrics, as well as diachronic change and phonetics) for the process: one observes then, for instance, that the process applies unexceptionally only to those segments which do form a natural class.

There are at least two further problems with internal evidence. Firstly, one obtains it via observation, introspection, elicitation or experimentation: what is it that one observes, introspects, elicits or experiments with? Certainly not the competence itself, but rather the ways in which it is USED by speakers. On the basis of this usage one can hypothesize about the mental representation of grammar in their minds, i.e. competence. Thus, internal evidence is mediated by external evidence. External evidence is a testing ground for the psychological reality of the claimed representations.

Secondly, internal evidence gives a picture of core competence, but is it the only one? Speakers are capable of manipulating their grammatical knowledge to obtain some intended results (e.g. puns, short words of various types, rhymes, word games, etc.), which points to the functioning of a sort of metacompetence (cf. Sobkowiak 1991, Ronneberger-Sibold 1992, 1996, 1997a,b, 1998). The evidence for metacompetence is clearly “external”.

The above are, among others, the reasons why Natural Phonology considers external evidence to be the central testing ground for linguistic hypotheses. In the history of phonology, external evidence was used, for instance, by Meringer (1908; slips of the tongue and child language), Baudouin de Courtenay (child language: cf. Chmura 1969) and Jakobson (1941; aphasia and child language). Especially Jakobson’s and Sapir’s works stimulated the interest in external evidence expressed already in the first works by Stampe and Donegan. The term “substantive” instead of external has also been used, following Skousen’s (1975) placing it on a par with internal evidence.

In order to guarantee an adequate use of substantive/external evidence in phonology, a bridge theory¹⁷ is needed which allows for the integration of the phonological theory with a given non-linguistic (e.g. sociological, psychological, neurological etc.) theory relevant for the empirical research concerned. A procedure for incorporating a bridge theory into phonological investigation in the naturalist framework is illustrated in Dressler & Wodak (1982), Dressler (1985), Dressler (1988a), Kilani-Schoch (1982), Dressler & Dziubalska-Kolaczyk (1995 a, b) and will be taken up further here in Part III. In fact, the necessity for a bridge theory is the criterion which truly distinguishes between internal and external evidence: a linguistic theory suffices to make use of alternation and distribution data, while it needs to be complemented by a bridge theory when one deals with a piece of external evidence.

Hereafter I will employ the distinction between internal and external evidence as a typological tool which systematizes the existing kinds of evidence¹⁸ in linguistics. I assume

¹⁷ The term “bridge theory” comes from Botha (1979): a theoretical link between linguistic theory and a theory specific to the field from which the external evidence is drawn (cf. Dressler 1979a).

¹⁸ One kind of evidence, i.e. that coming from the modelling of speech in speech technology seems to escape this typology. Potentially, it constitutes the third type of evidence, since modelling aims at obtaining the same effect that we experience in natural speech via internal and external evidence.

both internal and external types of evidence to be indispensable, due to the reasons specified above in this section.

2.3. The problem of acquisition in the naturalist framework¹⁹

2.3.1. The strong hypothesis.

The strong hypothesis constitutes the foundation of the original, already classical, model of Natural Phonology (cf. Stampe 1969, 1979, Donegan and Stampe 1979). It assumes the complete innateness of natural phonological processes which, being subject to suppression, limitation and ordering in the period of first language acquisition, reduce in number and capacity in order to conform with the requirements of a language-specific phonological system. In other words, the inborn phonological potential of an infant undergoes severe revision under the influence of the linguistic input s/he experiences. Importantly, the child is assumed to constantly refer to the phonological representation of the adult in the process of substituting his/her own segments for the intended ones; i.e., the child perceives in terms of the adult's phonemes.

The attractiveness of the strong hypothesis lies in the fact that it allows for strong predictions as to the development of first language phonology as well as with reference to second language acquisition (cf. latent processes, Hurch 1988b) and sound change. The child's phonological capacity is seen as decreasing with maturation rather than increasing as in the traditional view. The traditional view conforms with the most direct interpretation of the commonly assumed stages in the development of infant speech production (from the first vocalizations up to the first fifty words and on)²⁰, which could be paraphrased as "the child can say more and more, so his/her phonology grows". The strong hypothesis predicts that the child's phonology is more and more restricted until it finally attains the language-specific adult state.

Those processes present in the child's original phonology which never get triggered by the input from the native-language environment are logically thought to lie dormant in a state of latency or incubation awaiting the chance to be applied in another language in the course of second language acquisition. This should explain, for instance, why speakers of a language lacking final consonants would devoice word-final obstruents in a language lacking word-final devoicing.

The starting point of a sound change is also inferable from the strong hypothesis: it is the failure of a child to suppress, limit or order some process or processes in the way required by his/her native language.

Generally, the strong hypothesis accounts for the convergence among individual paths of acquisition of divergent phonologies and, thus, contributes to the explanation of linguistic universals.

Attractive as it appears, the strong hypothesis also has its drawbacks (cf. Dressler 1996). Phonology-internally, certain natural processes seem not to surface as expected during acquisition. Phonology-externally, the strong acquisition hypothesis is not applicable to the other components of language grammar. Universal processes, rather than inborn, are universally likely reactions to phonetic (and other phonology-related) difficulties the child encounters in

¹⁹ cf. Dziubalska-Kolaczyk (1998) for my earlier discussion of the issue.

²⁰ Diverse theories of infant speech production, i.e., e.g., the universal theory (Jakobson 1941), the articulatory learning theory (cf. Ingram 1989), the maturational theory (Locke 1983) and the refinement/attunement theory (Oller 1986), would refer their diverse predictions to the commonly assumed stages of motor speech development. These are (cf. Smith et al. 1995): the earliest vocalizations, reflexive (0-2 months), control of phonation (2-4 months), expansion/vocal play (5-6 months), canonical babble (7-9 months), variegated babble and first words (10-14 months) (the prelinguistic stage - up to the first word) and the period of the first 50 words.

acquisition. In fact, Donegan (1985) has already made two remarks substantially weakening the strong hypothesis:

The claim that natural processes are innate does not imply that they represent some genetically-transmitted neural program (...). Instead, what is meant is that because of the (genetically-transmitted) physical abilities and limitations of human speakers, some combinations and sequences of phonetic features are more difficult than others, and the substitutions that speakers make (in the mental processing of their speech) to ease these difficulties represent natural processes. (Donegan 1985: 26)

It would not alter the theory of natural phonology substantially to say that processes may be discovered by the child as he learns to use his vocal tract (...). Perhaps this discovery happens in babbling and in early speech. But if processes are learned, they are learned as matters of physical coordination are learned - by doing - not by the kind of cognitive processing that is required to learn other components of language, like syntax, or morphology, or morphonological rules. (Donegan 1985: 26, note 5)

Further, although the intention of Donegan's (1995) paper can be understood as a reappraisal of the strong hypothesis by means of claiming again the innateness of phonemic perception in children, still her statements about innateness and phonemic perception are more relaxed than the strong hypothesis would require them to be. In other words, she leaves a margin for a weaker interpretation of the innateness issue. It is the "developmental reorganization" of perception (Werker and Pegg 1992), taking place within the child's first year, which results in something much like phonemic perception. The latter is therefore innate only in the sense that the phonetic abilities and limitations which lead to it are innate, while it is learned - by learning which of these limitations must be overcome. The infant vocal tract has a broader oral cavity, a shorter pharynx, a gradually sloping oropharyngeal channel, a relatively anterior tongue mass, a closely approximating velum and epiglottis and a relatively high larynx (Kent 1992: 69). The fact that it begins to assume a more adult-like form by about 3-4 months of life also speaks against the "strong" claim about acquisition. Bases for claims about the child's adult-like perception and representation can also be interpreted within a weaker, constructivist model of acquisition. For example, perception and thus also representation of the child may be in terms of features or other distinctive units sufficient at a given level of acquisition, which are still far from the destination, i.e. the adult phonemic intention. The fact that the child is exposed e.g. to adult pronunciations [bʌʔn̩] or [bʌʔt̩n̩], but her/himself pronounces the word as [bʌd̩ən], does not yet prove that s/he has access to the representation /bʌt̩ən/. The pronunciation [bʌd̩ən] can be easily interpreted as the reaction against the difficulties of perceiving and, consequently, pronouncing a syllabic consonant as well as a voiceless consonant in the voiced context. Finally, according to Donegan, phonemic representation is not lexical but refers to the utterance, which allows for its interpretation as an intermediate representation mediating between the phonetic surface and the phonological underlying intention.

2.3.2. Self-organization: The weak acquisition hypothesis.

In view of the reservations expressed above against the idea of full innateness of phonological processes, a constructivist conception of acquisition in which language-specific and universal phonology grows with maturation seems to offer a better explanatory potential. The model of self-organizing processes may provide a bridge-theory, relating physiology, psychology and neurology to Natural Phonology, for the weak claim on innateness of phonological processes (cf. Dressler 1996). In this model, phonology is an outcome of the interplay of genetic

preprogramming (of phonetic processors and general cognitive principles) and selection of input information, which results in neuronal specialization and, ultimately, development of modules. The model predicts that phonological processes, rather than being available at once, arise at different stages of maturation in alternative set-ups. These reorganizations imply that processes are not absolute constraints on production and perception.

The theory of self-organizing systems is a scientific paradigm at the intersection of physics, chemistry, biology and sociology which aims at formulating the general laws that govern the spontaneous occurrence of order in nature and the evolutionary dynamics of such seemingly diverse phenomena as those encountered in physical, biological and sociocultural systems (Jantsch 1981, Haken 1981, Prigogine 1976, 1980, Lindblom, MacNeilage and Studdert-Kennedy 1984, Karmiloff-Smith 1992, Singer 1990). As observed in termite nest-building, local independent behaviours lead to a global structure, be it a nest or a language system. Self-organizational processes are mechanisms assumed within selective theories, in which selection and differentiation are the main principles of structure organization. Living systems interact selectively with the environment and they differentiate once their complexity has surpassed a critical value. In other words, once a system becomes, irreversibly, complex enough to differentiate, it gradually dissipates into functionally specialized subsystems or modules: a system becomes modular.

CHAPTER THREE

The role of the syllable in phonology

Since the times of Indian, Greek and Roman grammarians, the syllable has been traditionally assigned a “matter-of-fact” status in phonetics and phonology²¹. The history of views on the role of the syllable, however, reveals a great amount of controversial discussion devoted to its multiple aspects, e.g. the question of its composition or the problem of its undefinability. “The syllable has a long and troubled history in the development of phonology” (Bell and Hooper 1978: 4). This history will be outlined in the present chapter. While the following survey is intended to be comprehensive in the sense of distinguishing basic types of approaches to the syllable and classifying the theories as belonging to a particular type, it is not exhaustive in the sense that it does not describe, or even mention, all representatives of a particular type.²² The chapter will start with a critical presentation of the etymology and definitions of “syllable”, continue with a historical overview showing the role of the syllable in phonology, including Natural Phonology, and finish with the review of approaches which assign a peripheral role or no role at all to the unit.

3.1. Etymology and definitions of the syllable

Let me start with a review of traditional sources of definitions, i.e. dictionaries, encyclopedias and handbooks. Since the term “syllable” comes from Ancient Greek, the Greek sources will be scrutinized most meticulously.

3.1.1. The ancient Greek syllable.

Liddel-Scott's *Greek-English Lexicon* (1843/1961: 1672) supplies meanings of the verbal base ‘συλλαμβάνω’ (syllambánō), representative of which are: *collect, gather together, combine in pronunciation "as one word"*, in speaking *comprehend, comprise* as well as, more importantly, the meaning of the derived noun ‘συλλαβή’ (syllabḗ): *grip, hold in wrestling, passive what is held together, either letters or sounds taken together*. The analogy to wrestling is particularly illustrative of the relationship that was intended to be expressed by the term "syllable": a wrestler holding his partner in a grip reflects a similar relationship between a vowel (holder) and a consonant (being held).

Examining Ancient Greek grammars one notices that the main interest of the first

²¹ The issue of the relationship between phonetics and phonology will be brought up later in this chapter with reference to “phonetic vs. phonological syllable”.

²² Available surveys include Awedyk (1975), Murray (1988: 1-126), Allen W.S.(1973), Kloster Jensen (1963), van der Hulst and Ritter (eds.). 1999.

grammarians²³, starting with the second century B.C., was the language of poets who had lived centuries earlier, and, especially, of Homer (8th c. B.C.) (cf. Hermann 1923: 124). Thus, the early grammars are concerned with metrics and refer, basically, to the written language, or, at least, show no attempt to differentiate between written and spoken language. The purpose of the grammars was to supply pronunciation instructions for the correct recitation of poetry, in other words, to bridge the gap between the written form and its oral rendition. The instructions were used in the teaching of poetry and had little to do with any description or analysis of the spoken language (cf. e.g. Hermann 1923: 125). The syllable (συλλαβή) appears in these grammars in three distinguishable (at least from the modern point of view) capacities: (a) as a one-breath unit, (b) as a sequence or vowel of a long/short value, and (c) as a sequence that needs to be somehow divided at the end of the verse line. In whatever capacity, the syllable always represents a specific linkage of consonants to a vowel²⁴, which is already implicit in the respective names of these two groups of sounds: "vowel" (sonant) means "voiced", "consonant" (con-sonant) means "pronounced with a vowel" (cf. Dionysius Thrax 48, §7). One could venture to say that the only phonologically interpretable (again, in modern terms) distinction introduced by the Greeks in their grammars was the functional distinction between a vowel and a consonant. The distinction served as the basis of definition for the syllable, as in one of Dionysius Thrax's definitions: "a syllable is, properly speaking, the combination of a consonant²⁵ with a vowel" (quoted after Allen 1973:33). Consonants are weak in the sense that, even if there are many of them, they cannot fill in the syllable without the help of a vowel (cf. Dionysius Thrax, 205, §8).

Coming back to the three "syllable capacities": (a) according to Dionysius Thrax (48, §7), a syllable is that which takes together consonants and vowels under one breath, or (Dionysius Thrax 346,10, translated by Priscian, Inst.II 1, 44,2, in Apollonius Dyscolus 8,9), a syllable is a continuous grasp/grip of letters pronounced under one accent and one breath. The "one breath" unit referred either to words in isolation or words in verse, which could be divided into syllables to facilitate pronunciation. One can divide words into syllables, according to Dionysius Thrax (48, §7), and words consist of syllables (Priscian commenting on Apollonius Dyscolus 3) and may lose a syllable if they happen to have one vowel less (p.5). Those divisions clearly had a didactic background and consisted in distinguishing vowels as outstanding landmarks facilitating the successful reading of words.

The Greek grammarians applied the long/short distinction (b) both to vowels and syllables²⁶ (cf. e.g. Allen 1968: 97, Allen 1973: 53ff, as well as the grammars themselves), which led to notorious confusion, one which also had consequences for modern phonology, of two quantitative phenomena: that of weight with that of length (duration). This unfortunate and even unnecessary²⁷ confusion has ever since led to inconsistency and adhocness in the analysis of the structure and boundaries of the syllable. Let us first look at a few statements concerning length found in the Greek grammars. A long syllable according to Dionysius Thrax (49, §8) is a vowel followed by two consonants, even, as he adds, if the vowel is short, since then it is LENGTHENED (emphasis mine) by the following consonants. In this statement one can clearly trace the source of the confusion discussed: of course, the vowel itself did not lengthen, but the syllable became "longer" due to the following consonants.

²³ Below I will be referring to and quoting the following Ancient Greek grammarians: Dionysius Thrax (2c.B.C.), Dionysius of Halicarnassus (1c.B.C.), Herodian (2c.A.D.), Apollonius Dyscolus (2c.A.D.) and Hephaestion (2c B.C.).

²⁴ The term "linking together" is actually USED by Herodian (Herodian II, 407, Lentz).

²⁵ "They are called 'consonants' because by themselves they have no speech sound, but combined with the vowels they produce sound" (cf. Priscian, quoted after Allen 1973:33).

²⁶ Sometimes the length of syllables and the length of vowels were treated separately, but not exclusively (cf. Etymologicum Magnum 820, 17).

²⁷ See the discussion of quantity in Chapter 4 as well as in Chapter 9.

Dionysius Thrax called it lengthening "by convention" θέσει (théseī), as opposed to the length "by nature" φύσει (phýsei) of those syllables containing a long vowel or diphthong (Dionysius Thrax 17, quoted from Allen 1973: 54). This opposition became well-known under the Latin names *natura longa* vs. *positione longa* (cf. e.g. Allen 1973: 54).

Dionysius of Halicarnassus distinguished eight ways in which the syllable could become long: three ways "by nature", five "by position". Thus, for instance, a short vowel followed by two consonants always counted as long, no matter whether the syllable boundary fell as it does in *á.gros* or as in *ér.gon* (Dionysius of Halicarnassus 17, §8, quoted from Hermann 1923: 125). Similarly, Hephaestion assumed a syllable to be long if it ended in two consonants, if there were two consonants in the next syllable or if it had the following syllable beginning with two consonants²⁸, e.g. in *amnós, esmós, Hé.ktōr, é.ksō* (Hephaestion, quoted from Hermann 1923: 126). As becomes obvious from the above examples, the length (today's weight) of the syllable was independent of the syllable division, i.e. syllable-boundary placement. Explicitly, it is only the presence of consonants after the vowel, and not within the same syllable, that was taken as decisive regarding the length of the syllable. The rules of syllable division existed, however, quite independently, in the form of orthographic word-division rules at the end of lines (cf. (c) above), which led to another confusion: of speech and writing (cf. e.g. Allen 1968: 98). The orthographic divisions (separation in lines) could be easily mistaken for syllable divisions indicating the length/weight (due to the imprecise definitions of length) of syllables within a spoken (indeed, recited) verse²⁹. The Ancient Greek syllable division rules, however, referred exclusively to the written form of the language and not to pronunciation. The rules formulated by Herodian may serve as an illustration. (1) He provided no rules for the letters representing biphonematic units like <ξ> [ks≈xs] or <ψ> [ps≈fs] (cf. Hermann 1923: 126ff). (2) The text presenting the rules was entitled "On the competition of letters" (Herodian II, 393). "Linking together" of letters was fixed; for instance, a voiceless consonant and a sonorant came together with the following vowel, <s> came together with the following consonant, two consonants at the beginning of a word came together³⁰, a consonant in an intervocalic position came together with the following vowel. (3) Herodian and, after him, Priscian (Herodian II, 407; Priscian II, 3) also assumed divisions according to morphological boundaries, e.g. after a prefix or preposition, where again there was no overlap with a "phonological" syllable boundary. We can see that the so-called syllable division rules were orthography-oriented and clearly independent of weight, just as much as weight was independent of these divisions. In fact, there is no evidence that any syllable boundaries of a phonological/phonetic nature were posited at all.

Although the syllables were referred to as "one breath" units of which words consisted, the Greek grammarians did not discuss the structure of the whole unit, i.e. the consonants preceding AND following the vowel simultaneously. They talked either about consonants linked together with the following vowel, from which only implicitly, by means of a negative statement, came an inference about the ones possibly linked with the previous vowel, or they talked about consonants not being linked together (e.g. in *anthos*) or about a vowel and the following consonants if within a final syllable.

Possibly as an off-shoot of the various confusions, or as an apparent remedy in unclear

²⁸ The difference between the latter two specifications is unclear.

²⁹ As Hermann (1923: 123) notices, it is not clear whether the separation in lines was identical with syllable division. He is disturbed by the analysis where any vowel followed by a consonant, also word-finally in isolation before a pause counted as a long syllable, since it does not agree with metrics (Hermann 1923: 124). It could have resulted from a misinterpretation of an orthographic word-division.

³⁰ This rule makes it evident that the written language was in question. One would not consider whether to pronounce two word-initial consonants together or not (except in a language with the so-called syllabic consonants, which Ancient Greek was not).

cases, the term "common syllable" (κοινή συλλαβή *koinḗ syllabḗ*, cf. e.g. Liddell and Scott: 969) came into being. It was understood either statically, i.e. as a syllable which could be long or short (or was so treated by some poets), which need not have implied different syllable divisions as believed by modern interpreters, or dynamically, i.e. as a syllable that changes from short to long and vice versa. According to Hephæstion (in Hermann 1923: 125), a syllable was a common one if the next syllable started with an unvoiced consonant + continuant, e.g. in *hó plon, á kron, Pá trokle*. The syllable division here, however, might have easily been an overt (interpreter's) marker of the first syllable being treated for some reason as short. Dionysius Thrax (50ff, §10) supplied twelve ways in which a common syllable could originate, always by a change from long to short or the reverse.

3.1.2. The ancient Indian syllable.

For Indian grammarians the term "syllable" - *aksáram* - meant *das Unvergängliche* (Wackernagel 1896:278, quoted after Awedyk 1975:7), but *aksára* had also the meaning "vowel" due to the focal role of a vowel in a syllable. In fact, both Indian and Greek ancient grammars focused on defining a vowel-consonant dichotomy (whereby such terms as "independent audibility" and "contact" appeared), which led to the identification of the so-called "nuclear" vs. "marginal" functions respectively (cf. 3.1.1. above). A statement to the same effect is to be found in the phonetic treatise of the Ṛg-Veda: "A vowel with a consonant, or even by itself, forms a syllable" (quoted after Allen 1973:33).

3.1.3. The syllable in dictionaries and encyclopedias.

The Barnhart Dictionary of Etymology (1988) gives the following etymology of an English word "syllable": *sillable* in Chaucer's (1380) *House of Fame* (defined as "part of a word pronounced as a unit") comes from Anglo-French *sillable* < Old French *syllabe* < Latin *syllaba* < Greek *syllabé* ("several sounds or letters taken or joined together").

Not very different are the first words of the entry "syllables" in the *International Encyclopaedia of Linguistics* (ed. by Bright 1992: 106-111): "This entry is concerned with the minimum unit of sequential speech sounds, typically consisting of a vowel preceded and/or followed by consonants."

Crystal's (1992) definition describes a syllable as "A unit of pronunciation typically larger than a single sound and smaller than a word."

Enzyklopädisches Wörterbuch der Sprachwissenschaften (Todorov and Ducrot 1975: 213) supplies its definition of the syllable within a chapter entitled "Versifizierung", which is clearly symptomatic of its role in language being narrowed down to metrics: "Die Silbe ist eine phonemische Gruppe, die aus einem silbisch genannten Phonem und fakultativ aus anderen nicht-silbischen Phonemen besteht.(...) Die Silbe gewinnt NUR (emphasis mine) innerhalb eines bestimmten Leseverfahrens, das Skandierung genannt wird, sprachliche Realität."

3.1.4. The syllable in handbooks of phonetics and phonology.

While in dictionaries, encyclopaedias and early grammars one finds (largely due to the nature of these sources) some definitions of the syllable, handbooks of phonetics and phonology point rather to the general failure in defining it: Ladefoged (1975: 217) states simply that "this term has never been defined". Arguing for the importance of the syllable Ladefoged gives the

existence of so-called syllabic writing systems³¹ and the identifiability of the unit. The latter argument immediately becomes problematic when Ladefoged talks about (a) the discrepancies in syllable identification among speakers and (b) its unsuccessful phonetic identification, both from the perceptual and articulatory point of view.³² Similar reservations are expressed by Brosnahan and Malmberg (1970: 40-42):

The ...syllable is by no means a simple concept. Within the one language a child can usually count on its fingers the number of syllables in a sequence, but no phonetician has succeeded so far in giving an exhaustive and adequate description of what the syllable is... No physiological theory of the syllable so far developed seems sufficiently well founded instrumentally to be acceptable as definite and exhaustive.

According to Edwards and Shriberg (1983: 24), although the syllable is difficult to define, "structurally, ...it can be described easily".³³ This is a statement which does not really reflect the state of affairs concerning the description of the syllable in either older or newer phonology. It suffices only to mention here the numerous and, as yet, unresolved (unless within a given framework) disputes about the structure of the syllable: flat or hierarchical, if the latter, then with what constituents and government relations, et cetera (cf. e.g. the discussion between Clements and Keyser (1983), Fudge (1989), and Davis (1989) concerning the syllable rhyme, to be presented in more detail below in section 3.4.4.).

³¹ Cf. the detailed discussion of the syllabic writing systems in Chapter 13, and in Dressler and Dziubalska-Kořaczuk 1995a.

³² For descriptions of phonetic theories of the syllable cf. e.g. Ladefoged (1975:219ff) or, more detailed, Allen (1973: esp.38-45); see also 3.3. below:

a. respiratory theory: the syllable is "a sound-group produced with a single respiratory impulse" (cf. e.g. Viëtor 1894, Jespersen 1913; for sources see Allen 1973: 38 note 1); failure of the theory led some experimentalists to refute the syllable: Scripture, Panconcelli-Calzia (cf. Malmberg 1955, Rosetti 1959);

b. acoustic theory: acoustic sonority (Schallfülle) - "a portmanteau term" for voicing, aperture, expiratory force, pitch, muscular energy (of consonants), duration (of vowels), penetration (of fricatives); impressionistically, it is a measure of the audibility of sounds (basically voicing); there are difficulties, however, with ordering low sonority sounds;

c. articulatory theory: for de Saussure (1916) only aperture was a relevant criterion for defining the syllable; the syllable consists, thus, of explosion (i.e. sound(s) of increasing aperture) and implosion (i.e. sound(s) of decreasing aperture); with this definition the case of [pst] is accounted for, cases like [kt-] or [steps], however, remain unexplained.

Grammont (1946) defined the transition between syllables as a sound of decreasing "tension" followed by a sound of increasing "tension", but not otherwise (syllable contact law, cf. Vennemann (1988a), is reminiscent of this "tension" relationship).

d. motor theory: according to Stetson (1951: 42) "the syllable is constituted by a ballistic movement of the intercostal muscles" which is not controlled, so it cannot be changed during its course; "in the individuality of the syllable the sound is secondary: syllables are possible without sound." The syllabic pulse generally has the effect of setting the vocal cords in vibration to which a vowel is an essential accompanying articulation while consonants are auxiliary and non-essential movements: they may assist "release" and "arrest".

For still other attempts to give the syllable a phonetic and/or phonological definition see Hjemlev 1939, Haugen 1956, Håla 1961, Rosetti 1959, O'Connor and Trim 1953, and Pulgram 1970.

³³ What Edwards and Shriberg mean by an easy structural description of the syllable is to supply a gist of apparently neutral common phonological knowledge concerning the unit:

- a syllable consists of an onset (releasing consonant), peak (nucleus) and coda (offset, arresting consonant) – with peak and coda constitute core, where only the nucleus is obligatory
- nasals or liquids may function as peaks (→syllabic consonants)
- the syllables may be: open and closed, strong and weak, heavy and light
- they may occupy a weak (post-tonic: *interest*, *elephant* [ˈefet]; pre-tonic: *banana* [ˈnana]; word-final) and strong position.

Allen (1973) provides a short and representative collection of quotations which all point to the problematic nature of the unit. When being more positive, he describes a traditional differentiation between a phonological and phonetic syllable (cf. e.g. also Hyman 1975), of which the former is defined on phonotactic grounds and the latter has an articulatory, acoustic or physiological basis (cf. Footnote 12). He himself approves of and argues for Stetson's (1945, 1951, quoted after Allen 1973:40ff) motor or chest-pulse theory of the syllable.

Clark and Yallop (1990) supply, in an advanced handbook-fashion, a generous discussion of the problems connected with the segmentation of speech into "chunks" (Clark and Yallop 1990: 98) of various sizes, one of them being the syllable. They note correctly, that "units are not ends in themselves but are justified by their descriptive validity" (Clark and Yallop 1990: 93). Both explicitly and implicitly, in connection with various topics throughout the book, the handbook demonstrates that the descriptive validity of the unit syllable is highly questionable.

Laver (1994) takes a more pragmatic view for the purposes of textbook exposition. Admitting the perennial difficulties to define either a phonetic or a phonological syllable, the author adopts both concepts as useful explanatory constructs. Consequently, in the book (Laver 1994: 113-114):

The concept of a phonetic syllable will be treated rather as a construct of general phonetic theory useful in explaining a number of co-ordinatory relations between segments.

The concept of the phonological syllable will hence be adopted as a construct helpful for organizing the explanation of rhythmic and prosodic facts at levels above the segment, and as a convenient domain for expressing the mutual distribution of phonemic segments.

Bell and Hooper (1978: 3) provide a cautiously relative definition of the syllable as "a unit of phonological organization between the segment and the word".

Scrutinizing the above and similar attempts at definitions and definition failures, one can conclude that they tend to point to

- (a) the significance of vowel-consonant combinations whereby the vowel strongly tends to be more prominent
- (b) the phonetic basis of the way in which these combinations arise, and
- (c) the phonological function these combinations have, both in poetry and speech.

Let me now look at some representative approaches throughout the history of the syllable in order to see whether they are really able to superimpose on the above-mentioned combinations the form of a delimitable and structured, prosodic unit "syllable".

3.2. Types of approaches to the syllable

According to Bell and Hooper (1978), the relative importance of a syllable as against a segment serves as a criterion differentiating three basic types of phonological theories.

I. *The derived syllable*. The first type of theory takes segments in a sequence as primes and places syllable boundaries among them (within and around words). The proposals of Kuryłowicz (1948), Haugen (1956), Pulgram (1970), Hoard (1971), Hooper (1972), Vennemann (1972), Stampe (1973), Anderson and Jones (1974), Basbøll (1974), Kahn (1976) are of this type.

II. *The non-derived syllable*. According to the second type of theory, the syllable is an independent prime on the basis of whose structure the phonotactics of segments is predictable

(e.g. Fudge 1969, Hooper 1976). While the two types of theories basically differ in assuming a derived vs. non-derived nature of the syllable, the third type would do without it.

III. *No need for the syllable*. The third type of theory assumes bonds among segments which are responsible for their organization into particular, hierarchised sequences (e.g. the autosegmental approach of Goldsmith 1976, Bell 1976, Kreitmair 1984).

There is a number of issues that any phonological theory, no matter its orientation, needs to tackle:

3.2.1. The question of the level of assignment of syllabicity to segments.

3.2.2. The question of syllabification, i.e. the assignment of segments to syllables.

3.2.3. The question of the distinction between the so-called phonetic and phonological syllable.

3.2.4. The question of the possibility of syllabifications which are not one-to-one, i.e. mismatches between the number of segments and the number of syllables to which they get assigned (“ambisyllabicity” vs. “extrasyllabicity”).

3.2.5. The question of the syllable as a domain for the application of phonological processes.

There follows a review of approaches to the syllable throughout the history of phonology, guided, on the one hand, by the above general typology of theories I, II and III and, on the other, by questions 3.2.1. through 3.2.5.

The oldest, ancient approaches to the syllable largely escape the above threefold classification of syllable theories (I to III). The syllable was needed for orthographic and versificatory purposes rather than descriptive ones (typical of phonetic approaches) or explanatory ones (typical of phonological approaches). It is worth remembering (cf. the discussion above in 3.1.1.) that the very origin of the notion syllable was dictated by practical (orthographic/versificatory) needs. Starting with the 17th century, when interest in the investigation of speech arose anew, there was no real separation between what we would now call phonetics and phonology. The split came in the early 20th century with Trubetzkoy who placed phonetics outside linguistics proper, which gave him the name of “the father of phonology”.

The review below will thus cover, first, phonetic, and then, phonological approaches to the syllable in the above, historiographic sense. Phonetic approaches to the syllable can supply evidence to support potential phonological answers to questions 3.2.1. through 3.2.5. A distinction between a phonetic and a phonological syllable is comparable to the distinction between phonetics and phonology (cf. e.g. Ohala 1990c, 1991, 1997, Donegan 1996, Dressler 1987, Bertinetto 1987, Laver 1994 for the discussion of the relationship between phonetics and phonology). Conventionalist phonology would posit a strict (although not necessarily “clear-cut”) boundary between “the phonetic” and “the phonological” in the study of speech, and therefore disregard the physical nature ascribed to the syllable. Naturalist phonology, on the other hand, would acknowledge the vitality of the phonetic component in the sound system of the language and, therefore look for a mutual feedback between the phonetic and phonological features of the syllable.

3.3. Early phonetic approaches³⁴

3.3.1. Thausing (1863) classified sounds along the scale of voice damping - *Verdämpfung*, i.e. an early version of the sonority scale. Importantly, he maintained that the syllabic function was not inherent to a sound, but language and context dependent.

Merkel (1866), as opposed to the acoustic approach of Thausing, represented an articulatory viewpoint on the syllable. The syllable formation was dependent on the

³⁴ The review below relies partly, as far as the statement of the historical facts is concerned, on the reviews by Awedyk 1975, Murray 1988, W.S. Allen 1973 and on some less extensive ones and partly on original sources.

alternations in vocalic and consonantal articulations, whereby the latter were subordinated to the former, as well as on the adequate distribution of air-pressure and on rhythm.

The same alternation, but in perceptual terms, was employed by Whitney (1874): "The distinction of syllables is more in the ear of the hearer than in the mouth of the speaker" (Whitney 1874: 294, quoted after Awedyk 1975). For the hearer, then, it was a *crescendo diminuendo*³⁵ of closer (consonants) and more open (vowels) sounds.

Another perceptual interpretation of the syllable was given by Sweet (1877), for whom sonority served as a criterion for the division of breath-groups into syllables. His strategy of boundary placement was partly acoustic, partly articulatory, and largely unresolved.

3.3.2. A milestone theory of the syllable³⁶ was founded by Eduard Sievers who presented it in his famous *Grundzüge der Phonetik* (1893/1901). Since "eine einheitliche genetische Definition des Begriffs 'Silbe' lässt sich nicht geben" (Sievers 1901: 198, §515), he proposed an at least twofold definition, i.e. with respect to two criteria: expiratory force (*Stromdruck*) and sonority or resonance (*Schallfülle*). One controlled unit of expiratory force corresponded to one expiratory syllable (*Expirationssilbe* or *Drucksilbe*), while the degree of inherent sonority of its elements decided the delimitation of one acoustic syllable (*Schallsilbe*). Sonority levels were, according to Sievers, established experimentally, but at the same time he assigns them to sounds in accordance with their proximity to the nucleus: "je näher dem Sonanten, um so grösser muss die Schallfülle sein" (Sievers 1901: 204, §527). Here begins the well-known circularity in the interpretation of sonority.

Sievers' "kleine 'Nebensilben'" (Sievers 1901: 205, §534) can be interpreted as forerunners of the notion of "extrasyllabicity". Although the sequences like [pta, apt, sta, aps] and the like form single expiratory syllables, according to the criterion of resonance (sonority) they consist of *Hauptsilbe* and *Nebensilbe*. Already Sievers required of sonority that it be an absolute criterion and invented extra solutions to rescue its exceptionless application (cf. extrasyllabicity in modern phonology). Another such solution is represented by the notion of "ambisyllabicity". It also finds its predecessor in Sievers' analysis, in the form of *Schallgrenze* (acoustic boundary), which falls within a consonant of the lowest sonority whereby the latter seems to belong to both syllables (cf. Sievers 1901: 209ff). The placement of *Druckgrenzen* (expiratory boundaries) was free, i.e. language-specific and dependent on the possible syllable onset. Here again we find hints of future development: mixing up word onset with syllable onset and treating onset as more influential (cf. the modern Maximal Onset Principle). As for geminates, Sievers distinguished between double consonants and long consonants, as manifested in the localization of the expiratory boundary: in between the two consonants in the former (e.g. [an-na]) vs. before or within a consonant in the latter (e.g. [e-m:a] or [em:a]) (cf. Sievers 1901: §§555ff).

Sievers claimed (Sievers 1901: 222ff) that there was one more language-specific way in which sound sequences were divided in speech, i.e. according to the so-called syllable-cut (= *Silbenschnitt*, *Silbenschluss*). He distinguished between *stark geschnittener Silbenaccent* (=abruptly cut syllables) and *schwach geschnittener Silbenaccent* (=smoothly cut syllables)³⁷, as in [da] vs. [da:]. The former mainly refers to stressed syllables with a short vowel, the latter to stressed syllables with long vowels and unstressed syllables. The above distinction,

³⁵ Cf. the use of musical terms for the description of syllable prosody by Sievers (1901: p.207, §537): "Der einzelne Expirationsstoß hat (demnach) gewöhnlich entweder nur einen deutlichen Decrescendo-Ausgang oder zugleich einen deutlichen Crescendo-Eingang und Decrescendo-Ausgang, zeigt also entweder die Form (=)> oder <(=)>, wobei = die Zeit andeuten möge, während welcher der Druck eventuell gleich bleibt" and a modern adaptation of Sievers by Vennemann (1990, 1991a,b).

³⁶ Although not immediately acknowledged.

³⁷ Sievers refers to Kudelka as the author of the above terms (Sievers 1901: 223, §592). The English equivalents I quote after Vennemann (e.g. 1990, 1991a,b, 1992).

however, was, according to Sievers (1901: 224f, §598), largely independent of the syllable division. The role of the syllable cut in the Germanic languages has been discussed, for example, by Vennemann (1990, 1991a,b, 1992; cf. also Zinder 1960 in Awedyk 1975: 31f).

3.3.3. Other phoneticians did not follow Sievers: they opted either for the articulatory (Storm) or acoustic syllable (Trautmann, Vietor, Lloyd, Jespersen) (cf. Awedyk 1975: 13ff). I would like to quote one interesting criticism of Sievers brought by Awedyk (Awedyk 1975: 13, after Passy 1906): "Sievers did not understand that sonority was not only an inherent feature, but, in some cases, depended on other factors." Of all possible criticisms one could raise against Sievers, this one is definitely misguided: Had Sievers made sonority depend on other factors, he would have lost it as an independent, and thus reliable, criterion.

Jespersen's (1904/1913; in Murray 1988: 16ff) approach is not only much less attractive than that of Sievers, but also much less acceptable. He rejects Sievers' two-fold interpretation of the syllable and the concept of secondary syllables, but does not, unfortunately, propose any alternative to account for the exceptions to the sonority principle: he rejects their existence. He overlooks the problem which Sievers saw quite well and attempted to solve. Both of them, however, committed the same principled mistake: they wanted their criterion of sonority (resonance) to be an absolute universal, and not a universal preference (cf. Chapters 2 and 4 for a discussion of the notion *universal preference*).

Both for Sievers and Jespersen, resonance was related to the degree of constriction and voicing of a sound. They mentioned the importance of a universal criterion of resonance for diachrony.

3.3.4. The beginnings of acoustic phonetics brought almost a denial of the unit syllable. According to Panconcelli-Calzia³⁸ (1924: 119; after Awedyk 1975: 17) "Die Silbe phonetisch untersuchen und begründen zu wollen, ist...eine Utopie", since early oscillograms did not show any divisions which could have corresponded to syllables. There also followed, however, some more positive attempts to approach the syllable (see Awedyk 1975: 16ff).

Among these, de Groot's (1926) theory of the syllable was innovative in the sense that it had rhythm as its basis. He defined the syllable as the smallest rhythmic group of a language (de Groot 1926: 37, after Awedyk 1975: 22). He argued that speakers had a "sentiment" of rhythm, due to which they perceived kinetic and acoustic phenomena as rhythmical even if they in fact lacked rhythm. Among the universal features of speech he specified normalization, that is a tendency towards CV syllables, for which he gave examples like: glottal stop epenthesis prevocally, emphatic h-epenthesis in hiatus, phonostylistic resyllabification of the ha-te-res-ge-tan (*hat er es getan*) type. De Groot's theory constitutes a notable improvement in comparison to previous accounts since its author looks at the syllable from outside of the unit itself and tries to justify it by means of the principle governing speech behaviour in general, i.e. rhythm. This is certainly a valid choice (cf. Chapter 4 for the role of rhythm in phonology).

Grammont's (1933) distinction between the phonological and the phonetic syllable of which the former he considered perfect foretells a later distinction between the underlying phonological syllable and surface phonetic resyllabifications.

Stetson's (1951) chest-pulse theory of the syllable (cf. a short presentation of the theory in Footnote 12d above) was disproved in its motor component (cf. Ladefoged 1975), but still influenced other phoneticians and found followers (cf. Allen 1973) and remained

³⁸ Giulio Panconcelli-Calzia (1878-1966) was the last representative of the era of pioneer phonetics. He was probably the first one among phoneticians to separate phonetics and phonology: he saw phonetics as an independent scientific discipline unaffected by psychological or linguistic thought. Therefore, linguistic units like phonemes or syllables were of no importance to him (cf. Köster 1992/93).

valid in its basic distinction between a vowel as an essential articulation and consonants as auxiliary movements. Stetson's unilateral theory was exceptional at a time when acoustic phonetics established itself well enough to let the phoneticians consider, at least, both acoustic and articulatory (motor) factors in their descriptions of the syllable.

The latter included, for instance, Pike (1943) (cf. Awedyk 1975: 28f), who described the syllabic centres of syllables both articulatorily and acoustically. The centres were characterized by the greatest speed of the initiator movement and by the greatest prominence i.e. loudness, sonority and duration. Boundaries between the syllables remained vague. Other phoneticians espousing a multifactorial description of the syllable were, for example, Fischer-Jørgensen (1948/1962), Dieth (1950), or Durand (1954, 1955) (references to be found in Awedyk 1975: 29ff). Skaličková also (1958; cf. also Awedyk 1975: 32) was among their number, but her approach deserves a special mention because of its originality. She claimed that the elements of a syllable were connected in the closest way possible: the connection of a vocalic element with a consonantal one was closer than the connection of two consonantal elements, and of the former the connection C + V was closer than that of V + C. Connections existed also, but in a different way, across syllable boundaries. Therefore, an experimental determination of syllable boundaries was impossible. Although she did not go very far in specifying the criteria or principles determining these connections, her intuition about the degrees of closeness between the connected elements as well as, implicitly, about their binarity, was correct (cf. Chapter 4 for a discussion of bindings).

3.4. Phonology and the syllable

The title of this section is not intended to imply that all the approaches to the syllable presented thus far have been purely phonetic. It is difficult, or, in principle, impossible, to draw a clear-cut boundary between phonetics and phonology³⁹ (see 3.2. above for some relevant references). When a phonetically described entity is shown to serve systematic phonological functions, it does not lose its phonetic content which may constitute a motivating force in phonological processes.

As already mentioned in section 3.2., phonetic theories of the syllable supply potential evidence to help answer questions 3.2.1. through 3.2.5. Phonological theories of the syllable make these questions explicit.

3.4.1. Emphasis on boundaries.

The phonological syllable appeared first, according to Jakobson, in the work of Polivanov, under the name of "syllabeme" (see Awedyk 1975 for the references). Hjelmslev's (1939) syllable, which was defined independently of its manifestations, served him as the basis for distinguishing between vowels and consonants. He answered, thus, questions 3.2.1. and 3.2.2. with the non-derived nature of the syllable, which classifies his theory as type II (cf. 3.2. above).

Most of the theories developed from the 1940's to the 1970's, however, were of type I (cf. 3.2. above), i.e. assumed the secondary nature of the syllable with respect to segments. Kuryłowicz (1948), O'Connor and Trim (1953), Hockett (1955), Haugen (1956), Kučera et al. (1968) and others represented a distributional approach. Their syllable was delimited on the basis of the structure of words and/or morphemes (i.e. dictated by word/morpheme-initial vs. word/morpheme-final position), backed up by some phonetic criteria. Accordingly, they formulated rules of syllable division (as Pulgram did somewhat later, cf. Pulgram 1970) and "stumbled" over questions 3.2.2. and 3.2.4. In particular, what they discovered about various languages violated the requirements for the phonemic structure of language specified by

³⁹ Natural Phonology has succeeded in taking advantage of the phonology-phonetics "dichotomy" rather than suffer from it or ignore it (cf. Chapter 2).

Greenberg (1962), for example, that every phoneme had to belong to a syllable (since some phonemes appeared to be ambisyllabic, and thus belonged to none), or that every syllable had a nucleus (was a consonantal prefix a syllable on its own?). This discussion signals already, both a difficulty in deciding about the relation between phonology and morphology, and future solutions to problems of syllabification involving such notions as extrasyllabicity, empty nuclei, or levels of assignment of segments to syllables and, above all, the change of status of the syllable to that of a non-derived unit (with syllable structure constraints as a consequence).

Another type of a distributional approach was represented by Sigurd (1955) (cf. Murray 1988: 32ff). He established a hierarchy of consonants of Swedish on the basis of their distribution in clusters within monosyllables. In this way he arrived at an interesting generalization: the consonants turned out to order themselves according to the criterion of "vowel adherence" i.e. "the tendency of consonants to take the position adjoining the vowel in a syllable" (Sigurd 1955: 13; in Murray 1988: 32), e.g. l-| p ([l] was more adherent than [p]) since Swedish has [pl-] and [-lp] clusters, but not [lp-] or [-pl] ones (the adherence relation is in most cases asymmetric). Sigurd rejected Jespersen's sonority in favour of vowel adherence. Notice that these two criteria are different: it is the position of a consonant with reference to a vowel which decides about adherence (a distributional criterion) while it is the resonance of a consonant which decides about its relative sonority. The latter does not necessarily determine the consonant's position with reference to a vowel (e.g. in [mgV], [m] is more sonorous while [g] is more adherent). In later phonological models of the syllable, however, sonority is seen as an important, if not dominant, criterion responsible for the make-up of the syllable. It appears, of course, under different guises and may also be rejected altogether (cf. further discussions of sonority in Chapters 4 and 5, and later in the book at different places). But even Sigurd's replacement of sonority with vowel adherence could boil down to simply a terminological distinction, since consonants must have adhered to vowels by means of some property of the sounds in question, e.g. a difference in sonority? (cf. Chapter 4 for the discussion of bindings).

3.4.2. Syllable as a domain.

Chronologically speaking, the 1960's and early 1970's brought a neglect of the syllable in mainstream phonology, i.e. Generative Phonology, as evidenced in Chomsky and Halle (1968) or Foley (1977). This and later approaches which avoided or rejected the syllable will be discussed in a separate section of this chapter (section 3.5.).

The return of the syllable to the fore of the phonological scene in the 1970's was connected with the development of various post-generative and neo-generative models. Alongside the approaches of type I (syllable as a derived unit), approaches of type II (syllable as an underlying unit) and III (syllable as an epiphenomenon) came into being. In an effort to answer questions 3.2.1.- 3.2.5., the new theories supplied much more detail and variety in the treatment of sonority (and/or consonantal strength) as well as the unity, structure, boundaries and weight of the syllable than earlier phonetic/phonological approaches, although simultaneously they drew copiously from them.

Two traditional approaches, i.e. the distributional one and the sonority-based one, were developed further. The former concentrates on the observation that word-internal consonant clusters resemble combinations of word-marginal clusters. This "syllables-are-like-words" approach was continued (cf. 3.4.1. for earlier representatives) by Pulgram (1970)⁴⁰, Hoard (1971), Basbøll (1974), Anderson and Jones (1974) and Kahn (1976). It was noted, of

⁴⁰ Pulgram's (1970) universal phonotactics will be referred to in Chapter 5.

course, that the analysis of word phonotactics leads to the discovery of some common, maybe universal, or only partially language-specific property governing the organization of sounds into sequences (cf. sonority). Therefore, some claimed that the "words-are-like-syllables" solution was appropriate. The syllable was a proper domain for the statement of phonotactic constraints (cf. e.g. Hooper 1972, 1976) since its structure was universally governed by a specific sequencing of sonority inherent to segments (later labelled the Sonority Sequencing Generalization, cf. Selkirk 1984, earlier observed by many, e.g. Sievers 1901). At this point one could say that the distributional and the sonority approaches met half-way.

3.4.2.1. Natural Generative Phonology (Vennemann 1972, Hooper 1976) constitutes an example of the sonority approach. It assumes both phonological and positional strength. There exists an interrelation between strength and syllable structure, but strength is definable independently. With reference to the universal strength hierarchy for consonants and to the position within the syllable⁴¹, Hooper formulates the universal Syllable Structure Condition (Hooper 1976: 229). The condition requires that (1) a vowel constitutes the nucleus and consonants - margins of the syllable; (2) strength decreases from the outer limits to the nucleus; (3) stronger segments are allowed in the syllable-initial position than in the syllable-final one; (4) all languages have syllables of the CV shape. For diachrony Hooper predicts change in the direction of the preferred syllable.

Interestingly, Hooper states that within a word a consonant may not be stronger than a preceding consonant, e.g. in a C_1VC_2V , if C_1 is medium, C_2 can never be strong (Hooper 1976: 205; cf. bindings, Chapter 4 and 5). She also introduces the Syllable Initial Strength Condition which requires of a syllable-initial consonant that it be stronger than the preceding syllable-final one (Hooper 1976: 220; cf. Vennemann's (1988a: 40) contact law). The latter condition is illustrated with a diachronic example from Spanish: $ve[nir]á > ve[nr]á > ve[ndr]á$ '(it) will come'. The second form violates the Syllable Initial Strength Condition, which is no longer the case after epenthesis. The form after epenthesis, however, violates the former condition, the one referring to the whole word. The two conditions based on the consonantal strength scale contradict each other⁴².

Interrelationship between consonantal and positional strength is expressed by means of the Optimal Syllable Principle (Hooper 1976: 225) which predicts stronger consonants to be preferred in the stronger positions and consonants in general to be dispreferred in the weaker positions (cf. the rich-get-richer principle, Chapter 2). This explains, according to Hooper, such favoured diachronic changes as deletion of the syllable-final consonant, glide strengthening in initial position and others.

What we can see in Hooper's (1976) treatment of the syllable is a kind of multiple circularity, in which a popular "chicken-or-egg" question comes to the fore. The consonantal strength hierarchy results, apparently, from the behaviour of sounds in phonological processes, e.g. A is stronger than B since B assimilates to A. But the latter can just as well serve as a basis for positional strength: A must be in a strong position since B assimilates to A. So, is A strong due to its strong position, or is the position of A strong because A is strong? On top of that, the initial and final positions are understood as syllable-initial and -final ones, while they are often, in fact, implicitly or explicitly, word boundaries. Word

⁴¹ This makes her theory a type II theory, in which segments (their sequencing and properties) are predictable from the basic syllable structure.

⁴² An anonymous reviewer points out that the conflict between the two conditions would be resolved by ranking in Optimality Theory. In my view, ranking a constraint higher than another one in a given language in the OT fashion amounts to the same as DESCRIBING the operation of the two constraints in this language. As long as there is no PRINCIPLED reason for (in this instance) a syllable-based constraint to be ranked higher than a word-based one, the ranking remains descriptive and is not explanatory.

boundaries are true candidates to assist in determining the strong and weak position independent of the syllable, but unfortunately this is never clearly pursued. What is done is to add one more layer of circularity to the previous one: the position of A is syllable-initial since it is strong or A itself is strong; or, alternatively, since A is syllable-initial (here "word" is implicit) A is strong or A's position is strong.

This circle has been haunting phonology for quite some time and there appears to be little interest in finding a way out of it. The two main notions involved, sonority and syllable, continue to mutually define themselves. I will propose to abandon one of them, namely the syllable, in order to reveal the true role of the other, i.e. phonological sonority, in the organization of speech (cf. especially Chapter 4 and the following ones).

3.4.2.2. Vennemann's continued work on the syllable resulted in the preference laws for syllable structure (Vennemann 1988a). The laws originated as explicators of sound change. According to Vennemann (Vennemann 1988a: 1ff), every change in a language system is a local improvement relative to a certain parameter. For instance, every change of the syllable structure⁴³ is an improvement with reference to some preference laws. Therefore, infers Vennemann, if a change happens to worsen the syllable structure, e.g. syncope and apocope or diphthongization, it is not a syllable structure change (= a change motivated by the syllable structure), but a change on some other parameter (e.g. preference for briefness). He predicts that change attacks the worst structures first.

Vennemann clearly ignores the fact that both a "worsening" and an "improving" change do affect syllable structure in some way, so that the syllable is a common playground for them. Thus, both changes are motivated by the criteria according to which the syllable is better or worse, and not by the syllable structure itself. There are other problems⁴⁴ with Vennemann's interpretation of linguistic change. Some of them were explicitly stated by Berg (1990) in his critical review of Vennemann's (1988a) work.

Here I would like to restrict myself to a few general criticisms. First of all, the notion of a "preference law" constitutes a clear logical contradiction: "preference" and "law" are mutually exclusive⁴⁵. Either one states a law, i.e. an exceptionless and obligatory rule (or set of rules), or one formulates a preference, i.e. a tendency, which in principle is not exceptionless. A decision as to which of the two is applicable to the explanation of sound change and of the organization of sound sequences can only be taken within a well-grounded model of phonology (cf. Chapter 2 and 4). Still, I believe that the author of the preference laws was well aware of the consequences of the term. Thus, the preference laws expressed the general tendencies in syllable structure change rather than absolute rules.

Vennemann claims his preference laws to be universals, having their basis in "the human productive and perceptive phonetic endowment" (Vennemann 1988a: 4). He admits that they would be derivable - and thus explained - in a sufficiently rich phonetic theory. Unfortunately, he does not supply this explanation.⁴⁶

⁴³ The syllable is assumed to be a primitive by Vennemann (1988a: 5): "for the present discussion".

⁴⁴ At various places throughout this book the reader will find references to those examples with which Vennemann chose to justify (Vennemann 1988a: 13) the laws. It will be shown that the examples were selective and that some of them do not obey (and, therefore, do not "justify") the laws.

⁴⁵ An anonymous reviewer suggests that preference laws be seen as OT constraints. In this way, all laws can be overridden by higher ranking ones. This is a plausible solution as long as the ranking is universal (and principled). However, language-specific rankings, constituting language-specific grammars in OT, lose their explanatory potential since they are unpredictable (inductive). Indeed, if a language-specific ranking could be established on independent grounds, it would turn into a useful notation to express a hierarchy of preferences (or of constraints resulting in a preference).

⁴⁶ For the role of phonetics: in Natural Phonology see Chapter 2, in the Beats-and-Binding model - Chapter 4, in the discussion of the syllable - Chapter 16.

Last but not least, one finds in Vennemann's work (Vennemann 1988a: 69, Note 6) a statement pregnant with consequences for the notion of the syllable: "the preference laws remain valid even if syllable structure itself turns out merely to be epiphenomenal in a more general phonological theory."

3.4.3. The syllable in Natural Phonology.

3.4.3.1. The syllable is assumed to be a derived unit in Natural Phonology (for the presentation of the theory see Chapter 2), which makes it belong to type I theories with respect to the treatment of the syllable. Syllabification applies to the sequences of segments in the course of derivation and numerous resyllabifications are allowed to follow.

Most transparently, their views on the syllable are expressed by Donegan and Stampe (henceforth D & S) in their 1978 paper. According to D & S, phonological representations are segmental. Syllables are predictable from them and, thus, nondistinctive. Specifically, neither syllables nor accent-measures⁴⁷ are present in the phonological representation of words. They arise in the course of phonological processing.

Here are D & S's main points in the discussion of the derived nature of the syllable:

- a) Syllables, "unlike phonological segments, are rarely accurately reflected in writing systems" (D & S 1978: 25).
- b) There is evidence of an intermediate syllabification, distinct from either underlying or superficial syllabifications, e.g. in Lardil (an Australian language) [ŋ] undergoes palatalization in: /puntunèa/ -> [puntunè] -> [puntuɾè] -> [puntuɾ] 'tree species' but not in [puntunèa-n]. For D & S this is evidence of an intermediate syllabification after the apocope, which feeds the palatalization.
- c) If rules⁴⁸ (which precede processes⁴⁹ in speech production) are not sensitive to syllabic and accentual structures, then these structures arise in the phonological processing of speech.
- d) Phonological processes apply in hierarchic domains whose boundaries either impede or trigger a process. In the former case, a still smaller domain is always implied by the application of a process in a given domain, e.g. stop assimilation in English is obligatory within the measure (e.g. *shouldn't go* [-d.nt.g-] or [-g.ŋk.g-], but not *[-d.ŋk.g-]), therefore also within the syllable (*sandman* [-nd.m-] or [-mb.m-], but not *[-nb.m-]). In the latter case (when a domain boundary conditions a process), a still larger domain is implied, e.g. vowel preglottalization in German has the domain measure (*Ver[ʔ]éin*), and therefore also the phrase and sentence.
- e) "The more prominent values of intensity, duration, and pitch may serve as the nuclei of syllables and measures which are spoken at regular time-intervals, usually in a rhythmic alternation with less prominent elements" (D & S. 1978: 29). This relationship of prosodic structures with rhythm differentiates them from segments. Additionally, segments are perceived absolutely, while prosodies are perceived relatively, in terms of the relative contrast between neighbouring elements (cf. Lehiste 1970).
- f) Syllabification is the mapping of a segmental representation onto a prosodic pattern. This mapping may undergo a change in the course of the development of a language, e.g. from one in which syllables with long vowels or consonant clusters are mapped onto a double beat to one in which they are mapped, like other syllables, onto single beats in the rhythm of speech. (1978: 34)

⁴⁷ Accentual measure "extends from a primary or secondary stress to the end of the word or up to the next stress." (Donegan & Stampe 1978: 27)

⁴⁸ In the sense of Stampe and Donegan, i.e. morphonological and morphological.

⁴⁹ In the sense of Stampe and Donegan, i.e. phonological.

- g) "...there is little to recommend any particular internal analysis of syllables: virtually any linear breakdown of a syllable can be found in the evidence of alliteration, rhyme, secret languages, singing Yankee Doodle, etc." (1978: 30). Therefore, syllables have two slopes, the rise and the fall, both of which include the syllabic.
- h) The best slopes are obtained if the relative sonority (intrinsic perceptual prominence) of the rise increases and sonority of the fall decreases. The optimal slope, based on the principle of maximal prominence contrast (cf. the figure-and-ground principle, Chapter 2), is that of [pa]. The principle of contrast is a form of the principle of the attraction of opposites. "Since the syllable bond consists in the subordination of less-prominent to more-prominent segments, the greater the contrast, the greater the subordination" (D & S 1978: 30). Due to this, there are certain preferred onsets, offsets and syllabic divisions, also word-internally, e.g. V.CV, VC₁.C₂V, Vrd.nV, Vn.drV, or *hand~ han.dy* (in *hand+out* vs. *han.dout* there is additionally a morphological boundary).
- i) Another determiner of syllable structure, beside sonority, is accent (i.e. extrinsic prominence), which can override sonority, e.g. *atomic* [əˈt^hām.īk] beside *atom* [ˈæɾ.ēm].
- j) The third criterion determining syllable structure is quality. According to the attraction-of-opposites principle, phonetically similar sounds "repel each other" (D & S 1978: 31), e.g. *two* [tu:], not [twu:].
- k) All the cases in which the above criteria are not respected by the syllable structures of particular languages are treated as exceptions (as, e.g., in words like Grm. *stumpf*, Fr. *théâtre*, Pol. *rtęć* etc.). However, D & S remark that: "there is no reason to expect that any purely segmental pattern for the syllable, like the sonority curve, should be universally adequate" (D & S 1978: 32). A given pattern is only universally *preferred*.
- l) As far as the timing of speech is concerned "isochrony exists,..., in the intention and perception of speech rather than in its actuation" (1978: 33).
- m) Length is not a property of segments but of syllables. Evidence for this comes from compensatory length adjustments, e.g. in Old English (cf. Chapter 9). In *holhes* > *ho:les*, D & S predict the following sequence of events: *holh.es* > *hol.es* > *ho:les*. After the deletion of the syllable-final [h], "the rest of the syllable, and particularly the vowel" (1978: 34) is lengthened (however, a vowel is never lengthened to compensate for the deletion of a preceding consonant).

3.4.3.2. Let me comment on the weaknesses of the above statements (3.4.3.1.a. through m.) in the order of appearance:

- (a) Firstly, there is no necessary connection between the writing systems and the underlying representations of speech. Secondly, the argument is paradoxical since it is commonly brought up as evidence *for* rather than *against* the "syllable" in general. Thirdly, therefore, the argument can be taken up to serve the purposes of this book, namely, that writing systems do not prove the existence of the "syllable" (cf. Chapter 13)⁵⁰.
- (b) The statement contradicts the original assumption about the non-existence of underlying "syllabication".
- (c) If "syllables" belonged to the underlying intentional level of speech (which is phonemic), rules (which are morpho(no)logical and learned) could not be sensitive to them anyway, since rules⁵¹ are in principle insensitive to phonological structures. Thus, their behaviour cannot imply when in phonological processing the "syllables" may possibly arise.
- (d) The examples quoted do not unambiguously point to the syllable as a domain: other legitimate candidates are a foot, a morpheme or a word.

⁵⁰ See also Dressler and Dziubalska-Kołaczyk 1995a.

⁵¹ In the sense of Stampe and Donegan.

- (e) The statement points out exactly what the present author is driving at, namely the existence of a rhythmic alternation of more prominent elements of speech with less prominent ones as the underlying principle of speech organization. That does not imply, however, that the prominent elements become the nuclei of larger units.
 - (f) Firstly, the mapping of a segmental representation onto a prosodic pattern does not have to result in "syllabication". Secondly, the latter statement (the one in quotation marks) is inconsistent with the former, since it talks about the mapping of "syllables". In this way the definition of "syllabication" becomes a tautology. Thirdly, the notion of "beat" is not defined and therefore can be understood as an intuitive unit, based on a "feeling" for music and metrics⁵².
 - (g) The statement brings up some extra-grammatical evidence for the unidentifiability of the "syllable", or, more specifically, of its boundaries. D & S's solution is ambisyllabicity.
 - (h) What the syllable bonds quoted point to are binary bonds between segments (very much supportive for the argument of this book) rather than bonds across the slopes. As to the noted interaction of phonology with morphology, an explicit statement about the relation between the two components is missing.
 - (i) The source of the syllabifications given as examples to support the influence of accent (an accented vowel draws consonant(s) to itself) is not supplied, so the reader has simply to take the authors' word for it (cf. Bailey 1978).
 - (j) The "quality" criterion should be distinguished in status from the former two (sonority and accent), since it is phonetic.
 - (k) The notion of preference presupposes the existence of cases which do not undergo the preference. It is, therefore, incompatible with the notion of exception; the latter is relevant under the assumption of absolute universals.
 - (l) It is not clear how the timing constraints suggested by D & S⁵³ (evidenced in "actuation") relate to the different intended (and perceived) rhythms of speech.
 - (m) The notion of syllable quantity is very old (cf. this Chapter, section 3.1.) and length has been treated only phonetically as a property of segments. D & S are very imprecise in expressing what "really gets lengthened" since they do not espouse the hierarchic structure of the syllable, and thus cannot talk about rhyme. However, they suggest no alternative account.
- In general, in the framework of Natural Phonology the status of phonemes as intentional units is much clearer than the status of syllables as derived ones.

3.4.4. The structure of the syllable.

Potentially, there are a few possibilities of presenting the relationships among the constituents within a syllable⁵⁴. The structure most widely espoused by phonologists (e.g. Pike and Pike 1947, Kuryłowicz 1948, Fudge 1969, 1987, MacKay 1970, Selkirk 1982, van der Hulst 1984, Treiman 1983, 1985, 1986, Cairns and Feinstein 1982⁵⁵, Kiparsky 1979, 1981 and others) used to be one assuming onset-rhyme split, i.e. the one in which the nucleus is more closely related to the coda than to the onset (cf. below, *Figure 1*).

⁵² For the use of "beat" by D & S see also their 1983 paper, which will be referred to in Chapter 4.

⁵³ E.g. that within a slope, most feature values (like voicing, nasality, timbre) switch only once.

⁵⁴ Cf. e.g. Vennemann (1988b), Fudge (1987) or Vincent (1990) for surveys of studies on syllable structure.

⁵⁵ Cairns and Feinstein (1982) created a theory of syllable markedness. Another treatment of syllable markedness is found in the works of Kaye and Lowenstamm.

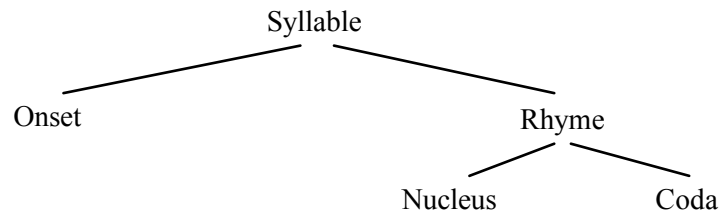


Figure 1.

The above structure, together with two other logical possibilities, i.e. a body-coda split (*Figure 2*) and a nucleus-margins split (e.g. Togeby 1951, cf. Fudge 1973: 293) (*Figure 3*), are examples of a hierarchical structure of the syllable, i.e. one consisting of constituents and subconstituents.

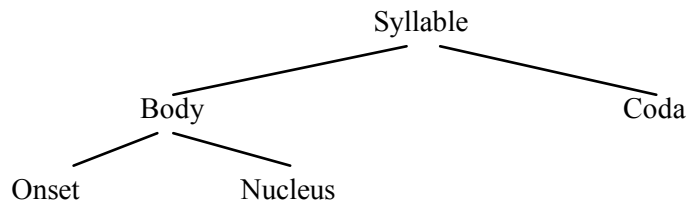


Figure 2.

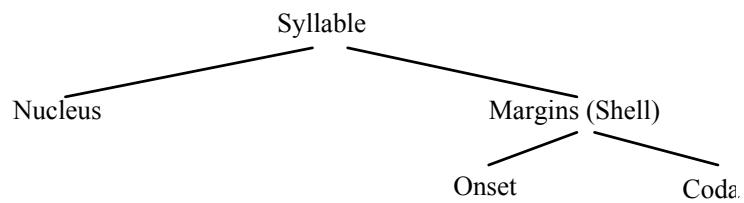


Figure 3.

If one combines an onset-rhyme split with a body-coda split, the result is a rise-fall structure (Figure 4), as proposed by Donegan and Stampe (1978; cf. this Chapter, section 3.4.3.).

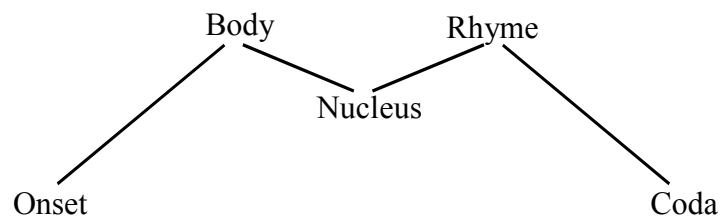


Figure 4.

Less complex are either the linear or flat structures of the syllable. Minimal complexity is obtained in the case of a linear structure whereby the syllable consists of a sequence of sounds. Particular constituents are distinguished within a flat structure, as in Figure 5.

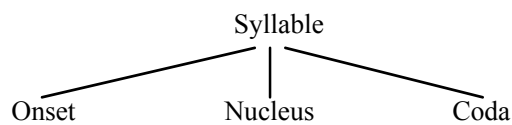


Figure 5.

Discussion concerning the structure of the syllable can be illustrated with a widely-known dispute about the rhyme. The following sorts of evidence have been claimed to support the rhyme constituent of the syllable (for reviews of evidence cf. e.g. Durand 1990 ch.6: 201ff, Davis 1982, Vennemann 1988b):

- (a) reference to rhyme in stress assignment (i.e. the role of heavy vs. light syllables e.g. in Latin);
- (b) the existence of phonotactic constraints between nucleus and coda;
- (c) the existence of an upper limit on the length of the rhyme in some languages (like (a), also connected with syllable weight);
- (d) evidence such as word games, speech errors etc.;
- (e) rhyming traditions.

A concrete example of the exchange of views *for* and *against* taking the above evidence seriously was the discussion between Fudge (1969⁵⁶, 1987, 1989) - *for*, and Clements & Keyser (1983) and Davis (1989) - *against*.

3.4.5. The syllable as an element of a prosodic hierarchy.

It was in fact the development of non-linear approaches to phonology⁵⁷ that returned the syllable its significant status in linguistic theory. Under their stimulus, the syllable started to be recognized as a unit of a higher order hierarchical prosodic structure as well as consequently to possess a structure of its own. Kahn's (1976) thesis is usually acknowledged to have constituted the first step towards recognizing the role of the syllable in generative phonology, followed by the work of Selkirk (e.g. 1982), McCarthy (1979), Kiparsky (1979), Halle and Vergnaud (1979), Leben (1980) and many others. Since then, a great number of non-linear models of phonology in general and of the syllable in particular have been developed. The syllable has been seen as part of a prosodic structure represented in terms of trees, tiers or grids reflecting differing views on constituency. Subconstituents of the syllable itself, therefore, have also differed depending on the approach (e.g. Vincent 1990 argues for the interlude, as Hockett 1955 did). Major phonological theories which rely on some form of the syllable for the sake of phonological representations and processing have been: Lexical Phonology (Kiparsky 1982; Rubach 1984, 1993), CV Phonology (Clements and Keyser 1983), Autosegmental Phonology (Goldsmith 1979, 1990), Metrical Phonology (Liberman and Prince 1977, Liberman 1979, Hayes 1980, Prince 1983), Dependency Phonology (Anderson and Ewen 1987, Durand ed. 1986), WU Phonology (Hyman 1985), Moraic Phonology (McCarthy & Prince, Archangeli, Hayes, Itô: see Tranel 1991 for references), and Optimality Theory (Prince and Smolensky 1992, Tesar and Smolensky 1993, McCarthy & Prince 1993, Archangeli and Langendoen 1997). This section closes with an example of the hierarchy of prosodic constituents (*Figure 6*) by Nespors and Vogel (1982). This hierarchy, albeit often with modifications⁵⁸, is most widely referred to in the phonological literature:

⁵⁶ Fudge (1969) was, in fact, the first to point out the inadequacy of the SPE's (Chomsky and Halle 1968) attempt to build a phonological theory without the notion "syllable". See also Anderson, S. (1974).

⁵⁷ For an introduction to non-linear phonology cf. Pulleyblank (1989) and, shortly, Broe (1992).

⁵⁸ Cf., e.g., an argumentation against the clitic group by Booij (1994, GLOW Meeting, Vienna); a discussion of the justifiability of various constituents/levels of prosodic structure proposed in research - by Vogel (1992: 124-126).

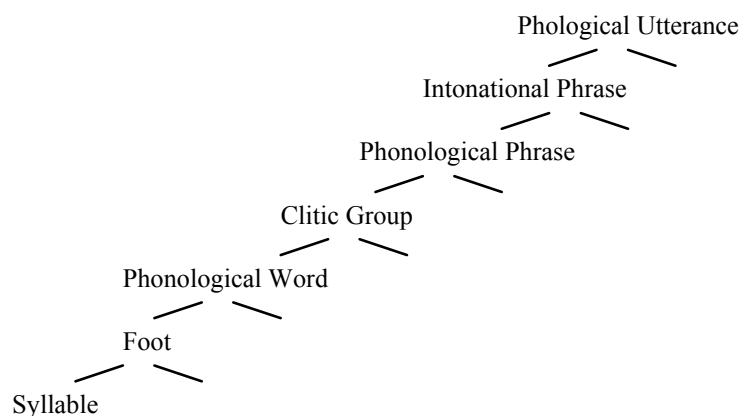


Figure 6.

3.5. Approaches disfavouring the syllable

In his 1983 paper "Quantity, resolution, and syllable geometry" Lass declares: "I will not enter into any discussion of the justification for the syllable itself as a phonological prime; I assume this is no longer a theoretical problem, and that recent discussions (Hooper 1972, 1976, Anderson and Jones 1974, Árnason 1980) have restored this traditional notion to a central position, and defused earlier arguments (e.g. Kohler 1966) against the necessity or desirability of the syllable" (Lass 1983: 151). This statement is likely to find supporters among the majority of linguists. I would like to show that arguments against the syllable have in fact not been defused. One can think of at least four ways in which the syllable has "nonexisted" in phonology: a. the syllable has been ignored; b. the syllable has been explicitly denied; c. the syllable has been implicitly denied (by not insisting on it); d. the syllable has been made partially redundant (language- or type-specifically). Early generative phonology (Chomsky and Halle 1968) limited phonological representation to linear strings of segments with no hierarchical organization of phonological origin⁵⁹. Consequently, the notion of syllable was simply omitted. Foley's (1977) concept of phonological strength did not involve the syllable either. Early generative views with respect to the syllable will not be discussed here, since, on the one hand, they are probably best known among the "syllable-less" views and, on the other, they have not brought solutions to the problem areas of phonology in which the syllable used to be involved. The majority reaction among phonologists was to reintroduce the syllable into the phonological description (cf. this Chapter, section 3.4.). The minority reactions will be sketched below.

3.5.1. The syllable explicitly denied.

Kohler's (1966) short argument against the syllable as a phonological universal is very often cited in the literature as one of the most explicit denials of the syllable⁶⁰. His statement about the syllable as either an "unnecessary", or "impossible" or even "harmful" concept in phonology has become widely known among phonologists, though frequently dismissed. Kohler based his rejection of the syllable exclusively on the boundary argument: the division of clusters is, language-specifically, independently predictable, indeterminate, or morphological.

⁵⁹ There was one provided by syntax.

⁶⁰ cf. also Heffner (1964).

While Hudson (1990) addresses a few randomly selected approaches to the syllable, criticising them in a rather fragmentary fashion, later (Hudson 1995) he gives an explicit proposal of replacing the notion "syllable" with the notion "consonant release". The phonological feature [unreleased] delineates syllables and in this way replaces syllable boundaries. [unreleased] accounts also for other aspects of syllable phonology, such as weakening of unreleased (=syllable-final) consonants, maximising released (=onset) consonants, or sonority scale which may be understood as the scale of releasability of consonants (the more sonorous=the less releasable). The weakness of this proposal is, in my view, that the predictability of release is comparable to the predictability of syllable boundaries, which equally amounts to the necessity of additional rules for exceptional syllabifications no matter whether release or syllable boundary is referred to. In Hudson's (1995) approach, the notion of the syllable reduces to the presence of a syllable nucleus or a [+syllabic] phone, while boundaries (and, indeed, consonant syllabicity) are derivable. In this sense, what remains to be done is to find a way to phonologically objectify the concept of nucleus.

In Government Phonology, the prosodic hierarchy below the foot level does not contain the syllable level, but the syllabic constituent level and the skeletal position level. The syllabic constituents are: onset, nucleus and rhyme. The coda has no status in the theory, nor does the syllable itself. There is a binary-branching limit imposed on all the constituents, while the non-branching constituents are unmarked. To account for final ("coda") consonants, the theory allows for final empty nuclei which license their position. Consonantal and vocalic properties of segments are a consequence of their non-nuclear or nuclear syllabic position. Vowels play a central role in the organization of the phonological string and as such are "reminiscent of the 'backbone' of the DNA molecule" (Kaye 1990b: 4) while consonants are built on the vowel representation and are crucial in lexical access.

Though explicit, the denial of the syllable by Government Phonology crucially differs from the other two approaches mentioned in this section. The theory discards the syllable as a constituent and, thus automatically, also the notions of syllable boundary and weight, but it retains the structural components of the syllable and their basic nuclear and non-nuclear functions.

3.5.2. The syllable implicitly denied.

Bell and Hooper (1978: 4f) talk about those theories which do not "insist upon syllables at all". Such theories posit bonds among segments as crucial to their organization. Bell himself (Bell 1976) criticised the concept of the distributional syllable as untenable and reformulated the problem of the syllable as the problem of the organization of segment strings. This led him (Bell 1979) to propose a segment bonding theory, which made coherence between segments superior to syllable membership. It is worth noting here that Bell followed some of the insights of Natural Phonology⁶¹. In Bell's model, the bonding relations between segments (of four types⁶²) are determined by universal and language-specific principles referring to segment characteristics and segment sequences as well as morphological and prosodic structure. The

⁶¹ For example, rule vs. process distinction and specifics of the lexical vs. post-lexical organization of segment strings (Bell 1979: 13f).

⁶² I.e. the proximity bond (binds all segments), the segmental bond (produces complex segments like affricates and diphthongs), the sequence bond (sequences simple or complex segments which are bound more closely than by proximity) and the onset bond (forms an onset sequence) (Bell 1979: 13).

bonds allow him to treat the vowel-consonant dichotomy as fundamental rather than the syllabic-nonsyllabic one. Vowels and vocalics, therefore, have to be specified in the lexicon. Syllabic consonants differ from vowels (by at least one segment less in the margin(s)), a difference which is stipulated in Bell's model by a constraint on the onset bond. Sequence bonds are optional.

The bonds manifest themselves through adhesion which "governs the strength with which segments affect one another as well as their resistance to processes that would separate them" (Bell 1979: 14). This property seems to be replacing sonority in the model. Stylistic variation, traditionally accounted for in terms of syllable structure (e.g. Bailey 1975), is explained by means of the differences in segment adhesion, reflecting differences in the strength of the proximity bond (which binds all segments). So, for instance, segments are bonded more tightly at faster tempos, or certain sequences are bonded more tightly than others (e.g. nasal + consonant). Also morphological structure may influence segment organization.

As much as Bell's basic idea of bonding is very appealing, his model possesses a number of weaknesses. 1. The proliferation of bonds he suggests blurs the picture of what is purely phonological and what purely phonetic in the relations between and among segments. 2. "The marginal poverty" of syllabic consonants should follow from the fundamental vowel-consonant dichotomy without additional stipulation. Since it does not, one is led to conclude that the dichotomy itself is not adequately handled. 3. Adhesion should allow for some, at least probabilistic, quantification. For that purpose, however, there should exist some measure of adhesion. 4. The bonds or their absence within a sequence seem ad hoc: the criteria of bonding are not specified. 5. It is redundant to talk about bonds in the cases when morphological structure overrides phonology. 6. The fact that the strength of bonds varies with style, tempo or particular features of segments renders the notion of bonding phonologically unpredictable and, thus, weak.

Vennemann's statement about the potential epiphenomenal nature of the syllable (quoted in section 3.4.2.2. of the present chapter) implies that it is possible to find the principles and formulate the rules responsible for the organization of segmental strings without recourse to this unit. In a number of works (e.g. Vennemann 1982, 1988b, 1994), Vennemann argues for the nuclear structure of the syllable (a restricted version of flat structure) or, in more general terms, for nuclear phonology. He draws two kinds of consequence from this position, one of which seems to be methodologically unsound while the other, highly promising.

The first is that syllables, apart from having nuclear structure, can assume any of the proposed structures "depending on the syllable-related phenomenon under study" (Vennemann 1988b: 269). For instance, regularities of stress and meter impose rhyme structure on the syllable. Exceptionally, however, they may also impose body structure, as does stress in Aranda (Vennemann 1988b: 270). Or, a segment may syllabify to the right, to the left or remain ambisyllabic, depending on the language-specific regularities recognized. Vennemann believes that it would be "a methodological error" (Vennemann 1988b: 270) to insist on a single structure of the syllable only. I think, conversely, that it would be a methodological error not to do so, once the syllable is assumed. Allowing for manifold structures and letting them depend on the phenomenon to be accounted for renders the whole concept of the syllable redundant and leads to a purely inductive description.

The second consequence of assuming the nuclear structure of the syllable is a need for a general theory of phonological structure, which Vennemann calls nuclear phonology (Vennemann 1988b:273) to distinguish it from syllabic phonology. In this theory, "except for the position of nuclearity, all the syllabic aspects of expressions should fall out as consequences of the action and interaction of the cohesion relations" (Vennemann 1988b: 273) in groups of

speech sounds. Bell's model (see above this section) and its elaboration by Kreitmair (1984) exemplify this promising line of research.

Kreitmair (1984: 30ff) distinguishes five types of bonding⁶³ and, additionally, affinities partly responsible for the presence of bonds. Three affinity types are most significant: 1. *Silbengipfelaffinität* - peak affinity: between the syllable peak and segments bonded to it by the syllabic bond; 2. *Gipfelumgebungsaffinität* - peak environment affinity: between syllable-bonded segments preceding and following the peak; and 3. *Sequenzaffinitäten* - sequence affinities (onset and offset), that is, between segments within onsets and offsets. Affinities are defined, sometimes even for each particular nuclear sound, independently of sonority considerations while congruity between affinities and the sonority hierarchy is universally preferred. Consequently, violations of the sonority hierarchy by syllable structures of many languages are no longer treated as such: they are cases of language-specific affinities. Bell's problem with the marginal poverty of consonantal nuclei is accounted for within Kreitmair's model by means of peak affinity. For instance, only obstruents may have, in a given language, sufficient peak affinity to create margins to syllabic liquids.

Kreitmair conducted a statistical analysis of the structure of the syllable, or rather word, in German by examining monosyllabic words. This resulted in a statement of phonotactic constraints operating in German monosyllabic words. He tried to apply his *Segmentbindungsmodell* to the results obtained. So, for instance: (a) he concludes that a nucleus of a stressed syllable has to span over two timing units (=segments) (Kreitmair 1984: 85); (b) he constrains the syllabic bond to stretch over maximally two segments left and right of the nucleus. The unbonded segments remain extrasyllabic (Kreitmair 1984: 85). He remarks that, (c), intervocally, in polysyllabic words, not all segments have to be syllabified (Kreitmair 1984: 92). Unfortunately, the application-of-the-model part of Kreitmair's work is very disappointing. I do not see any advantage in his account of German phonotactics over the existing or potential accounts of purely syllabic models. What is the difference between (a) above and a branching nucleus, (b) extrasyllabicity condition, and (c) interlude?

As much as I agree with Vennemann that developing theories of phonological cohesion constitutes the most promising line in phonology and "should be a great challenge to the linguistic community" (Vennemann 1988b: 281), I do not approve of some of his accompanying assumptions and speculations as to the potential workings of the models *à la* Bell and Kreitmair. First of all, a well-developed theory of phonological cohesion WILL make the syllable superfluous. A theory will unnecessarily lose on generality if, for instance, it allows segments both to associate with syllables as well as to remain extrasyllabic, once all the relations between and among segments have, anyway, been sufficiently and exhaustively accounted for by cohesiveness principles (such as affinities and/or bonds).

Secondly, if rules are to depend on the cohesiveness of segments, they cannot be triggered by various affinities in an ad hoc manner. For example, why, in principle, should rules of accent and meter look for loosely bonded segments and not find them in an onset or body-bond? Even if this happens to be the case, what is needed is some basis or measure of cohesion and a principled way of stating differences between bonds.

Thirdly, rather than locally differentiating between bonds, they should be differentiated along one parameter only, i.e. that of the strength of bonding. In this way, it would be possible

⁶³ I.e. *Segmentfolgebindung* - segment sequence bond (defines the sequence of segments), *Komplexbindung* - complex segment bond (produces complex segments like affricates or diphthong), *Silbenbindung* - syllabic bond (binds segments into syllabic complexes; it is optional), *Anfangsrandbindung* - onset bond (is a body-bond) and *Nukleusbindung* - nucleus bond (produces complex nuclei).

to isolate bonding as one of the parameters of cohesion and investigate its interaction with other parameters, stemming from rhythm, accent or phonetics.

Fourthly, the statement that "evidently phonological descriptions cannot be based on phonetic explanations" (Vennemann 1988b: 277) can be given the riposte "however, phonological explanations can be motivated by phonetic descriptions", at least within such models as Natural Phonology.

Other theories of phonological cohesion or cohesiveness have also been developed. Within Berg's (1989) psycholinguistically based intersegmental cohesiveness theory the hierarchic syllable structure and sonority are required to account for cohesiveness.⁶⁴ Phonetics offers no shortage of studies of cohesion, some of which give explicit lack of support to the unit syllable (e.g. Hirst 1993).⁶⁵

3.5.3. The syllable made partially redundant.

Auer (1994) proposes that the syllable is not a universal phonological category but rather a language-type specific category, characteristic of "syllable languages" *Silbensprachen* as opposed to "word languages" *Wortsprachen*. He warns the reader explicitly, however, against comparing his intention to that of Kohler (1966; see section 3.5.1.):

"Hier geht es nicht um die Abschaffung der Silbe und die Rückkehr zu einer morphologisch überfrachteten, segmentbasierten Phonologie, sondern zu einem typologischen Modell, in dem aus einer Hierarchie prosodischer Kategorien von Sprache zu Sprache jeweils die typische Hauptkategorie gefunden werden muß. Es scheint, daß in einer größeren Gruppe von Sprachen diese Hauptkategorie nicht die Silbe ist" (Auer 1994: 76).

In this statement the author overlooked the possibility of discarding the syllable and NOT returning to the "morphologically overloaded, segment-based phonology". What he presents in the paper, however, is definitely interesting, though not conclusive. He gives examples for which syllable-based accounts do not work. First, there are instances of historical change which contradict the syllable-optimization principles of Vennemann, in particular Head Law and Coda Law (Auer 1994: 58f). He notices that there is no reason to treat these "exceptions" as less natural than the cases obeying the laws. A better idea is to explain them as results of the preferences at a different phonological level, namely that of a phonological word.

Second, he distinguishes between languages which select out of the prosodic hierarchy (Nespor and Vogel 1986) either a syllable or a phonological word as their basic prosodic category. Languages of the former group behave according to the predictions of syllabic phonology. On the contrary, languages of the latter group select a larger prosodic category as the domain of various phonological processes - the phonological word. Auer's examples of the word-languages are German and English as well as !xóó̃ (a Khoisan language, spoken in the south-west of Botswana and Namibia) and Tamang (a Tibeto-Burman language from Nepal). In !xóó̃ both tone assignment and phonotactic constraints seem to operate within the domain of the phonological word. The same is true, according to Auer, of tone assignment, phonotactics and assimilations and dissimilations in Tamang.

⁶⁴ Berg's views will be discussed in Chapter 15.

⁶⁵ These will be elaborated on in Chapter 16.

Third, for German Auer tries to prove that: 1. the phonotactics of the language is word-based; 2. word-internal syllable boundaries are hard to identify; 3. the number of syllables is unstable; 4. assimilations at a normal tempo of speech are blocked by morphological boundaries and resyllabification is possible only within words. As to resyllabification, it is obligatory with suffixes and enclitics (e.g. in /art+ig/, /ist+er/), but very restricted with prefixes, proclitics and in compounds (e.g. in /fer+axtn/, /der+andərə/). Auer concludes that a phonological word, assuming it contains all the above mentioned morphemes, needs to be supplemented by a less central category (in between word and syllable) which he calls a prosodic stem - *prosodischer Stamm* (Auer 1994: 71).⁶⁶

Fourth, the author discusses traditional evidence for the syllable in German, i.e. r-vocalization, [ç] vs. [x] distribution, s-palatalization, *Auslautverhärtung* and glottal stop insertion. Most interesting is the account of *Auslautverhärtung* as a process sensitive to the boundaries of prosodic categories of which the syllable is only one and not the most important category (Auer 1994: 74f). In fact, *Auslautverhärtung* is "als phonologisch plausibler (natürlicher) Prozeß überhaupt nur vor Pausa zu begründen (vgl. Shannon 1987, Heike 1992: 12)" (Auer 1994: 75, footnote 20).

Even if all the examples considered by the author were convincing of his case, still his idea of language- or type-specific prosodic categories weakens phonological theory considerably. What are, then, if any, the universal prosodic principles of sound structure organization?

A somewhat similar reservation may be addressed to the approach towards the syllable represented by Hyman's Theory of Phonological Weight (Hyman 1985).

"Some languages go on to construct syllables, others do not. It is my claim that many of the syllable analyses given in the recent literature need not involve the syllable and that we are in need of a theory that will tell us when and where syllables are constructed as a distinct level in the prosodic hierarchy" (Hyman 1985: 95f).

However, Hyman's distinction between languages which make use of a syllable level of the prosodic hierarchy and those that do not differs from that of Auer. It is based on typological characteristics of phonological processes rather than languages⁶⁷. For example, stress is expected to require syllables for its assignment while tone weight units. This is already incompatible with some of the generalizations made by Auer with reference to tone assignment within a phonological word. On the other hand, Hyman's often quoted claim that there are "no syllables in Gokana" (Hyman 1985: 26ff) is structured similarly to the antisyllabic claims of Auer. Namely, Hyman attempts to show that the typical phonological properties which are sensitive to the syllable in other languages are sensitive to units like the foot and phonological word in Gokana. Cases like that of Gokana (and the like), however, do not invalidate the universal status of the syllable within the prosodic hierarchy.

3.6. Final remarks

⁶⁶ Auer is not in favour of a foot (1994: 71, footnote 15): "Der Terminus 'Fuß', obwohl von manchen Phonologen und Phonologinnen verwendet, scheint mir wenig glücklich zu sein; weder reflektiert er die morphologische Basis der phonologisch-prosodischen Einheit, um die es hier geht, noch ist er mit dem phonetischen Begriff des Fußes kompatibel, der (eben genau umgekehrt) von der Morphologie gänzlich unabhängig ist."

⁶⁷ Of course, the former contribute to the latter.

This chapter has shed light on the history of the notion "syllable" and its role in phonology. It is evident that the syllable has been, and will likely continue to be, present in the description of speech, either as a major psycholinguistically real unit or as a convention, despite the need to search for better, more comprehensive and holistic explanations of phonological phenomena than the ones prompted by the syllable. This need is evident in the approaches discussed above (3.5.), which look for either an alternative or an amendment to the syllable. This book is also such an attempt.

CHAPTER FOUR

Beats-and-Binding Phonology: principles

Embedding a model in a larger explanatory framework entails its compatibility with the framework's epistemology. I will discuss the epistemological background of Natural Phonology first in this chapter, with special emphasis on the notion of "preference". Subsequently, the fundamental notions and principles of Beats-and-Binding phonology will be introduced, followed by a proposed scenario of the rise of structure in phonology. Finally, the relationship between phonology and morphology will be treated on semiotic grounds.

4.1. Epistemological background

The model of phonology proposed in this book is embedded in the epistemological framework of Natural Linguistics (NL henceforth, cf. Chapter 2). This entails that it will be explicitly constructed as a *preference theory* rather than a general descriptive theory, and it will employ the epistemological approach of *functional explanation*. Particular linguistic choices are seen as results of goal-oriented linguistic behaviour of language users and as such cannot be explained in the *deductive-nomological* fashion, i.e. by the *covering-law model*, where an explanation is derived from general laws and background conditions (i.e. the explanans deductively entails the explanandum). On the covering-law model, a satisfactory explanation has the same logical structure as a prediction derived on the basis of a scientific theory: "If we have an adequate explanation of some occurrence, then, in principle, we could have predicted it before it actually took place (or before we knew that it had taken place)" (Gasper 1993: 291). Since absolute predictions with reference to language behaviour are impossible (cf., e.g., dysfunctional behaviour or multi- and plurifunctionality, Chapter 2, section 2.2.4.), causal explanations of the deductive-nomological type cannot be satisfactory⁶⁸.

Still, NL does make *deductively* valid inferences⁶⁹, stemming from extra-linguistic premises, the form of which, however, are not absolute statements, but preferences.

⁶⁸ There are many serious problems with this model of explanation (among others, when you can explain without having predicted or the other way round), see Gasper (1993), Stegmüller (1983).

⁶⁹ "A *deductively valid inference* is one that, in a certain sense, is best possible: an inference such that there is no possible way in which the premises could be true and the conclusion false" (Boyd 1993: 4). "*Inductive inferences* are the sorts of inferences scientists make when they take particular observations or experimental results to justify the acceptance of general conclusions about the behaviour of natural (or social) phenomena" (Boyd 1993: 4). "[I]nductive inferences are never deductively valid" (Boyd 1993: 4).

Preference implies a human agent, i.e. (some) control of language by the selves of the speakers, reflecting behavioural strategies preferred by them (cf. Ritt in press; Dressler and Dziubalska-Kořaczyk 1994 on functional explanation in SLA). "[T]he way from external constraints to language internal design leads right through the realm of human minds, which are under the influence of allegedly autonomous, free-willed human selves" (Ritt in press): preferences are used by NL to describe/explain/model this realm.

Decision logic (also called *rational decision theory*, cf. Stegmüller 1979: 203-209) supports preference theories. Decision theory is concerned with man as a practical, deliberating creature who takes decisions under risk, under uncertainty, or under certainty. Consequences, needs and probabilities are taken into consideration in decision-making. Decisions under risk are of particular interest, since the consequences can be predicted only with some probability, while the estimates of probabilities are subjective. Decision theory posits criteria of rational behaviour; for instance, the decision rule of Bayes⁷⁰ states that a rational person will always choose a behaviour with the highest expectancy value. It is characteristic of people to have preferences, i.e. wishes of a higher order, of which they are aware (animals also have preferences, but they are not conscious of them) and which, therefore, make them either prefer or refute a given behaviour, as well as order the preferences themselves (preferences of higher order).

Although the notion of diachronic and synchronic tendencies was established already in 19th century linguistics, Vennemann (1983), Natural Phonology or Natural Morphology are explicit, coherent theories of preferences.

4.1.1. Vennemann's (1983) preference theory

Vennemann (1983) arrives at a theory of linguistic preferences via a critique of usual practice in linguistics of constructing general descriptive linguistic theories.

[A] general linguistic theory [of the sort making universal qualifications] is by its very nature incapable of telling us what is usual and what is rare in the languages of the world; it can only tell us what is possible and what is impossible (Vennemann 1983: 10).

[W]e can arrive at explanations for the regularities within a certain domain by turning to theories that are *not* theories for that particular domain (e.g., for grammatical theories, these include: theories of phonetic production, perception, learning, memory, communication, action, semiotic theories etc.) (9).

The above is, in fact, a plea for the use of external evidence, and is thus very much in line with the epistemology of NL.

Theories of linguistic preferences propose a rank order on a scale of preference relative to a specified parameter (Vennemann 1983: 11). If you formulate a preference which says, for instance, that everything else being equal, open syllables are better than closed syllables, it amounts to the same as to saying that *having only open syllables is preferred to not having only open syllables* (Vennemann 1983: 12). A concept of graded preference allows Vennemann to foresee that the less preferred a structure, the more tendency it has to change (in order to improve).

According to Vennemann, a theory of linguistic preferences provides only a weak (non-deductive) explanation of preferences (since strong explanations are derived from non-

⁷⁰ Bayesianism "represents a sophisticated and elaborate attempt to characterise rational inferences in science in terms of canons of probabilistic inference" (Boyd 1993: 21, footnote 15)

linguistic theories) in the sense of elucidating the properties of individual languages (cf. Vennemann 1983: 13). *Figure 1* below is a collapse of Vennemann's figures 2 and 3 (Vennemann 1983: 14).

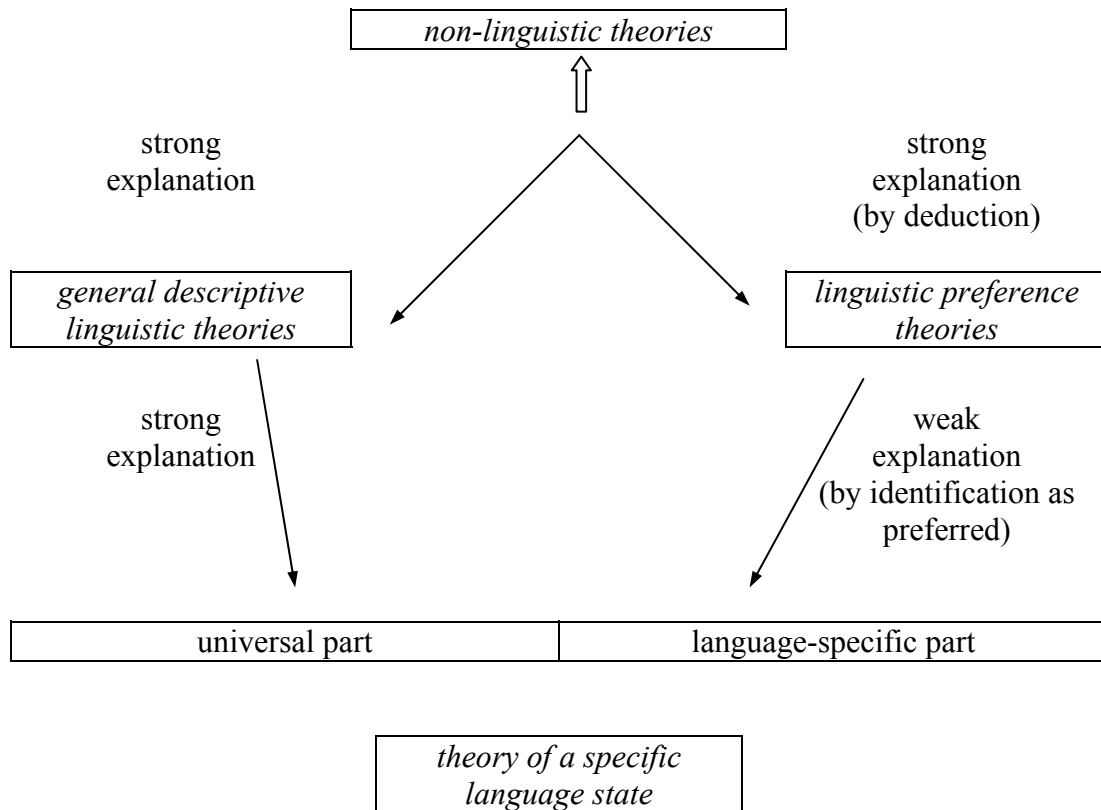


Figure 1. Relationship between linguistic and non-linguistic theories (cf. Vennemann 1983: 14, Fig. 2 and 3).

4.1.2. Natural Linguistics as a preference theory

Natural Phonology and Natural Morphology are explicit theories of preferences. Dressler (1990b) criticised a tradition in which "the most frequent/(intuitively) most natural state of affairs (e.g. biuniqueness between phoneme and allophone) is elevated to the only state of affairs allowed by the given theory/model" (19) and postulated to replace absolute constraints with preferences. A semiotic theory of linguistic preferences receives its explicit, full-fledged presentation in Dressler (1999a). In NL linguistic preferences are explanatory since they are derived from non-linguistic levels (cf. the discussion of Vennemann 1983 above). This results in a "hierarchical, deductive system within which linguistic preferences occupy a general second rank, below higher principles and above the specific linguistic consequences of preferences" (Dressler 1999a: 390) (cf. the quintuple (Dressler 1985: 292) from universals, through type and system adequacy, to norm and performance, presented in Chapter 2).

Let us envisage this system graphically and illustrate it with an example:

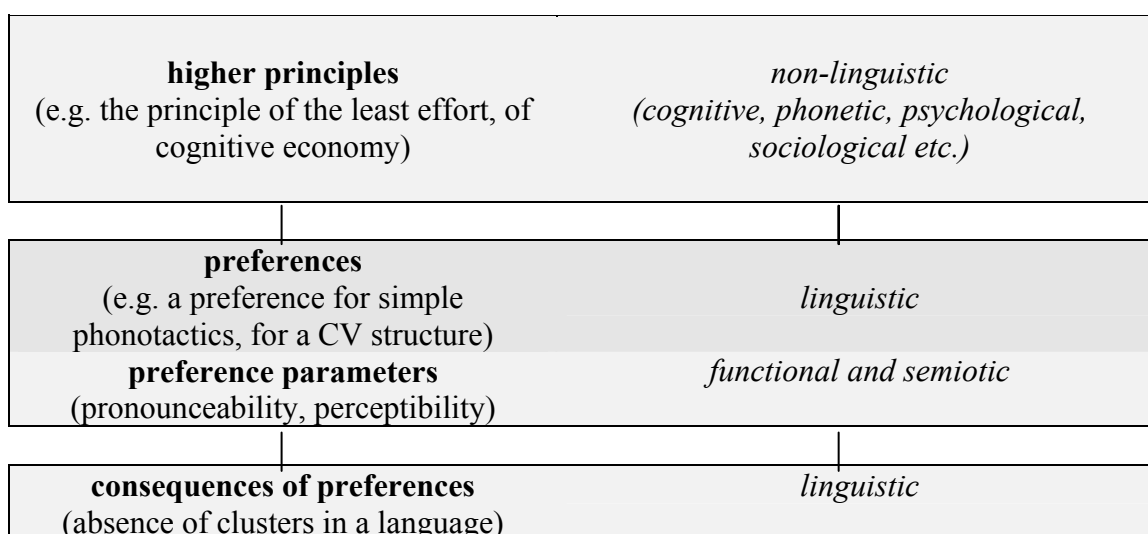


Figure 2. The explanatory system of Natural Linguistics.

"The comparative concept of preference „consists of criteria and choice of principles for ordering the criteria” (Feger and Sorembe 1983:605, after Fjellmann; in Dressler 1999a: 391). Preferences are parametrised; and on a given parameter they are: transitive, asymmetric and irreflexive. The meaning of preference corresponds, in diametric opposition, to "more or less marked", i.e. the more preferred = the less marked.

Conflicts may arise between preferences. If they do, then "agents strive towards maximal benefits or expected utility" (Dressler 1999a: 392), i.e. in the direction of more *natural* which in itself is a relative and gradual concept meaning: "cognitively simple, easily accessible (especially to children), elementary and therefore universally preferred, i.e. derivable from human nature, or unmarked/less marked" (Dressler 1999b: 135).

Conflicts between preferences reflect the divergence of preference parameters. Solutions are either according to higher-order universal preferences and universal principles or they are local, i.e. type adequate or language-specific⁷¹. Preferences of NL are explicitly based on extralinguistic fundamentals: "preferences in the use and acquisition of language become frozen in preferences of language structure" (Dressler 1999a: 394); thus, for the validation of universal preferences, "external evidence is MORE important than internal evidence" (Dressler 1999a: 394).

⁷¹ Thus, for instance, it is possible to trace the effectiveness of universal preferences in the absence of system adequacy (e.g. in language acquisition) in extragrammatical operations.

4.1.3. Preferences and constraints

4.1.3.1. Ontology

In modern linguistics the concept of preference has been seriously challenged by the notion of constraint. Dictionaries of linguistics feature *constraint* as:

a formal limitation on the application of rules, especially the inputs to rules (Trask 1993);

general conditions for the use and formation of rules which universally restrict phrase structure rules and transformational rules so that they only generate the structures of natural languages; they make empirical declarations about the structure of human languages, they are part of biologically asserted expectations; conditions for well-formedness (Bussmann 1996);

whereas *preference* is defined as:

the structural markedness of options; preferred option = the unmarked (has a less complex structure) (Bussmann 1996).

In my view, a statement may be given the meaning of either an absolute or a violable constraint, with the following consequences of such meanings:

- *an absolute constraint*: a non-violable, universal principle, e.g. "mechanical" constraint in Maddieson's (1999) terminology; defines the borders of the possible; ontologically *a law*, OR
- *a violable constraint*: a violable, universal tendency, whose applicability is influenced by "ecological" factors (cf. Maddieson 1999) - leading to type-specific and system-specific differences; defines direction of selection from the possible; ontologically *a preference*

4.1.3.2. Natural Linguistics vs. Optimality Theory

In the above sense, as long as given constraints are not absolute, they express preferences. With this inference in mind, let us inspect the use of both notions by Natural Linguistics in comparison to a constraint-oriented Optimality Theory (cf. Prince & Smolensky 1993, Archangeli & Langendoen 1997, Kager 1999). The comparison seems justified on the ground that Optimality Theory is, on the one hand, an off-spring of the generative tradition in phonology and as such is expected to apply different epistemology than Natural Linguistics, while, on the other hand, it is in fact a preference theory and as such appears to be nearer to Natural Linguistics than any other present-day theory⁷². In *Table 1* below Optimality Theory and Natural Linguistics are schematically compared with reference to their treatment of constraints, preferences and resolution of conflicts among constraints and preferences respectively.

As far as the terminology used by the two theories is concerned, Optimality Theory

⁷² "The approach I have taken could be viewed as an attempt to extend Stampe and Donegan's work, making use of Optimality Theory to establish a more direct connection between phonetics and child phonology." (Hayes 1996: 25, footnote 17) In his phonetically driven phonology (cf. Hayes 1996) Hayes proposes an algorithm of inductive grounding which makes reference to the productive and perceptive capacities of the speaker in creating the set phonological constraints.

operates with constraints while Natural Linguistics – with preferences. The question is whether these two are also different epistemological tools in the understanding of the respective theories. Constraints of Optimality Theory constitute wellformedness conditions describing acceptable structures; they are universal tendencies and as such may be violated. The same description is applicable to preferences in Natural Linguistics. The difference lies in the fact that the constraints are inductive generalizations about grammars of the studied languages while the preferences are deductive inferences about grammars based on universal higher-order principles applicable to language as well as to other natural phenomena. Thus, while an Optimality constraint may be identical to a Natural preference, their origins will be different. The term preference may also be avoided in Optimality Theory since it brings associations with performance rather than competence. On the other hand, the term constraint in Natural Linguistics is identified with the aforementioned principles which, among others, naturally *constrain* human speech capacity.

Table 1. Constraints and preferences in Optimality Theory and Natural Linguistics.

	OT	NL
<i>constraints</i>	wellformedness conditions, describe acceptable structures, violable, universal, statements of "general tendencies, not absolute laws" (Archangeli 1997: 7)	extra-linguistic principles, language-external conditions on linguistic competence (see Ritt in press), universal
<i>preferences</i>	since constraints are violable and express tendencies, they are ontologically preferences; still, the theory is interested in "ideal competence", and the concept "preference" suggests "performance"; therefore, not used in the theory	correspond to "constraints" of OT (exactly the same description); metagrammatical statements of tendencies (Singh in press); intermediate-level elucidatory principles (Dressler 1999a, Vennemann 1983), "below higher principles and above the specific linguistic consequences of preferences" Dressler (1999: 390)
<i>resolution of conflicts among c/p</i>	via language-specific ranking, descriptive	universal hierarchy of functionally and semiotically based parameters, additionally shaped in a given language by language-specific ecological constraints (basis of selection from among the possible, cf. Maddieson 1999), "principled constraint ranking", weak explanation in Vennemann's (1983) terminology

The other discernible difference between the treatment of constraints and preferences by the two theories concerns the proposed solution of conflicts which arise among constraints or preferences. Optimality Theory employs language-specific ranking of constraints by means

of which the preferred outputs are selected. Natural Linguistics employs principled “ranking” of preferences. This means that in a given language/style/situation those preferences will be at work which observe a hierarchy of semiotic and functional parameters of naturalness (deriving from non-specifically-linguistic principles) universally applicable to this given language type, style or situation. Thus, in fact, rather than by ranking preferences, conflicts are resolved at a higher level of actually conflicting (contradictory) parameters of naturalness (see also section 4.1.2. above).

Indeed, the formulations of Harmony-Theoretic Phonology, an early version of OT (cf. Smolensky 1986, Prince and Smolensky 1991), came nearer to natural linguistic thinking than the later versions. As Mester (1994: 9f) reports, the notion of 'preference' is formalized there as

"a ranked hierarchy of *principles and mechanisms* (emphasis mine) governing well-formedness, against which representations are optimized. Languages typically do not choose one mechanism (...) to the total exclusion of another (...) - rather, both mechanisms form part of the grammar, but with a preference relation defined on them. (...) For phonological representations, it is also not the case that a certain configuration is categorically ill-formed or well-formed - we are instead dealing with degrees of well-formedness (or 'better-formedness'): Optimization means that representations must attain the best state available, not that they must always reach absolute perfection."

4.2. Beats-and-Binding (B&B) phonology: principles

4.2.1. Introduction: word, foot, mora, and beat

4.2.1.1. The word

Reliably enough, both speakers and phonological processes have access to words, on the one hand, and to feet, on the other. It appears to be a common feature of the languages of the world that words are stored in the lexicon⁷³ to which speakers of a given language have free access⁷⁴, no matter which model of word recognition and lexical access one assumes to be the most plausible⁷⁵. Among the general assumptions held by such models is the one that speech is processed sequentially, word by word (cf. Gósy 1991: 372). Therefore, a speaker is able to supply the citation form of a lexical item with clear-cut boundaries, which is not possible in the case of a syllable. Although syllables and subsyllabic constituents are also claimed to play a role

⁷³ Cf., for instance, the following definition of the lexicon: "The lexicon, considered as a component of the process of recognizing speech, is a device that accepts a sound image as input and outputs meaning." (Cutler 1989: 342)

⁷⁴ "Lexical access is the process of formulating an appropriate input and mapping it onto an entry in the lexicon's store of sound images matched with their meanings" (Cutler 1989: 342).

⁷⁵ The reader is referred e.g. to Gósy (1991) for a concise review of existing word identification and lexical access models. She distinguishes between two main types of models: the modularity type and the interactive type. As important representatives of both she lists: Morton's logogen theory, Marslen-Wilson's cohort theory, Foster's autonomous speech model, Klatt's LAFS model, Cole and Jakimik's sequential word recognition model, Wickelgren's context-sensitive allophones model, Elman and McClelland's interactive-activation theory, Pisoni and Cutting's information-processing model, Foss, Harwood and Blank's "blackboard model", the analysis by synthesis model (espoused by Gósy herself) and models involving the motor theory. Some of the above references will be found in the REFERENCES list at the end of this book; for some see Gósy (1991).

An extensive review of speech perception models, in which word recognition and access models are embedded, is given by Klatt (1989). See also Blumstein (1980) and Johnson (1987).

in the processing of both spoken and printed words (in the sense of facilitating and/or slowing down the recognition and access procedures)⁷⁶, these claims are based on theory-internal and thus extremely diverse assumptions about what constitutes syllables and their components. Therefore, the interpretation of the experimental data is also theory-specific. The theories concerned here are basically theories of phonology married with certain psycholinguistic models, although one also finds generalities like "phonologically, morphologically, and orthographically defined syllables" (Burani and Cafiero 1991: 43, from Lima and Pollatsek 1983). In general word access studies, apart from the widely understood phonological⁷⁷ and psycholinguistic aspects, semantic and syntactic constraints are also investigated, and the potential or putative role of a unit-like syllable constitutes only a fraction of the results of these studies.

4.2.1.3. *The foot*

The term foot⁷⁸ has been used to refer to the unit of rhythm in poetry (poetic metre), in phonology (language metre) and in music. "[T]he term is taken from 'the movements of the human foot in its simplest form of progress' (Dale 1968: 211), i.e. its progressive raising and lowering" (Allen, W.S. 1973: 122). So understood, it could be applied to a minimal binary contrast either in the sphere of music or language. Since its function is that of 'beating time' (Allen, W.S. 1973: 122) to manifest a prosodic pattern (rather than formless succession), a foot must involve alternation (contrast) and cannot be a single element⁷⁹. It also cannot be a succession of two equally strong elements, since those would not involve contrast either; in this sense, a spondee cannot be a foot on its own.

Access to feet is guaranteed by the fact that it is generally impossible not to act rhythmically (cf. Allen, G.D. 1975), i.e. a preference for isochrony⁸⁰ and for the rhythmic structuring of a sequence in general is rooted in universal principles of human perceptual and motor behaviour. Indeed, the study of rhythm has been conducted not only in the realm of linguistics (including phonetics) but also in a much broader perspective, in connection with the rhythm of music and dance. Yamamoto (1996) claims, for instance, that there is a close relation between the rhythm of ethnic dance, music and language, in which a common underlying principle is that of a degree of muscular energy concentration, i.e. a clearly kinesthetic principle.⁸¹ "Rhythm is an indispensable element of all human languages, although rhythmic performance varies greatly across the languages of the world" (Fijałkowska 2000: 42). Rhythm can be broadly defined as "the structure of a sequence" (cf. Allen, G.D. 1975, Allen, G.D. and Hawkins 1980) consisting of not necessarily linguistic units. Humans possess strong motor-perceptual biases, which on the one hand constrain their production (in rate and pattern) and on the other impose structure on auditory sequences, even if the structure is physically not there. In speech, rhythm facilitates communication and intelligibility.

"Rhythmicity is inherently connected with beat and periodicity" (Fijałkowska 2000: 42). A simple metric pattern in which the metric beats are of the same phonological form and tend to be equally spaced in time has been termed *isochrony*. Traditionally, one differentiated between

⁷⁶ cf. e.g. Burani and Cafiero (1991), Cutler (1989); to be discussed in Chapter 15.

⁷⁷ cf. e.g. Frauenfelder and Lahiri (1989).

⁷⁸ **foot** (Crystal 1992: 140): Traditionally, a unit of rhythm in the metrical system of a language, described in terms of a sequence of stressed and unstressed syllables. Basic types: an iamb (an unstressed + stressed unit, e.g. *apart*), a trochee (a stressed + unstressed unit, e.g. *David*), a spondee (a two-stress unit, e.g. James Bond), a dactyl (a stressed unit + two unstressed, e.g. *Hilary*), and an anapest (two unstressed units + a stressed one, e.g. *disbelieve*). The notion is no longer restricted to metrics, but is used for the analysis of linguistic rhythm.

⁷⁹ But see below for a different approach.

⁸⁰ It is important to note that we talk about a *preference* for isochrony, and *not* about strict isochrony; cf. the discussion below.

⁸¹ This will be returned to in section 4.2.2.1. below.

two types of isochrony, i.e. "syllable-timing" and "stress-timing" (cf. Pike 1945, Abercrombie 1967; "isosyllabic" and "isoaccentual" in Donegan and Stampe 1983) and classified in the first group such languages as French, Telugu or Yoruba, and in the second - Russian, English or Arabic (Abercrombie 1967: 97)⁸². In 1983, Dauer gave the following classification based on the literature survey:

Stressed-timed languages: English, Russian, Germanic languages, Arabic, Thai (conversational), Brazilian Portuguese, Tibeto-Burman languages of Nepal: Newari, Chepang, Gurung, Tamang.

Syllable-timed languages: French, Spanish, Yoruba, Telugu, Hindi, Tamil, Indonesian, Japanese (a mora-timed language) (Dauer 1983: 56).

However, strict isochrony does not characterize the rhythm of language. Humans "merely perceive intervals between beats as isochronous" (Couper-Kuhlen 1985: 52); they adjust temporal intervals unconsciously, even if the actual length of those intervals varies considerably in production (cf. Roach 1999). The complexity of phonological rhythm does not lend itself to an easy description since the parameters involved in it (duration, pitch, loudness) participate simultaneously in other phonological contrasts. In the isochrony debate, one finds "believers" in isochrony and "disbelievers" - since they do not see acoustic evidence for it (cf. Couper-Kuhlen 1993: 5-14; see also Chapter 16⁸³). The traditional strict dichotomy between "syllable-timing" and "stress-timing" has been gradually replaced by the notion of rhythm understood as a continuum along which languages can be classified according to phonological criteria (cf. Roach's 1999 scalar approach: from maximally stress-timed to maximally syllable-timed). Bertinetto (1989), for instance, after having reviewed all existing types of phonetic and phonological approaches to the rhythmic dichotomy, suggests, rather than two opposite types of rhythm, "a single type with polar orientations, so that the various languages differ in terms of scalar deviations from the ideal prototype of pure isochrony (characterized by equal ISI⁸⁴)" (Bertinetto 1989: 121). Languages might differ, then, in terms of the "different degrees of flexibility they exhibit at all relevant levels of structure" (Bertinetto 1989: 123). The languages contrast since they possess to different degrees the features directing them more towards one of the two poles. The phonological features concerned, according to Bertinetto (1989: 108), are:

- (a) vowel reduction vs. full articulation in unstressed syllables;
- (b) relative uncertainty vs. certainty in syllable counting, at least in some cases;
- (c) tempo acceleration obtained (mainly) through compression of unstressed syllables vs. proportional compression;
- (d) complex syllable structure, with relatively uncertain syllable boundaries, vs. simple structure and well-defined boundaries;
- (e) tendency of stress to attract segmental material in order to build up heavy syllables vs. no such tendency;
- (f) relative flexibility in stress placement (cf. the "rhythm rule") vs. comparatively stronger rigidity of prominence;
- (g) relative density of secondary stresses, with the corresponding tendency towards short ISI, and (conversely) relative tolerance for large discrepancies in the extent of the ISI.

⁸² cf. also Roach (1982).

⁸³ For a comprehensive treatment of English speech rhythm, including a historical overview of the studies and the discussion of rhythm in general, see Couper-Kuhlen (1993).

⁸⁴ ISI = inter-stress interval

Bertinetto is among those researchers who emphasize the importance of experimental evidence in the investigation of isochrony. The new wave in experimental isochrony started with the discovery of perceptual centres or “P-centres”, i.e. reference points based on which listeners judge the timing of sequences. Closer inspection of the available results of the research on P-centers shows the relative unimportance of the syllable as opposed to words and feet in their determination (see Chapter 16 for the relevant discussion).

One of the most holistic interpretations of rhythm was suggested by Donegan and Stampe (1983), who see a close correlation between the isosyllabic vs. isoaccentual type of timing and such diverse aspects of language as a falling vs. rising phrase accent, syntactic word order, presence of case markers, position of affixes with respect to the word, as well as word accent, tone, syllable structure and vowel characteristics, and features of music and verse. As rightly noticed by Bertinetto (1989: 110), this proposal would be hard to test, but the line of research might be promising.

Halliday (1985) distinguished between "syllable-timing" and "pedalian rhythm" or "foot-timing" and noticed as well that feet *tend* only to be isochronous. Evidence for foot-timing, based on the evidence for a foot as a better perceptual unit than a syllable was found by Fijałkowska (2000: 82ff), according to whom, more and less prominent beats within a foot are easy to recognise due to their varied duration. In the syllable-timed pattern the units (beats/syllables) are of approximately equal duration; such a pure sequence of beats, some of which are more stressed than others, is insufficient for recognising their rhythmic structure. What a listener needs to successfully recognise and memorize an utterance rhythm is varying duration of its units. Division into feet makes prominent units recur at nearly equal periods, and this helps ordering them within the structure. The figure-and-ground principle (in this case best identifiable with the rich-get-richer principle) is thus observed much better in foot-timing (via a further sharpening of contrast) than in syllable-timing. Fijałkowska (2000) found empirical evidence for the above preference in the performance of Polish children, to whom she administered a learning task, with the assumption that the preferred rhythmic pattern helps in memorizing utterances. The subjects of the experiment preferred stress-timing to syllable-timing; they also preferred arhythmic pattern to syllable-timing.

Another approach to the unit foot in phonology is to see it as a unit of quantity, i.e. basically as a domain for stress assignment. This could be called a top-down approach (foot as a domain for something smaller), as opposed to a bottom-up approach described above (foot as a unit of something bigger). In standard metrical phonology (e.g. Hayes 1980), for instance, the quantitative trochee is defined as "a syllable of any weight followed by an optional light syllable" (Mester 1994: 2). This definition allows a single syllable (light or heavy) to constitute a foot. This is not compatible with the idea of the foot presented above, according to which a foot must involve a contrast, and thus cannot be a single element. However, when seen from a moraic perspective (e.g. Hayes 1987), the quantitative trochee consists of two morae, which may be manifested by a single heavy syllable (but not a light one). The moraic interpretation of the foot is thus more compatible with the rhythmic interpretation than the metrical one. This parallel may prove instrumental in distinguishing between quantity-sensitive and quantity-insensitive language types. Quantity-sensitive languages will be expected to have both types of feet, while quantity-insensitive ones, only the rhythmic feet. We will come back to this issue in the following sections.

4.2.1.3. *The mora*

Japanese is often referred to as a mora-timed language, i.e. a language in which morae are produced at approximately regular intervals. In Latin *mora* means 'time necessary, needed'. The concept of the mora as applied to language has meant:

Phonological measurement for a short syllable that consists of a short vowel and (at most) one consonant. Syllables with a long vowel or with a short vowel and two or more consonants consist of two morae. According to another definition, light syllables that end in a short consonant consist of one mora, while all other syllables are heavy and consist of two morae. (Bussmann 1996)

According to Martinet (1954), the concept of the mora is a purely analytical device, since it does not correspond to phonetic reality. As such, it facilitates a description of phonology in some languages (e.g., in Japanese or Ancient Greek) while not in others. The concept has been used both in traditional descriptions (cf. Allen, W.S. 1973 for some discussion) and in modern phonological models, known as moraic ones (e.g., Hyman 1985 or Hayes 1989). Beside the bimoraic treatment of heavy syllables, some admit tri-moraic superheavy syllables (i.e. with rhymes consisting of a long vowel and a consonant or short vowel and two consonants). Prevocalic consonants in the onset are nonmoraic, and thus cannot contribute to weight. Moraic models of the syllable have been partly competing, partly conflating with onset-rhyme models, both trying to account for such problematic issues as the weightlessness of onsets, long consonants and geminates or compensatory lengthening (cf. van der Hulst and Ritter 1999 for a thorough discussion).

4.2.1.4. *The beat*

In B&B phonology, the unit called *beat* will be proposed. A beat is a unit rather than a measurement or device (see the discussion of a mora above) and as such needs some referent in phonetic reality. It is expected to be better accessible than the mora, on the one hand, and the syllable, on the other. Its functioning in phonology in relationships with other units of structure called non-beats (these relationships are called bindings) is expected to account better for the structure than the functioning of mora or syllable.

Before defining a beat for the purposes of the present phonological model, let us inspect the entry 'beat' in the lexicon of English (OED) and in a linguistic dictionary (a dictionary of phonetics and phonology).

beat (OED):

- (the sound produced by) a regular sequence of strokes, e.g. of the heart, the pulse, a clock;
- a pulsation or periodic variation of amplitude produced by the combination of two sounds or other oscillations (e.g. radio waves) and slightly different frequencies;
- a unit of measurement of greater or lesser rhythmic accentuation (expressed as a certain number of beats to or in the bar);
- (the movement of a conductor's baton indicating) the principal recurring accent of a piece of music.

beat (Trask 1996):

1. the accent, stress or ictus in a metrical foot;
2. in grid versions of metrical phonology, any mark in the grid above the bottom (syllabic) level, representing a metrical unit which is 'strong' at that level.

Both definitions emphasize regularity and relative prominence in connection with the beat.

In Beats-and-Binding phonology, a **beat** is a *regularly recurring skeletal prosodic unit of phonological representation, of a size corresponding to that of a segment*. The most basic

organizational principle of a sequence is the alternation of beats (which are relatively more prominent) and non-beats (which are relatively less prominent). Beats and non-beats have direct phonetic correlates both in production and in perception.

To construct a useful signalling system out of sound, there must be some differentiation between different parts of the signal in time. It appears that a basic organization of this differentiation of sound in all (spoken) languages consists of an alternation between louder and quieter levels of sound, with a period not too far from 150-200 ms (Maddieson 1999: 2525).

This amounts to

[a] fairly regular wave-like alternation of amplitude peaks and valleys. The occurrence and timing of this pattern have been suggested to be related to a natural frequency of the jaw, which can be approximately equated with a comfortable mastication rate (Maddieson 1999: 2525).

More evidence for a beat comes from drawing a parallel between speech and music. Cohen (1978), not rejecting the syllable altogether, classifies the beat as a basic time unit. According to the degree of emphasis and acoustic information contained in them, beats are classified as accented or unaccented (Cohen 1978: 46). If one beats out the rhythm of a spoken phrase, the beginning of each stroke coincides with the beginning of a vowel, and not with the beginning of a syllable. In the experiment the author conducted the durations measured from one vowel to another were of almost equal length. Also, a link between a metrical beat and a musical beat has been shown: beats of metrical feet can be successfully replaced by musical beats in order to capture rhythmic structure of verse in musical notation.

Depending on a language, a beat will function in one or two capacities. In all languages, it is a unit of the rhythmic or timing tier: **the timing beat**. Recurring timing beats are what speakers are able to count and usually arrive at the same number of for a given word or sequence (traditionally, the number of syllables). Timing beats constitute rhythmic feet (cf. the discussion in section 4.2.1.2. above), i.e. feet which necessarily involve contrast between a stronger and a weaker beat. The timing beats may be weaker or stronger (a) intrinsically, i.e. depending on their inherent sonority value and (b) extrinsically, i.e. depending on the degree of stress assigned to them. In some languages, called quantity-sensitive languages, the other capacity is activated, i.e. that of a beat as a unit of weight: **the quantity beat**. The quantity beat is comparable in its function to the mora. (In a moraic framework, quantity beats would constitute quantitative moraic feet (cf. 4.2.1.3. above)). The number of quantity beats, counted from one timing beat to another (from **B** to **B**)⁸⁵ will decide about stress assignment in quantity-sensitive languages, and thus, basically, about their phonology. For instance, a CVC sequence (i.e. consonant + long vowel + consonant) corresponds to a non-beat + beat + non-beat sequence (i.e. {**nBn**}, where **B** = a timing beat) on the timing/rhythmic tier. In a quantity-sensitive language, however, the same sequence corresponds also to three quantity beats of the weight tier: a long vowel corresponds to two quantity beats (**b+b**), while the final consonant counts as the third one (in which case the

⁸⁵ For instance, if you analyze the candidates for stress in the English word *window*, counting from the first **B** up to the second gives 3 **b**'s (*ind*), counting from the second up to the end of the word gives 2 **b**'s (*ow*), thus stress falls on the first **B**. Similarly, the number of **b**'s decides about stress assignment in *under*, *other* or *alone*. In such words stress is fixed and doesn't shift. However, the number of quantity beats is not the only criterion of stress assignment in English. Among others, a **B←n** binding (see below 4.2.3.) is conducive of assigning stress to the **B** concerned, especially if it does not cooccur with the **n→B** binding, as in *enough* (2**b**'s vs. 2**b**'s, but the second **B←n** binding alone) or *thirteen* (3**b**'s vs. 3**b**'s, but the second **B←n** binding alone).

sequence becomes superheavy (**b+b+b**), in syllable terms). In this way a quantity beat constitutes a weight unit, just as a mora does in a moraic framework. Graphically, the structure may be represented as follows:

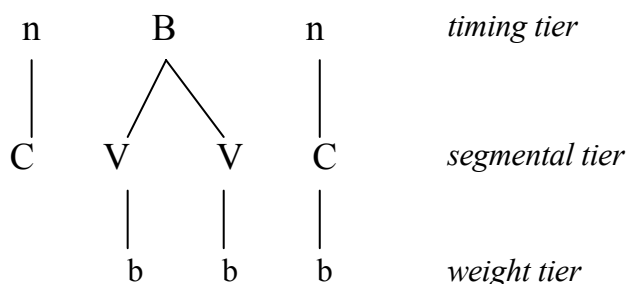


Figure 3.

Counting, thus, proceeds according to the following pattern:

$$\check{V} = b$$

$$\bar{V} = b+b$$

$$C = b$$

In Beats-and-Binding phonology, neither syllables nor morae are of need (unless insisted upon as epiphenomenal), since both rhythmic and quantitative phenomena are expressed in terms of beats. In a quantity-insensitive language, speakers count timing beats (**B**) only; in a quantity-sensitive language, speakers count both timing beats (**B**) and quantity beats (**b**). In so-called mora-timed languages, speakers count quantity beats (**b**) only. One can immediately predict that the latter are going to be at a disadvantage with reference to the other two groups of speakers with reference to second language acquisition. The controversial typology of syllable- vs. stress- vs. mora-timing is modified in the B&B phonology to refer to varying sensitivity to beats in the speakers of respective languages.

Below, whenever the term **beat** is used, it is to be understood as the generic timing beat, unless otherwise specified.

4.2.2. Universal preferences involving beats

There are a number of preferences which specify the patterning, strength and realization of beats in a sequence.

4.2.2.1. The preference for a trochee.

Beats in a sequence constitute feet, i.e. basic structural units of rhythm, both in speech and in music. There is a universal preference for two beats per foot: the former beat is preferably strong, the latter - weak, i.e. they constitute a trochee (a metrically falling accent). Three aspects of the above statement require some discussion: (a) the preference for a trochaic foot pattern, (b) the preference for a binary foot pattern and (c) a parallel to music:

4.2.2.1.(a) The preference for a trochaic foot is well-established in phonological theory and there exists a very rich literature on the subject, including some works denying the preference (e.g. Vihman et al. 1998). Interestingly, in metrical frameworks (cf. also 4.2.1.2. above), one

distinguishes between the standard trochee [$\sigma(\tilde{\sigma})$] and the moraic trochee [$\mu \mu$], i.e. "either a sequence of two light syllables or a single heavy syllable" (Mester 1994: 2). The latter is constrained by bimoraic minimality (no monomoraic feet) and bimoraic maximality (no trimoraic feet) conditions (Hayes 1987 in Mester 1994). Although both types of the trochee are understood as quantitative in metrical terms, in Beats-and-Binding terms they would be constituted by the timing beats vs. the quantity beats respectively. The widely acknowledged trochaic preference, however, in most cases refers to the patterning of the timing beats.⁸⁶

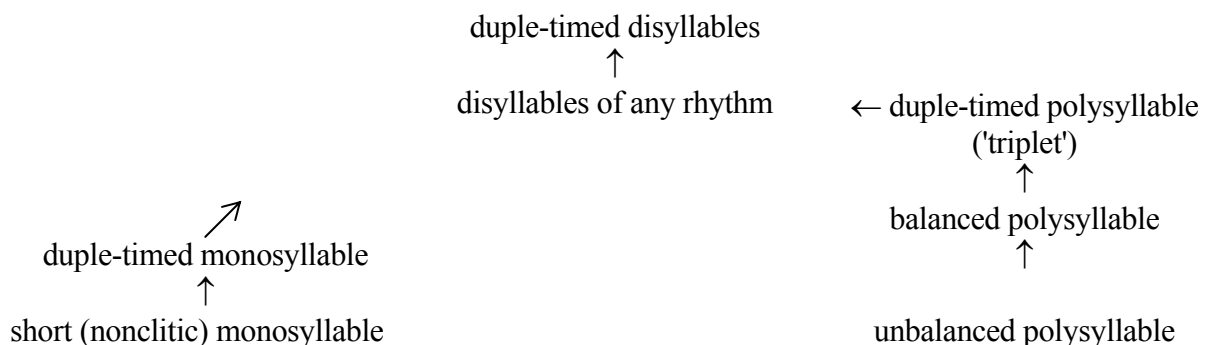
For instance, Dogil (1980) suggests the Trochaic Projection Constraint (1980: 92) to account for elementary accent systems of the world's languages due to the existing internal evidence (89ff). He sums up extensive external evidence for this constraint which comes from a variety of sources (Dogil 1980: 92f):

- a trochaic principle was suggested for the process of the "grammaticalization of intonation" (Hyman 1977 and Bolinger 1978);
- the natural metric of children's words was argued to be trochaic (Allen and Hawkins 1979, but compare Vihman et al. 1998; see also Chapter 10 of the present book);
- the falling intonation was observed to be acquired first in a pre-lexical stage of L1 acquisition and realized over the span of time corresponding to two syllables of adult language (Crystal 1979 and others);
- a tendency for two syllables per word was noticed for African Pidgins, Chinese and Melanesian Pidgin English (Manessy 1977);
- aphasics were noted to regularize their speech output towards a trochee, e.g. *September* -> `sem,te (Dressler pers.comm.) and to perceive trochaically patterned sequences better (Mierzejewska pers.comm.), (cf. Chapter 12 of the present book);
- tongue twisters of a trochaic form are simpler than others, e.g. *Fischers Fritze fischte frische Fische* vs. *Fischers Fritz fischt frische Fische*.

Hurch (1996) discusses the preference of "falling patterns of the trochaic-dactylic structure" over "rising patterns of the iambic-anapaestic structure". Examples of the evidence he quotes are, for instance:

- quantitative adaptations like 'iambic shortening' in Latin *míhi*: > *míhi*, or
- 'iambic reversal' (Liberman and Prince 1977) as in *New Yórk Cítý* -> *Néw York Cítý*, which illustrates the tendency to resolve accent clashes towards a falling pattern (discussed, of course, also by many others, e.g. Dressler 1990: 81, also with reference to (b) below).⁸⁷

Miller (1978) proposed the following rhythm-preference hierarchy, with optimality increasing towards the top:



⁸⁶ This, however, does not preclude the potential of widening of its scope to the patterning of quantity beats as well.

⁸⁷ On a language-specific level, English has been repeatedly noted to be a 'trochaic' language (Allen and Hawkins 1980, Allen 1975, Allen and Hawkins 1979, Chomsky and Halle 1968, Martin 1972).

Miller (1978, 1993) provided numerous examples from Greek and Latin as well as from some other languages, e.g. Hungarian, of what Allen (1973) calls 'moric balance', i.e. both reductions towards the trochee of longer sequences and avoidance of monosyllables.

4.2.2.1.(b) The preference for a binary foot structure can be subsumed under the general preference for binary paradigmatic and syntagmatic contrasts (Dressler 1990: 81, 85; 1996), which is neurologically based (cf. the binary choice between presence and absence of a neural firing) and also reflects a semiotic principle of figure-and-ground, best realizable through a binary contrast. Thus, two-beat prosodic feet are preferred over pluri-beat or mono-beat ones (and adjacent figures are avoided). Correspondingly, two-beat words are preferred over three-beat and mono-beat ones.

Binary branching in accentual systems is supported by the following internal evidence (Dogil 1980: 94; 90f):

- penultimate and final accents never co-occur in the same word;
- penultimate and initial accents can co-occur only on words consisting of at least four beats;
- in many languages a primary stress is echoed (as a secondary stress) on successive, odd-numbered beats, e.g. in Czech or in Dyirbal the primary initial stress is echoed in this manner.

Hurch (1996) mentions additionally processes which lead to the reduction of three-beat feet to binary ones: syncopation and apocopation, both in diachrony, e.g. Lat. *géneru* > Sp. *yerno*, Lat. *dómina* > It. *donna*, Lat. *mánicu* > Prov. *manje*, Fr. *manche*, and in synchrony, e.g. *family* -> *family*, *interest* -> *interest*.

4.2.2.1.(c) According to the holistic interpretation of rhythm by Donegan and Stampe (1983: 350), "in verse and music, the ideal form of the language is manifest". They wonder whether this could be due to the parallel dichotomization of verse and music on the one hand, and language, on the other, into falling vs. rising types. The analogy between rhythm in music, verse and language can undeniably be drawn (cf. also 4.2.1.2.). One can talk about a common cognitive origin of the metrical structures underlying speech, music and verse (cf. e.g. Lerdahl and Jackendoff's generative theory of music as discussed by Couper-Kuhlen 1993: 103ff). Lindsey and Gil (1991) outline a theory of tonal interpretation which posits a common tonal faculty for both music and language, independent of both the music faculty and language faculty. They assume a modular organization of the mind, within the cognitive spirit of Chomsky. Panagl (manuscript) presents a compact overview of research on the relationship between language and music, listing possible arguments supporting the analogy, reviewing linguistic notions used in the study of music, and warning against "faux amis".

Musicians, when asked about the basic rhythmic pattern underlying sequences of notes in a musical score, answer usually with a two-fourths tactus, less frequently with a three-fourths one. It is exactly this metrical level of classic Western music which is more prominent than others: "this is often the meter in which the piece is notated, the level at which performers tap their feet, and the one at which the conductor waves his/her baton" (Couper-Kuhlen 1993: 105). And this meter "happens to be" or rather, is predictably analogous to the one preferred in speech: strong beats are spaced uniformly at either two or three beats apart.

Monteverdi introduced three types of singing in his operas (cf. an article in Bühne 1993): (1) spoken (recited) singing (*das sprechende Singen*, *cantar recitando*, *Rezitativ*), (2) chanted (sung reciting) (*das singende Sprechen*, *recitar cantando*, *Accompagnato*) and (3) pure singing (*das reine Singen*, *Belcanto*, *Arie*). In recited singing (1), the note values are sung, but the rhythm of speech remains in the foreground. In sung reciting (2), the general bass has the function of supporting words. The meter is four-fourths. Pure singing (3) is noted in the three-

fourths meter, and the melody is decisive, since often several notes are sung over one "syllable". This seems to point out to a parallelism between the meter underlying speech and music (two or four quarters) as opposed to singing (three quarters).

Rhythm is regarded as the primary element of music, prior to its remaining constituents. There are many cultures expressing their music solely by means of rhythm. "Many cultures do not know harmony, some may not even know melody but each one knows rhythm" (Vincent d'Indy 1902 in Rudziński 1987: 32), (Fijałkowska 2000: 8).

As pointed out by Fijałkowska, "the [r]hythmic pattern of spoken language is the key structure upon which the rhythm of a musical piece is usually based." (Fijałkowska 2000: 20). She provides numerous illustrations of this relation: recitative, Romantic song, Polish folk music with laments, nursery rhymes and merchant calls, African speaking drums, American jazz scat singing, Indian drumming systems, Nubian rhythm-based music and Japanese theatrical performance. According to Halliday (1985: 10), "in all probability the structure of the musical composition is itself, in origin, an elaboration of the intonation and rhythm of natural spoken language". The analogy goes further to dance and body movement in general, which in turn lie at the background of the speech rhythm (cf. an elaborate discussion of these issues in Yamamoto (1996). He claims a direct intracultural relation between the language, music and dance of a given ethnic group sharing the same culture. In this connection he derives a two-fold typology of rhythm, i.e. duple-time and triple-time rhythm. "In primitive music, two-fourth or binary time prevails, unless some surplus syllable in the text expands it in ternary time" (Sachs 1962: 114 quoted by Yamamoto 1996). Yamamoto claims further that in the present world all human beings share duple-time rhythm, while triple-time is characteristic of the speakers of stress-timed languages⁸⁸. This confirms both the trochaic preference and the binarity one ((a) and (b) above) while also leaves space for quantity-sensitivity.

4.2.2.2. *Preference for the vocalic beat.*

A beat (henceforth notated as 'B') is realized by a sound which is traditionally referred to as a syllable nucleus; preferentially, it is a vowel (notated as 'V'); secondarily, a consonant (notated as 'C') may acquire the function of beat. A vowel is a better candidate for a beat due to its saliency potential based on its high sonority value and articulatory openness. Therefore, those consonants which possess the latter two features to a higher extent qualify better for a beat than do others.

A vocalic beat, however, is also qualitatively different from a consonantal beat. Although consonants and vowels continue along the same parameter of sonority in a quantitative sense, they are separated as categories by a qualitative border-line, constituted by the parameters of noise/obstruction and laryngeal activity. This is an implicit explanation of the term '*consonantal strength*' (emphasis mine), applied by Vennemann (1988: 8) in the sense of: "a phonetic parameter of degree of deviation from unimpeded (voiced) air flow", although the parameter is used to hierarchize both consonants and vowels. The qualitative difference between a consonant and a vowel implies that the contrast between a consonant and a vowel is always more salient than the one between two consonants, even in the case of the same sonority distance obtaining in the respective pairs. Notice also that two vocalic beats can be adjacent (e.g. Pol. *aorta*), while consonantal beats always need a support of adjacent consonant(s).

⁸⁸ Thus, for instance, the Anglo-Saxons have triple-time rhythm in addition to duple-time, while the Japanese have only the latter.

4.2.2.3. Preference for the alternation between beats and non-beats.

In accordance with the semiotic principle of figure and ground (cf. Dressler 1985; see Chapter 2, 2.2.5.), a hiatus between two beats is avoided by means of inserting a non-beat (henceforth notated as 'n') in between, i.e. a consonant. Only in this way do the figures, i.e. beats (B), receive a necessary ground, i.e. non-beats (n), in the form of consonants (cf. also 4.2.1.3.).

So, thanks to the preferences 4.2.2.1., 4.2.2.2. and 4.2.2.3., speech flow consists of beats and non-beats, which are phonetically realized by perceptually and articulatorily contrasting sounds - vowels and consonants respectively.

4.2.3. Bindings

4.2.3.1. Types of bindings.

Beats (B) and non-beats (n) in a sequence are joined by means of sonority-based bindings. The bindings are binary, i.e., e.g. in a sequence {**BnB**} there are maximally two bindings, i.e. a **B←n** binding (a non-beat is bound to the preceding beat) and an **n→B** binding (a non-beat is bound to the following beat), i.e. {**B←n n→B**}. A beat, however, may potentially stay alone while a non-beat must be bound to a beat. Thus, in the {**BnB**} sequence there may alternatively be one binding only, combined with a single beat, i.e. either {**B n→B**} or {**B←n B**}.

Bindings in a sequence are binary; sound sequences are combinations of two basic binary bindings: **n→B** and **B←n** (and, possibly, single beats). The binarity of two basic bindings themselves refers to the principle of contrast, in this case an optimal perceptual contrast between a beat and non-beat, measured by sonority (cf. below Section 4.2.3.2.), which is best realizable by two contrasting elements (for binarity cf. 4.2.2.1.(b) above). Bindings are thus perceptually motivated

Bindings have a basis not only in the perception of speech, but also in general perception. For an act of perceiving to take place we need to see, hear, sense or taste a figure against a ground (cf. again the semiotic principle of figure and ground; see Chapter 2, 2.2.5.), i.e. we need a binary contrast between the elements we are exposed to. What we then perceive is BOTH a figure and a ground, not as a unit, but as two bound elements, the binding between which is a necessary prerequisite for successful perception. The bigger the contrast, the better we perceive, and thus the stronger the attraction between the two elements⁸⁹.

4.2.3.2. The strength of bindings.

The two bindings differ in strength: the **n→B** binding, i.e. the binding of a non-beat to the following beat (preferentially realized by a /CV/ sequence), is always stronger than the **B←n** binding, i.e. the binding of a non-beat to the preceding beat (preferentially realized by a /VC/ sequence). I.e.: **n→B** > (stronger than) **B←n**.

This preference refers to the position of a non-beat with respect to the beat: sonority distances between a non-beat and a beat being equal, the non-beat *preceding* the beat is bound more strongly to it than the one following. An acoustic phonetic basis for the preference consists

89 One could argue further for the reality of binary bindings between contrasting elements by reference to a general principle of attraction of opposites taken from the natural sciences. For example, opposite potentials (physics) or opposite sexes (biology).

in the observation that acoustic modulations in a consonant-vowel transition can be much better perceived than in a vowel-consonant one. To quote Ohala and Kawasaki (1984: 117): "it is generally the case that the most salient acoustic modulations in a syllable occur near the CV interface" and (1984: 118): "auditory cues present in CV's are more robust than those in VC's". Also articulatory factors contribute to a better perception of CV's. As Ohala (1990b: 265) put it: "since there is a richer, more reliable set of place cues in the CV transition than the VC transition, listeners weight the former more heavily than the latter in deciding what they've heard." And, on the speaker's side, according to Ohala and Kawasaki (1984: 119): "the speaker actively tries to create temporally more well defined, more precise, articulations near the CV as opposed to VC interface."⁹⁰

Preference for the **n→B** binding is best reflected in the universal prototypicality of the CV sequence in phonology. The preference for a binding, though, is not equivalent to the preference for a CV-syllable, since:

- the preferred binding may also be realized by a CC sequence, with a *consonantal* beat;
- the preferred binding may arise due to the reduction of a consonant neighbouring on a vowel in a CCV sequence, thus *not* preserving the CV-syllable, but a CV sequence;
- the preference for the **n→B** binding is valid also in those languages which do not prefer CV-syllables, i.e. the languages which have tripositional syllables (cf. Noske 1989 and 1993, who argues that West Germanic languages and languages like Wiyot and Navaho have tripositional syllables, while others have bipositional ones).

There is a lot of phonetic and phonological evidence for the prototypicality of a CV-syllable, which in fact refers to the prototypicality of the CV sequence, and thus, supports the preference for the **n→B** binding. Below I will summarize the evidence, which comes from divergent sources: Dogil and Braun (1988: 13f), Dogil and Luschützky (1990: 22f), Edwards and Shriberg (1983), Bell and Hooper (1978: 8ff), Pulgram (1970), Krupa (1973: 55f), Krupa (1968: 26ff).

1. According to Maddieson's (1984) survey⁹¹, there is no language which does not have CV's, but there are many languages which have only CV's (see Bell and Hooper 1978: 9, who admit only a few near misses, e.g. Piro). Polynesian languages (i.e. Easter Island, Hawaiian, Tahitian, Tuamotuan, Rarotongan, Maori, Samoan and Tongan) are widely accepted as CV-languages, i.e. the languages in which only open syllables of a (C)V type are admitted (cf. Krupa 1973). In Maori (cf. Krupa 1968), apart from (C)V, a (C)VV sequence is also frequent, i.e. a consonant followed by two identical vowels (but never followed by another consonant). Diachronically, however, this vowel hiatus is a consequence of a loss of the intervocalic consonant in the development from Proto-Austronesian, e.g. *too* 'stem' < ^c *tebu*, *raa* 'sail' < ^c *layaR*, *hoo* 'give' < ^c *beRay*. Some other CV-languages are: Kpelle (Liberia), Aymara (Bolivia), Ga (Ghana), Igbo (Nigeria), Yoruba (Nigeria), Beembe (the Congo), Guaraní (E. Paraguay), Malagasy (Madagascar).⁹²
2. CV's are acquired first in first language acquisition (cf. e.g. Allen 1981, Moskovitz 1971, Ingram 1978, Locke 1983). Edwards and Shriberg (1983) give the following examples from early speech: *dog* [da], *block* [ba], *blue* [bølu].⁹³
3. CV's are preserved in the speech of aphasics (cf. e.g. Dogil 1984).⁹⁴
4. Phonological restructuring in diachrony tends towards the creation of CV's (cf. e.g. Kisseberth 1970, Ohala and Kawasaki 1984; see Part III).

⁹⁰ NB, the same kind of acoustic-articulatory criteria contribute to the subjective sensation of sonority itself. Still, the sonority scale has traditionally been describing segments independently of their position with respect to other segments in a sequence.

⁹¹ cf. also Jakobson's universals.

⁹² For a discussion of phonotactics of consonantal clusters see Chapter 5.

⁹³ For a discussion of the order of acquired structures in L1 acquisition see Part IV, Chapter 10.

⁹⁴ For a discussion of the structures found in aphasic speech see Part IV, Chapter 12.

5. Also synchronic variation often leads to the creation of CV's, either through consonant reduction (e.g. *often*: VCCVC -> VCVC) or vowel epenthesis (e.g. *film*: CVCC -> CVCVC). Sandhi processes (hiatus-breakers and others) also result in the formation of CV's, e.g. in English linking and intrusive 'r', contraction and others (e.g. *far away* -> *fa[rə]way*; *law and order* -> *law [rə]nd order*; *you are* -> [jɔ:]; *an ear* -> a[nɪ]ar).
6. There exists rich phonetic evidence for the prototypicality of the CV sequence (already mentioned at the beginning of this section; see further among others Chapter 16): (a) Consonant and vowel constitute an ideal articulatory contrast between closed and open vocal tract. (b) The "p-centre" is situated close to the CV transition. (c) Perceptual classification of stops by place of articulation has been proven to proceed much better in CV's than in VC's. (d) In the case of vowels preceded and followed by identical consonants (like *pap*, *bab* etc.), the initial and final transitions are not symmetrical. Only the parameters of the initial transition may be successfully used as features of the adjacent (preceding) consonant place of articulation. (e) Listeners tend to follow the CV cues, if the cues are different at VC and CV transitions. (f) Speakers are more precise at the CV interface.
7. The typology of segment sequences allowed in the languages of the world points not only to a special status for the CV sequence, but also to the implicational relation between more complex and simpler structures. Pulgram (1970) supplies substantial phonotactic data which illustrate the above. The data will be referred to in Chapter 6.

4.2.3.3. *The measure of bindings: sonority.*

A subjective perceptual measure of contrast between a beat and a non-beat is constituted by sonority. Beats are uniformly more sonorous than non-beats. In objective terms, it is the degree of modulation⁹⁵ in several acoustic parameters (amplitude, periodicity, spectral shape, F0; cf. Ohala 1990a) that decides whether an **n**→**B** binding is actually realized as stronger than a **B**←**n** one (cf. 4.2.3.2. and footnote 22).

Actual distances between segments in terms of sonority become relevant for phonotactics. Sonority is a relative measure of distances between consonants and vowels, the values of which decide the fate of segments in a phonotactic sequence. The universally preferred values of distances between segments in a sequence measured in sonority (i.e. phonotactic preferences) will be derived in Chapter 5. The notion of sonority itself appeared repeatedly in a report on the history of research on the syllable in Chapter 3.

Although segments are ordered along the sonority scale or hierarchy (or, indeed, strength hierarchy⁹⁶), there is no transparent phonetic criterion (nor a set of them) which would unambiguously line up phonetic segments to match the scale. There exist candidates which could possibly serve as such phonetic criteria, for instance a degree of articulatory opening, acoustic intensity or a degree of auditory distinctiveness, none of which, however, seems to work in all cases (cf. Dogil and Luschützky 1990⁹⁷: 15-17). This state of affairs disturbs many phoneticians and some phonologists. Both groups also tend to express concern about the insufficient predictability force of the traditional sonority sequencing principle⁹⁸. Suggested solutions oscillate between totally rejecting sonority (cf. Ohala 1990), deriving it from other features (e.g.

⁹⁵ As Ohala (1990) notices, larger modulations have more survival value than lesser ones and therefore will persist in languages

⁹⁶ See e.g. Dogil and Luschützky (1990) for a discussion of both strength and sonority.

⁹⁷ Dogil and Luschützky (1990) derive sonority from the branchedness of the feature structure.

⁹⁸ See Clements (1988) for an extensive historical overview of the relevant research.

Dogil and Luschützky 1990, Clements 1988, Rice 1992) or amending it with other criteria (e.g. Rice 1992, Butt 1992). My approach classifies with the latter type of solutions in a sense which is programmatic in natural linguistics: never rely on one criterion only in explaining linguistic structure; instead, identify relevant criteria and discover their hierarchy or a set of available solutions provided by them. Thus, distances of sonority (understood as a default intrinsic property of a phonological segment) between segments constitute a listener-friendly side of phonotactics. A speaker also has a say, though. This approach may be supported by Maddieson's (1999) approach to 'strength of articulation' of consonants:

Differences in articulator height, one possible index of articulatory force, are principally allied with distinctions in 'sonority' - particularly between the aerodynamic states which characterize stops, fricatives and approximants. This seems a dominant use of articulator height. Internal to such a sonority class, 'strength' differences seem to be *subordinate* (emphasis mine)(...) Maddieson's (1999: 1965).

Maddieson proposes a principle of *subordination* of physical differences between segments on a given measure to another parameter (or indeed the same but more salient) which supports the distinction more clearly. So, for instance, strong vs. weak distinction among consonants is usually subordinate to a contrast of voicing or duration (gemination). However, in some languages strength is not a subordinate: Maddieson shows that in Dagestani languages Dargi and Archi, strength distinction in fricatives, realized by variation of constriction degree, is not a subordinate of laryngeal settings. Indeed, the escape channel shown on a palatogram for a weak fricative is much wider than that of a strong one, and the difference is significant. In terms of sonority one could say that those languages distinguish between more and less sonorous fricatives, while in other languages such fine distinction is subordinate to the more salient distinction between fricatives and less sonorous stops on the one hand, and fricatives and more sonorous approximants, on the other. The principle of subordination may help explain specific solutions taken up across languages.

4.2.4. Universal articulatory preferences

Two main functions of phonology: to serve clarity of perception and ease of articulation, are reflected in perceptual, listener-friendly preferences, on the one hand, and in articulatory, speaker-friendly preferences, on the other. Thus, besides the perceptually based preferences concerning phonological structure, there operate also speaker-friendly preferences for articulatorily easy phonotactic sequences. According to a well-known study by Janson (1986: 193), favoured combinations are those in which the articulators do not have to make extensive movements from the consonant gesture to the vowel gesture. He found the following sequences to be favoured: *dental/alveolar consonant + front vowel; liquid + front vowel; labial consonant + back rounded vowel; velar consonant + back rounded vowel.*

While contrast is an underlying principle for perceptual preferences (cf. the figure-and-ground principle), similarity underlines the articulatory preferences (cf. the proximity law, Chapter 2).

4.2.5. The universal tendency for balance between perceptual and articulatory preferences.

Conflicts among universal preferences, and especially those between listener-friendly and speaker-friendly preferences, are mediated by the major tendency for balance (cf. Maddieson

1992)⁹⁹, which is realized on a language-specific level. Thus, besides the bindings and preferred sonority distances between segments (listener-friendly), articulatory adjustments between segments are possible (speaker-friendly), which eventually also serve the listener. Conflict solutions are implemented language-specifically to establish language-specific or typological relationships between bindings, phonotactic preferences and articulatory preferences.

In order to account for the structure of sequences, phoneticians have tended to assign priority either to articulatory or to acoustic criteria. So, for example, Janson's (1986) results (cf. above) appear to contradict Kawasaki's (1982) claim about the primacy of acoustic distinctiveness in the creation of sound sequences. For instance, /w/ and labialized consonants tend NOT to be followed by a rounded vowel or /j/ and palatalized consonants tend NOT to be followed by front vowels, due to insufficient auditory contrast in these sequences. Instead of treating the above as a contradiction, one should assume the principle of balance between acoustic and articulatory criteria which leads to the creation of optimal sequences. This approach has been to various degrees represented e.g. by Lindblom (1986 and later), Ohala (1990), and Maddieson (1992), Maddieson and Precoda (1991), Lindblom and Maddieson (1988). The last of these state, for example, that "Consonant inventories tend to evolve so as to achieve maximal perceptual distinctiveness at minimum articulatory cost" (72). In the present work, the effectiveness and optimality of the balanced solutions are and will be emphasized, which is clearly possible within a functional approach to phonology advocated by the natural framework.

4.2.6. A suggested scenario for the structuring of phonology

The scenario which I want to propose does not aspire to solve the eternal "chicken or egg" problem in the ontogeny of speech. I assume the problem to be unresolvable and, moreover, to be largely irrelevant to the discussion of a probable synchronic scenario of structure creation in phonology. Also interpretations of diachrony are immune to the "question of origin", since both $A \rightarrow B$ and $B \rightarrow A$ changes are observable, and the best one can do is to state the preferred direction.

4.2.6.1. "Rhythm comes first."

Rhythmic preferences form the skeleton for phonological structures. This is well evidenced both in first language acquisition with a foot as the first unit acquired and in other areas of external evidence, for instance in aphasia or phonostylistics with rhythmicization towards a simple trochaic foot (see Part IV, Chapters 10, 12, 14). Foot-timing is a default unmarked rhythm. Typologically, languages diverge from the default either in the direction of prototypical stress-timing or in the direction of prototypical beat-timing. The type of isochrony is compatible with types of bindings obtaining in a sequence.

(a) *beat-timing*: in an $\{nBnB\}$ sequence (phonemically preferably /CVCV/) there is no $B \leftarrow n$ binding (in /VC/), i.e. the sequence contains only two out of the possible three bindings (two $n \rightarrow B$ bindings).

In first language acquisition, the bindings come into being according to the principle of contrast, i.e. $n \rightarrow B$ arises before $B \leftarrow n$ (cf. the strength of bindings, 4.2.3.2.). They combine also accordingly, i.e. firstly $n \rightarrow B$ with $n \rightarrow B$ to produce an $\{nBnB\}$ sequence, which figures a potential place for the other binding, $B \leftarrow n$, to develop. This pattern of development has been observed e.g. in Polynesian languages, in which "the bulk of the morph stock consists of bivocalic morphs (pattern (C)V(C)V)" (Krupa 1973: 56), while a peripheral, deviant pattern

⁹⁹ But see also Maddieson (1999) for a more cautious approach to the idea of balanced inventories of consonants and vowels in the world's languages.

(C)VC is a truncated variant of the former¹⁰⁰. Cross-linguistically, there exist many more restrictions on the consonant in a post-vocalic (word-final) position than in an initial position. For instance, Telugu allows only a sonorant, a glide or /s/ in a /CVC/ word. A /CVC/ may also originate due to morphological and sandhi rules, e.g. in Telugu: *mana + to = manto*: 'with us', *win + a + nu = winnu*: 'I won't listen' (Auer 1991: 300)¹⁰¹.

Traditional CV-languages (cf. 4.2.3.2.), i.e. the languages which lack clusters of consonants, which often have tones and develop at the most pitch-accent, possess this characteristic of *not having* a **B←n** binding in their phonology, which has been traditionally accounted for by means of right-syllabifying word medial consonants (i.e. by the lack of ambisyllabicity).

As a consequence of the lack of an internal **B←n** binding, one expects no weakening of an intervocalic consonant in this type of language¹⁰², since the consonant participates in an **n→B** binding and hence: (i) needs to stay strong; (ii) needs to stay at all to protect the sequence from hiatus. The internal consonant has the same status as the initial one with reference to binding in the sequence discussed, and is not expected to weaken or delete, just like the initial one is not expected to do so. The initial non-beat (consonant) is additionally protected due to its word-initial position (cf. below Section 4.2.7.). The described phenomenon is well reflected, for instance, in a reluctance towards assimilations in true beat-timed languages. Another consequence of the lack of a **B←n** binding is a difficulty in the identification of word boundaries: indeed, a word-internal {**nB**} sequence differs from a word-initial {**nB**} sequence only by not being word-initial. The phonotactic potential of both non-beats is comparable: there are no more restrictions on the word-internal consonant than on the word-initial one.

Languages of this type need some other ways of fulfilling the linguistic function of distinctivity, otherwise served by the missing bindings, e.g. complex tonal systems. Prototypical beat-timed languages are thus predicted to develop tonal systems. This is confirmed by the results of Gil's (1986) study on a prosodic typology of languages, which show that simple segmental structures cooccur with phonemic tonal distinctions (211f) (incongruing with the predictions of Gil's prosodic typology). He points to a trade-off relation between segmental and tonal structure: either a CVC or a CV with a tone, i.e., in our terms, either a **B←n** binding or a tone.

(b) towards stress-timing: *non-prototypical beat-timing*: in an {**nBnB**} sequence (phonemically preferably /CVCV/) stress develops¹⁰³.

In first language acquisition this process begins with a regularization of rhythm towards a trochee, i.e. the first beat of a {**nBnB**} sequence grows more prominent: {**nBnB**}. In this way, stress-timing gradually develops. Now the second beat gets weaker: {**nBnB**} and it may even elide: {**nBn**}. Consequently, a binding **B←n** (in /VC/) is necessary (a non-beat cannot stand alone), and possibly also an additional quantity beat **b** (as a result of compensation for the lost

¹⁰⁰ Japanese also disallows a **B←n** binding. Therefore, the possible underlying origin of a sequence /CVC/, as in Nippon, is that the final consonant is a remnant of an **n→B** binding, with a beat unrealized phonemically. Thus, the consonant may function now as a separate quantity beat **b**.

¹⁰¹ Telugu appears to be a non-prototypical beat-timed language (see (b)).

¹⁰² A strengthening, on the other hand, is possible, just as always in the case of a consonant in an **n→B** binding position. Word-internal strengthenings - in "internal syllable-initial position" - cause interpretational difficulties within syllable frameworks, since they are expected only in word-initial position. (Hock 1992 claims that initial strengthenings are restricted to sonorants and occur only if medial obstruents, but not sonorants, weaken as well - cf. Luschützky 1993: 180ff.)

An example of such a problematic case from Spanish is cited by Luschützky (1993: 184, Note 3) after Harris-Northall (1990: 53): "There are even sporadic examples of this [onset strengthening] in internal syllable-initial position: *mangual* < MANUALE, *menguar* < MINUARE." In the B&B model, this is explained with the lack of a **B←n** binding, and thus the equal status of an intervocalic and initial consonant.

¹⁰³ Again, I make no claim as to which comes first: stress or a segmental configuration assumed to condition it.

beat; the first beat may thus count as two quantity beats **b+b**). In segmental terms, the described change assumes the following structure:

/CVCV/ → /CVC(V)/ → /CV:C/ or /CVvC/ (where /Vv/ signifies a diphthong)¹⁰⁴.

The appearance of a **B←n** binding in an {**nBnB**} sequence marks a beginning of quantity distinctions, due to which stress is traditionally interpreted to be conditioned by the so-called heavy syllable: in our terms, two neighbouring quantity beats **b+b** (which either obtain by lengthening of the beat participating in a **B←n** binding or by counting the non-beat as **b**). Also it is at this point that an intervocalic consonant comes to be traditionally interpreted as ambisyllabic: it now participates in two bindings. Phonotactically it is much more restricted than the word initial, prevocalic one. For example, !xóõ (a Bushman language, spoken in the south-west of Botswana and in Namibia) admits all consonants in an initial position of a phonological word (about 119!) and only six (!) consonants in an intervocalic position. Also the second vowel position is restricted, which would point to the trochaic nature of the word (cf. Auer 1994: 63).

Languages of the non-prototypical beat-timing type demonstrate a **B←n** binding, but at the same time they strongly favour an **n→B** binding. This is why they might show some quantity-sensitive stress (like Italian¹⁰⁵), and yet have phonological rules enhancing **n→B** bindings, (French, Italian). Therefore, a difficulty with the identification of word boundaries mentioned above with reference to prototypical beat-timed languages (see (a)) remains a feature of the non-prototypical ones, too¹⁰⁶.

(c) *non-prototypical stress-timing*: if the development sketched above goes in the direction of vowel deletion (deletion, and not reduction to schwa), so that consonantal clusters come into being while, at the same time, moving away from quantity-conditioned stress and towards lexical stress on the other, then non-prototypical stress-timing develops.

Languages of this type do not reduce unstressed vowels and tend to have lexical stress. Both bindings function in them. Examples of languages: Polish and Arabic. Arabic has phonologically determined stress, but no reduced vowels and less complex consonantal clusters than Polish, which has lexical stress.

(d) *prototypical stress-timing*: if the above development (described in (b)) goes in the direction of unstressed vowel reduction to schwa and this becomes a rule of a language, then true stress-timing emerges. As to consonants clusters, the two inter-vocalic consonants are licensed by the bindings themselves. Longer clusters possibly arise from other vowel reductions.

Languages of this type demonstrate both quantity-sensitive stress and lexical stress. They employ both bindings and do not abound in rules enhancing the stronger binding. Since they are rich in clusters, they allow for a lot of assimilations. Examples: English and Russian.

Traditional typologies mention, apart from "iso-syllabic" and "iso-accentual" languages, also "mora-timed" languages (with Japanese usually being given as an example, although cf.

¹⁰⁴ See Part III for an illustration of the discussed change with the Old English/Middle English material.

¹⁰⁵ In Italian geminates bring additional evidence for **B←n** binding - there is no sonority distance between the two members of a geminate, so they could not survive in a sequence without a binding on both sides.

¹⁰⁶ The ease with which speakers of Italian manipulate word boundaries is demonstrated, for instance, by the following pun:

- "Che fine RAI? - asked of Berlusconi (July 1994)

- *FiniRAInvest* - answered by Berlusconi." (Dressler: personal communication). Berlusconi, an Italian prime-minister, owner of *Fininvest*.

Bertinetto (1989: 105, 122f) for discussion). The concept of a mora is used first of all to express quantity distinctions applied by languages, e.g. in Old Germanic languages, Modern Estonian, Lithuanian, Scandinavian languages (except Danish). In pitch-accent languages, i.e. those utilizing both stress and tone, e.g. Ancient Greek, one also refers to the concept of a mora. Allen (W.S. 1973: 92) states, also quoting others, that the concept of the mora "does not correspond to a phonetic reality, but is a purely analytical device; there are languages in which the use of the mora facilitates a clear description of the phonology, and others in which it does not - but that is all."

In the Beats-and-Binding model, quantity distinctions are expressed by means of quantity beats (**b**'s). There is a preference to keep the number of quantity beats **b**'s within a foot equal. For languages having long vocalics, one presupposes historical compensatory processes of the sort: $\{\mathbf{n} \rightarrow \mathbf{B} \ \mathbf{n} \rightarrow \mathbf{B}\} \gg \{\mathbf{n} \rightarrow \mathbf{B} \ \mathbf{B} \leftarrow \mathbf{n}\}$, i.e. /CVCV/ \gg^* /CVC/ \gg /CV:C/, i.e. maintaining the original **b b b**. In languages having also consonantal quantity, e.g. in Old Germanic, the correlation extends to: /CVCV/ = /CV:C/ = /CVC:/. A long consonant is the result of an attempt to get an equal count of three in still another way, without the help of vocalic quantity. The languages in which the counting of quantity beats (traditional mora-counting) is important for the sake of segmental quantity distinctions can be classified in this respect as non-prototypical beat-timed languages.

4.2.6.2. *Resumé of language types with respect to timing.*

TYPES:

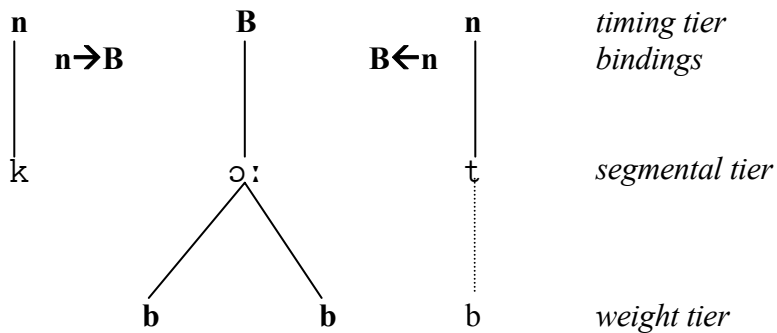
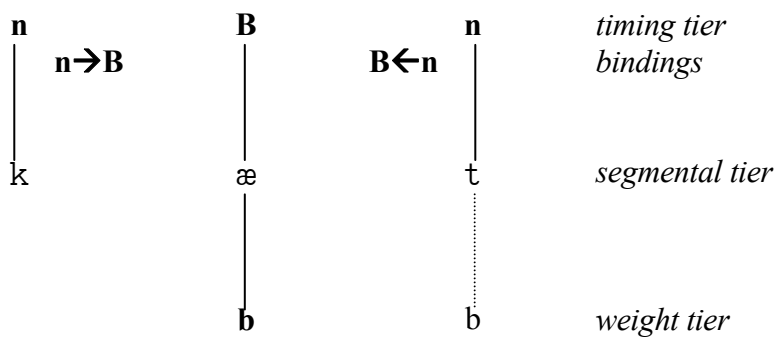
- prototypical beat-timing (PBT)
- non-prototypical beat-timing (NPBT)
- non-prototypical stress-timing (NPST)
- prototypical stress-timing (PST)

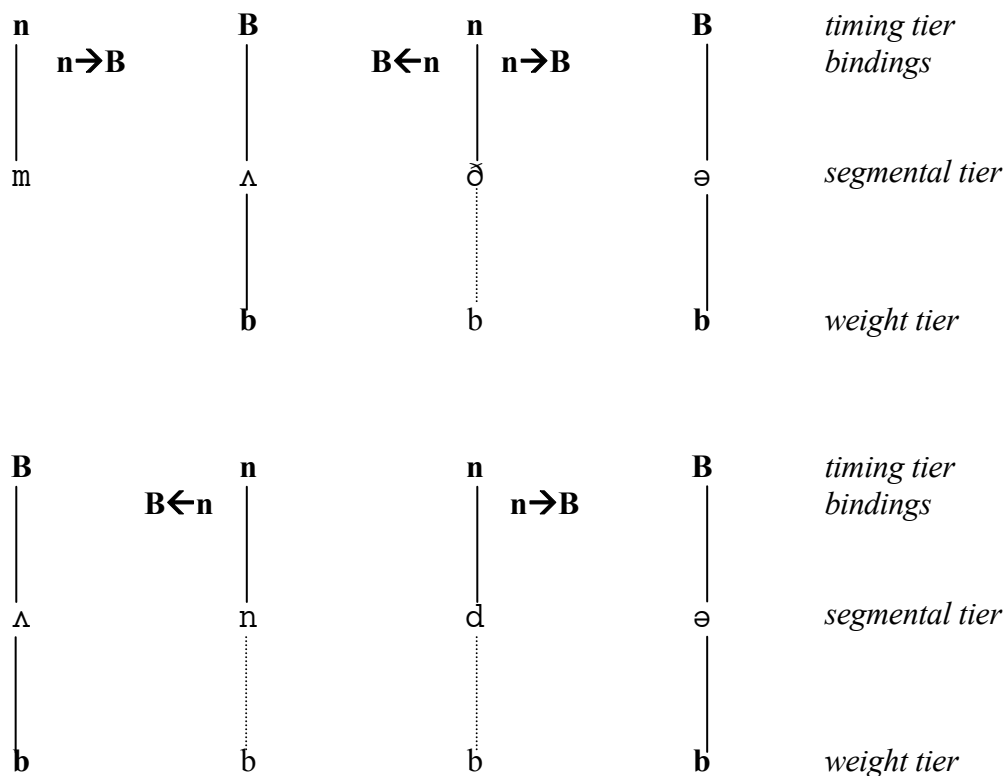
FEATURES:

- (1) $\mathbf{n} \rightarrow \mathbf{B}$ binding
- (2) $\mathbf{B} \leftarrow \mathbf{n}$ binding
- (3) unstressed vowel reduction
- (4) unstressed vowel elision
- (5) quantity-sensitive stress
- (6) lexical stress
- (7) tone
- (8) rules enhancing $\mathbf{n} \rightarrow \mathbf{B}$ binding
- (9) consonant clusters
- (10) rules weakening an intervocalic consonant
- (11) restrictions on an intervocalic consonant

PBT	NPBT	NPST	PST
1. +	+	+	+
2. -	±	+	+
3. -	±	-	+
4. -	+	+	+
5. -	+	±	+
6. -	-	+	+
7. +	+	-	-
8. +	+	-	-
9. -	±	+	+
10. -	±	+	+
11. -	±	+	+

4.2.6.3. Representations in the B&B model: examples from English.





4.2.6.4. The role of phonotactic preferences.

Phonotactics (governed by universal preferences) accommodates itself language specifically to a given timing pattern. Those clusters become stable in a language which obey universal phonotactic preferences and thus can survive due to the sonority distance between their members. They do not succumb to the overwhelming preference for the two sequenced **n→B** bindings. There are no interconsonantal bindings, but consonants do combine into clusters due to sonority distance between them. Chapter 5 will be devoted to a detailed presentation of universal phonotactic preferences.

4.2.6.5. The role of articulatory preferences.

Speaker-friendly processes aim at facilitating the articulation of segment sequences. This is realized predominantly by means of assimilations and reductions. The more consonant clusters a language has, the more assimilations and reductions are expected to occur. The preference for ease of articulation partially governs the choice of segments and thus codetermines the shape of phonotactics (together with the perceptual sonority-cued preferences). So, for example, too much articulatory effort in moving from one articulation to another will be avoided (cf. above Section 4.2.4.).

The phonostylistics of casual speech is also predominantly governed by speaker-friendly preferences. Lenition processes work towards a simplification of segment sequences for the benefit of the speaker. There are, however, cases in which listener-friendly preferences come to the fore in phonostylistics.

This concerns, first of all, a regularization of rhythm towards a trochee, a common phenomenon in casual speech, e.g. when stresses delete or shift in order to allow for a strong-weak beat alternation (e.g. in Polish).

Secondly, in the case of no change in rhythm, the effect of a phonostylistic process is the more noticeable the more it distorts the binding preferences. In other words, a distortion of a more perceptually salient sequence is more noticeable than that of a less salient one. Let us, for instance, compare the following three processes:

- a deletion of a consonant which results in a vowel hiatus, e.g. Sp. *amádo* (past participle masc. sing.) -> *amáo*, Pol. *widziałem* -> *widziaem*;
- a deletion of a word-final consonant, e.g. Sp. *Madrid* -> *Madri*, Pol. *bidon* -> *bido*;
- a deletion of a vowel and, simultaneously, replacement of the lost beat with a consonantal beat, e.g. Pol. *przykład* -> *p[ɛ]kład*.

The outputs of the above processes are perceptually noticeable in a descending order:

- in the first process, both **n→B** and **B←n** bindings are distorted and a hiatus results;
- in the second process, only a weaker, **B←n** binding is distorted, but in this way a preference for an **n→B** binding comes to the fore;
- in the third process, no binding is distorted, since a new, consonantal beat participates in two bindings, just like the original, vocalic beat (the new sequence is even better in the sense of not starting with a consonantal cluster).

Thirdly, emphatic speech and motherese are subject to perceptual preferences, since they are definitely listener-oriented. Most conspicuously, a preference for an **n→B** binding is noticeable when schwas or other vowels are inserted by a speaker to facilitate the perception of consonantal clusters by a listener. E.g. in motherese: "nie mówi się *doknąć*, tylko do[ɪ]knąć" 'you don't say [...] *touch*, but [...] *touch*'.

4.2.7. Semiotic precedence scale

4.2.7.1. Words and morphemes have semiotic priority over phonological entities.

(a) There is a preference, for respectively different reasons, for a word-initial {**nB**} sequence and a word-final {**Bn**} sequence.

A word-initial {**nB**} guarantees salience obtained due to contrast, which is essential in any (left-to-right) lexical search, as well as a more informational load (consonants are more informative than vowels). In a word-final {**Bn**}, the final consonant serves as a marker of a word-boundary (closes a word). The above preference is documented, for instance, by the following psycholinguistic evidence:

- a predominantly left-to-right fashion of word recognition (cf. e.g. Gósy 1991);
- recognition of words by subjects before having heard the words completely (Marslen-Wilson 1989);
- TOT (tip-of-the-tongue) phenomena: subjects in an experiment were able to recall, among others, letters at the beginnings and ends of words (cf. Cowan 1992: 276f).

(b) The particular salience of word onset has priority over and thus may come into conflict with other preferences.

(c) Also the morphological structure of a word may override binding preferences.

4.2.7.2. Explanation of the semiotic precedence scale.

For interpretation of the morphology-phonology interface, I adopt a semiotically based model of Natural Morphology (cf. Dressler 1990, Dressler et al. 1987; cf. also Dressler and Dziubalska-Kołaczyk 1995b).

Semiotically, words are primary linguistic signs, whereas morphemes and morphological rules are only secondary linguistic signs, i.e. non-autonomous signs obtained by decomposition of the primary sign-type of words. Phonological rules, phonemes and other phonological units are tertiary signs. Since Natural Morphology requires its constructs to attain psychological reality, the semiotic precedence of words over morphemes results in the claim that also in planning words have precedence over morphological rules and units smaller than the word, and that morphological units and rules have precedence over phonological rules and units.

This is compatible with current psycholinguistic models: nearly all assume that all words (including complex ones derived via word formation rules) are stored; many assume that, among inflectional word forms either all that are frequently used are stored (e.g. Lukatela, Carello & Turvey 1987; Stemberger and MacWhinney 1988) or at least citation forms (e.g. Miceli and Caramazza 1988; Badecker and Caramazza 1993). Such complex words or word forms may then be decomposed into their smaller morphological units with the help of morphological rules (cf. Burani and Laudanna 1992; Burani 1992; several papers in Marslen-Wilson 1989); in production, phonological processing comes after morphological processing (cf. Butterworth 1993: 247).

The scale of semiotic precedence is reflected in the relative saliency of units. Also in morphological planning, more salient units have more prominence in planning. According to Dressler (1988b) one can assume the following saliency scales:

- Morphological words are more salient than stems, and stems more salient than roots. Lexical units (words, stems, roots) are more salient than affixes, which are attached to lexical units by morphological rules (cf. Tyler et al. 1990).
- Among affixes, prefixes are more salient than suffixes (cf. Hall 1992; Wandruszka 1992).
- The other affix types, i.e. infixes, interfixes, and circumfixes are less salient than prefixes and suffixes.

4.2.7.3. *The figure-and-ground principle for words.*

The first consonant of a word is always a figure against the ground of the whole word (the final consonant, but to a lesser extent, is also a figure). In a single consonant word onset, the figure status of the consonant is even enhanced through the contrast between the consonant and a following vowel, i.e. through the non-beat's participation in the binding **n→B**.

In word-initial consonant clusters, e.g. **C₂C₁V-**, the principle of balance decides the extent to which the figure status of **C₂** overrides the phonotactic preferences for a word-initial position. This depends on the phonotactics of the initial cluster:

- (a) In a cluster which is built up according to the phonotactic preferences (cf. below, Chapter 5) and, thus, has chances to survive as a cluster, e.g. *pr-*, the figure status of **C₂** is enhanced. Therefore, if it does come to cluster reduction (e.g. in L1 acquisition), it is **C₁** rather than **C₂** that gets deleted: *prV* → *pV*.
- (b) In a cluster like *kn-* or *ps-*, whose chances of survival are smaller due to the phonotactically unfavourable distances distribution with respect to the following vowel, the basic **n→B** binding preference (not counteracted any more by phonotactic preferences) "nominates" the non-beat bound to the beat to the status of a word-figure (i.e. the **C₁** of the cluster), whereby **C₂** loses its figure status, and becomes susceptible to deletion, e.g.: *knV* → *nV* or *psV* → *sV*. After the deletion, former **C₁** immediately replaces former **C₂** as a figure. This also happens with prosodically weak word-initial vowels (unstressed), which often reduce (L1, phonostylistics, aphasia), and in this way get automatically "replaced" by strong ones in a word-initial position.

4.3. Mathematical operationalization of the model¹⁰⁷

In this section I will perform basic statistical analysis of the probabilities with which particular sequences of beats and non-beats come into being. In other words, I want to find out which combinations of bindings are most likely to underlie particular segment sequences.

Segment sequences are the result of combinations of two basic bindings $n \rightarrow B$ and $B \leftarrow n$, less preferably also single beats $\{B\}$ - since a beat can stand alone. So, for a particular phonemic sequence, there is more than one possibility of an underlying combination of bindings (except for the sequence $\{nBn\}$ /CVC/ which has only one possible underlying representation consisting of the bindings $n \rightarrow B$ and $B \leftarrow n$).

We assume that the creation of words can be treated as a sequence of events by which we understand the occurrences of $\{nB\}$, $\{Bn\}$ and $\{B\}$. The occurrence of a particular element is accidental, but described by a particular probability. We assume that event A signifies the occurrence of $\{nB\}$ in a sequence, event B - the occurrence of $\{Bn\}$, and event E - the occurrence of $\{B\}$. We assume further that the events are independent, i.e. the occurrence of any of the three elements has got its own probability. Words are then sequences of the elements $\{nB\}$, $\{Bn\}$ and $\{B\}$, which occur in an optional order with a given probability.

Our statistical investigation of word structure will be limited to the most basic sequences constituting words of the languages of the world. Let us assume that:

$$P(A) = p \quad P(B) = q \quad P(E) = t$$

where p signifies a probability of event A (i.e. of $\{nB\}$), q - a probability of event B (i.e. of $\{Bn\}$), and t - of event E (i.e. of $\{B\}$). The probabilities remain in the following relation:

$$t < q < p < 1$$

Let us assume, for illustrative purposes, the following probability values:

$$p = 0,9 \quad q = 0,6 \quad t = 0,09$$

Let us consider now the probabilities of possible combinations of $\{nB\}$'s, $\{Bn\}$'s and $\{B\}$'s in the creation of five basic segment sequences, phonemically, /CVC/, /CVCV/, /CVCVC/, /CVCCVC/ and /VCV/.

(a) $\{nBn\}$

$$\{nB\} + \{Bn\} \quad Pa = p * q = 0,54$$

(b) $\{nBnB\}$

$$1. \{nB\} + \{nB\} \quad Pb1 = p * p = 0,81$$

$$2. \{nB\} + \{Bn\} + \{nB\} \quad Pb2 = p * q * p = 0,486$$

$$3. \{nB\} + \{Bn\} + \{B\} \quad Pb3 = p * q * t = 0,0486$$

(c) $\{nBnBn\}$

$$1. \{nB\} + \{nB\} + \{Bn\} \quad Pc1 = p * p * q = 0,486$$

$$2. \{nB\} + \{Bn\} + \{nB\} + \{Bn\} \quad Pc2 = p * q * p * q = 0,2916$$

$$3. \{nB\} + \{Bn\} + \{Bn\} \quad Pc3 = p * q * q = 0,324$$

(d) $\{nBnnBn\}$

$$\{nB\} + \{Bn\} + \{nB\} + \{Bn\} \quad Pd = p * q * p * q = 0,2916$$

¹⁰⁷ For a discussion and helpful hints concerning a possible or potential mathematical operationalization of the Beats-and-Binding model I owe thanks to mathematician Jacek Kroll.

(e) **{BnB}**

- | | |
|------------------------------|-------------------|
| 1. {B} + {nB} | Pe1 = 0,081 |
| 2. {Bn} + {B} | Pe2 = 0,054 |
| 3. {Bn} + {nB} | Pe3 = 0,54 |

On the basis of the obtained probability values, one can make a few interesting observations pertaining to the predictability force of the Beats-and-Binding model. As predicted by the model, the most probable sequence is:

➤ a sequence **{nBnB}** when consisting of two identical bindings **n→B**.

The second order probability is obtained by:

- the sequence **{nBn}** (consisting of **n→B** and **B←n**), fully in agreement with the predictions;
- the sequence **{BnB}** when consisting of **B←n** and **n→B**; the sequence differs from the above one, however, by having still two other possibilities of origin.

Since the order of occurrence of elements was ignored in our statistical considerations, the above two sequences of two basic bindings in both orderings showed equal probabilities. The model explains, however, why the first of the two sequences, i.e. **{nBn}**, is more preferred irrespective of the combination of bindings. This is due to the figure-and-ground principle as applied to the word. An **n→B** binding has greater saliency potential and thus should preferably come first in the word.

So, the scale of probabilities for particular combinations of **{nB}**, **{Bn}** and **{B}** is the following:

{nB} + {nB}	P = 0,81
{nB} + {Bn}	P = 0,54
{Bn} + {nB}	P = 0,54
{nB} + {Bn} + {nB}	P = 0,486
{nB} + {nB} + {Bn}	P = 0,486
{nB} + {Bn} + {Bn}	P = 0,324
{nB} + {Bn} + {nB} + {Bn}	P = 0,2916
{B} + {nB}	P = 0,081
{Bn} + {B}	P = 0,054
{nB} + {Bn} + {B}	P = 0,0486

The scale should not be treated as a reflection of the frequencies with which particular sound sequences occur in the languages of the world. The scale shows which underlying combinations of bindings and beats are expected to be optimal for basic segment sequences according to universal binding preferences. As I have stated in the present chapter, there are also articulatory, phonotactic and semiotic preferences, which contribute to the shaping of phonological structure.

4.4. Functional perspective of the Beats-and-Binding model

Beats-and-Binding organization of phonology reflects the distribution of "interests" between the speaker and the listener, i.e. between two basic functions of phonology: ease of articulation and clarity of perception. Phonological analysis in terms of the B&B model allows us to give a functional account of phenomena which would be rendered dysfunctional by syllable-based phonologies. Therefore, the present model is able to supply a natural explanation of a much wider array of phonological events than, mostly conventional, syllable models. For instance,

phonotactic sequences breaching the Sonority Sequencing Generalization turn out not to be dysfunctional when accounted for in terms of beats and bindings.

The three following parts of the book will be devoted to the presentation of numerous cases, from a variety of phonology-internal and -external sources, in which an underlying functionality of phenomena cannot be accounted for in syllable-oriented models. Simultaneously, a functional account within B&B model will be provided. Before that, however, the model of phonotactics in Beats-and-Binding phonology will be presented.

CHAPTER FIVE

The model of phonotactics in Beats-and-Binding Phonology

Beats-and-Binding phonology is a model which accounts for the representation of segments in sequences. Specifically, it focuses on explaining how sequences come into being as well as which sequences are preferred to others and why. In this chapter I will show how B&B phonology models phonotactics.

5.1. Consonant clusters: Introduction

Consonant clusters are rare in the languages of the world (Maddieson 1999). In a sample of 30 representative languages 70% had no consonant clusters or less than 1%. In every one of these languages at least 85% of the syllables had simple or zero onsets (Maddieson 1999: 2525). The ground for this is the universal preference for the CV-structure which in terms of Beats-and-Binding phonology is predictable in accordance with a major preference for the **n→B** binding. The latter means that a combination of a non-beat (=n) with a beat (=B), best realized by a consonant+vowel syntagma, is the most preferred phonological structure. It provides a good phonetic contrast which is both easy to hear and pronounce. Preference for the **n→B** binding (and, in consequence, for the CV) is derived from higher order semiotic and functional principles of, respectively, figure-and-ground and perceptibility /pronunciability. The CV-preference, if alone, would prevent the occurrence of any consonant clusters at all. There are languages, however, among them also some major world languages with respect to the number of speakers, which do allow for clusters of consonants. Though they differ from language to language, clusters share certain universal traits which either guarantee their survival in a language or let them be similarly treated by children, aphasics, learners of foreign languages or every-day casual talkers. Those universal traits are expressible in terms of phonotactic preferences which derive the preferred clusters for all positions. Their function is, on the one hand, to *counteract the CV-only preference* and, on the other, to *counteract the creation of dysfunctional clusters*. Most typically across phonological models, such conditions on clusters are expressed in terms of phonotactic *constraints*. In B&B phonology, epistemologically embedded in the theory Natural Linguistics, well-formedness conditions on clusters are ontologically *preferences* (i.e., in other words, violable constraints, if one insists on the term constraint).

Consistently with the above remark, phonotactic preferences in Beats-and-Binding phonology specify, for a given position in a word, the hierarchy of clusters from the best through tolerable (with decreasing degree) and intolerable (with increasing degree) down to the impossible ones. In other words, they divide a potential *cluster space* into preferred clusters, dispreferred clusters (which are possible, though dysfunctional in the given position) and impossible clusters.¹⁰⁸

5.2. The Optimal Sonority Distance Principle (OSDP)

Clusters, in order to survive, must be sustained by some force counteracting the overwhelming tendency to reduce towards CV's. This force is a contrast of sonority¹⁰⁹.

The conditions of co-occurrence of segments in clusters are specified with reference to the phonological parameter of sonority. The *Optimal Sonority Distance Principle (OSDP)* defines the way in which segments should order themselves in a successful sequence: the relations between sonority distances between pairs of neighbouring phonemes¹¹⁰ should be *optimally balanced*. I.e., the distances between pairs of segments as measured in sonority are neither expected to be maximal nor minimal, to increase nor decrease, but to be optimal with respect to the output cluster. "Optimal" means different things depending on the context. Optimal sonority relations take the form of well-formedness conditions holding for double, triple and n-member clusters in all positions in a word, i.e., initial, medial and final. They refer to the sonority values of the scale below:

vowels	semivowels	liquids	nasals	fricatives	affricates	plosives
0	1	2	3	4	5	6

Figure 1. The sonority scale¹¹¹

e.g., *la* = distance of two positions = 2, *sw* = distance of three positions = 3, *ka* = distance of six positions = 6, etc.; so, e.g., *ka* > *sw* > *la*

5.3. A step-by-step derivation of the Cluster Space

¹⁰⁸ The dispreferred clusters are all potentially existent. They are dispreferred due to their misplacement within a word. The impossible clusters are excluded on logical grounds by well-formedness conditions.

¹⁰⁹ Cf. a discussion of sonority in Chapter 4, section 4.2.3.3.

¹¹⁰ Bindings are binary and the interdependencies between segments in a sequence also have a binary basis. There is a seed of similarity in this approach to the analysis Kuryłowicz (1952) proposed to grasp the phonotactics of the syllable in Polish. He based his predictions concerning the grouping of consonants in clusters on universal sonority requirements for pairs of consonants (cf. Gussmann 1991 and 1992 for a discussion and assessment of Kuryłowicz's analysis).

¹¹¹ Instead of a sonority scale, one may think of a sonority hierarchy, represented as a branching structure from the most general, major classes (consonants and vowels) to those most specific (particular manners or even particular laryngeal features). Specific languages would make use of such a hierarchy to varying degrees; for instance, in a CV language, only major classes would be of use, while in a language with double clusters at the most, three positions in a hierarchy would be necessary (i.e. Cs and Vs, and among Cs, sonorants and obstruents). The scale I'm referring to, however, is supposed to serve as a universal reference point, mid-way between a much less complex and much more complex hierarchy. Balancing sonority distances between segments remains a valid measure throughout, although, with increasing complexity, the hierarchy would require amendments.

In this section the above-mentioned well-formedness conditions for double and triple clusters in word-initial, -final and –medial position will be derived.

5.3.1. Double initial clusters

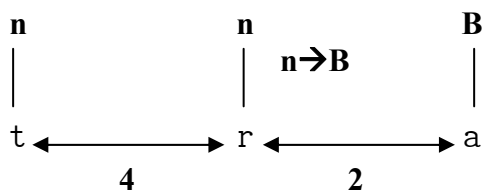
The preferred double initials are defined by the following condition:

†	C₁C₂V:	$ \text{son}(C_1) - \text{son}(C_2) \geq \text{son}(C_2) - \text{son}(V) $ i.e.: $\text{sondis}(C_1, C_2) \geq \text{sondis}(C_2, V)$
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The condition reads:

*In word-initial double clusters, the sonority distance (**sondis**) between the two consonants should be greater than or equal to the sonority distance between a vowel and a consonant neighbouring on it.*

For instance, as in a sequence /tra/:



Sonority distances between segments as specified by the phonotactic conditions show a regular distribution when plotted on a two-dimensional diagram. Below a diagram representing preferred double initials is shown.

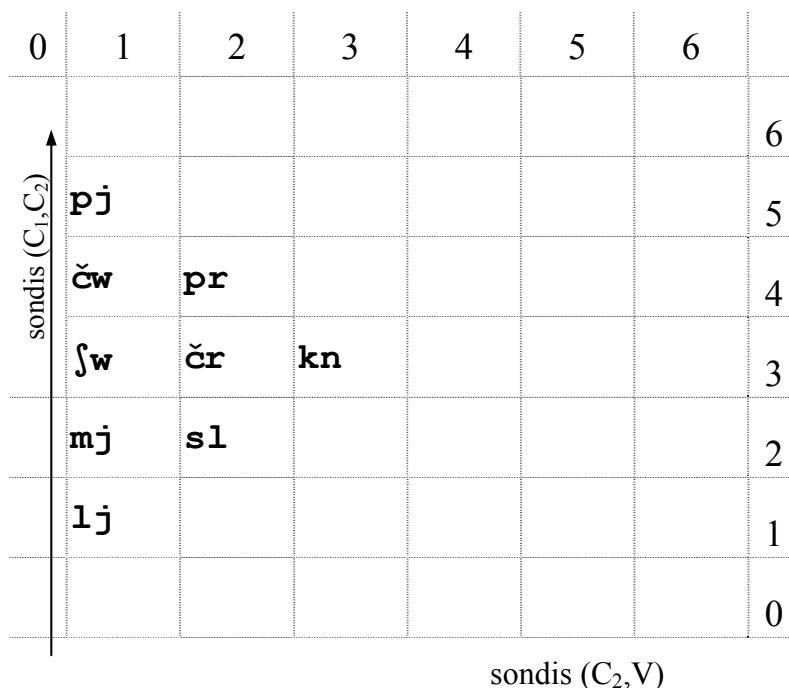


Figure 2. Cluster Space of preferred double initials

Sonority distance between the two consonants of the cluster is plotted on Y ($\text{sondis}(C_1, C_2)$), sonority distance between a vowel and a consonant neighbouring on it – on X ($\text{sondis}(C_2, V)$). Clusters are plotted according to condition 1 above (i.e. a given value Y must be greater than or equal to its corresponding value X). In this way, we arrive at a picture representing the

space of initial double clusters. For the sake of clarity of the picture, the consonants in the clusters shown in the graph are specimens of a given class having the same sonority value (e.g., /p/ represents stops, /j/ represents semivowels). This means that /pj/ stands for any stop+semivowel cluster. Within such a cluster space we can differentiate among degrees of preferability of clusters: the best (i.e. the most preferred) are the ones showing the greatest difference between the two values of **sondis**. Thus, the best clusters are the /pj/ - type ones, then /čw/, then /pr/ and /šw/, then /čr/ and /mj/, and finally /kn/, /sl/ and /lj/- type ones. Clearly, a condition (or constraint) which does not impose an absolute requirement on the outputs must be a preference.

5.3.2. Double final clusters

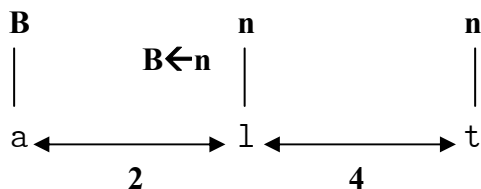
The preferred double finals are defined by the following condition:

2	VC₁C₂:	$ \text{son}(\text{V}) - \text{son}(\text{C}_1) \leq \text{son}(\text{C}_1) - \text{son}(\text{C}_2) $ i.e.: $\text{sondis}(\text{V}, \text{C}_1) \leq \text{sondis}(\text{C}_1, \text{C}_2)$
---	-------------------------------------	--

The condition reads:

*In word-final double clusters, the sonority distance (**sondis**) between the two consonants should be greater than or equal to the sonority distance between a vowel and a consonant neighbouring on it.*

For instance, as in a sequence /alt/:



Below a diagram representing preferred double finals is shown.

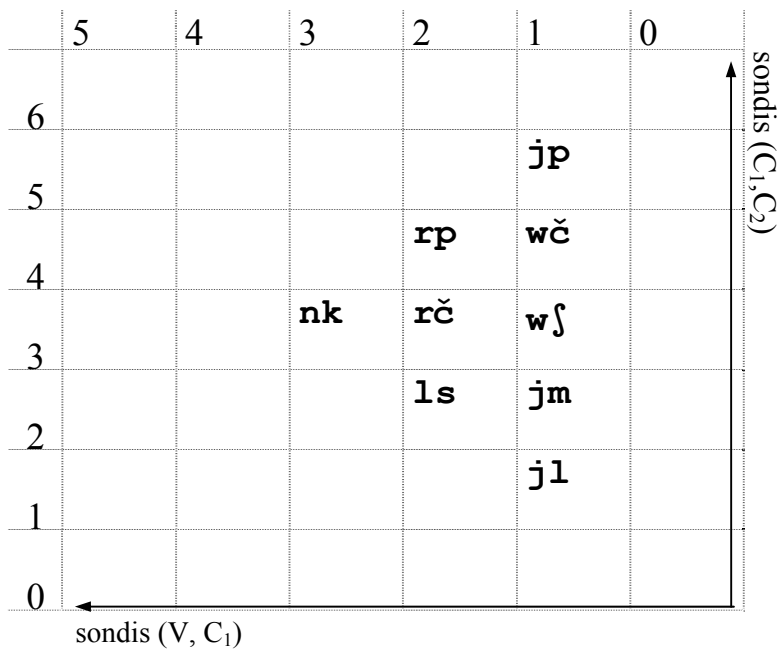


Figure 3. Cluster Space of preferred double finals

Below in Figure 4, Figure 2 and Figure 3 are collapsed to show initial and final double clusters together.

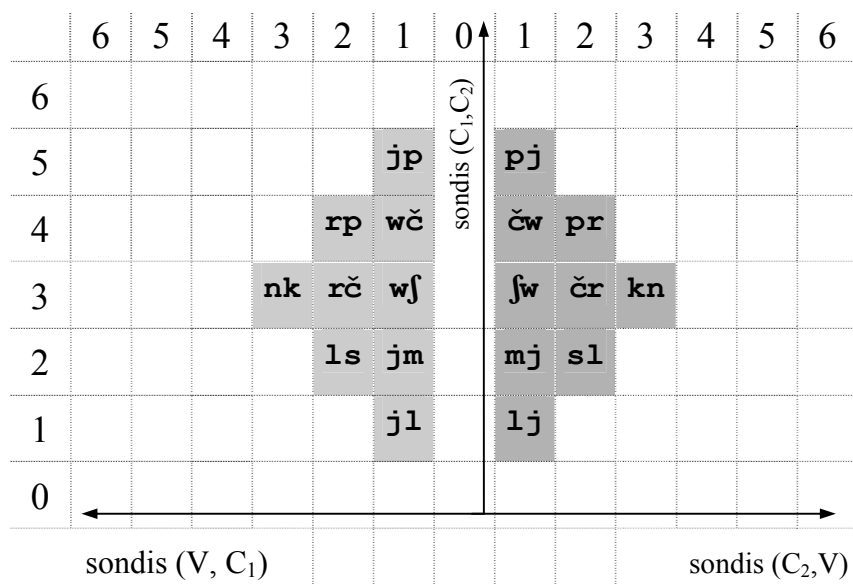
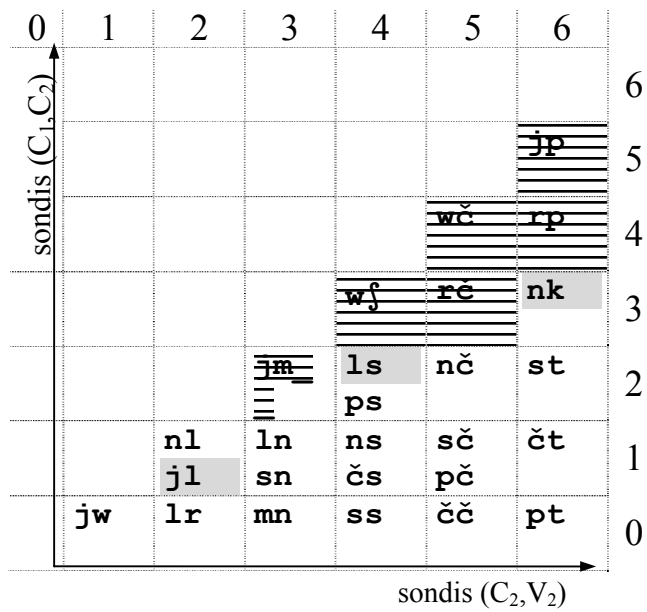


Figure 4. Cluster Spaces of preferred double initials [(C₂, V), (C₁, C₂)] and finals [(V, C₁), (C₁, C₂)]

5.3.3.1. Graphic derivation of the right-hand side of the relation 3., i.e. $\text{sondis}(C_1, C_2) < \text{sondis}(C_2, V_2)$



- medials overlapping with preferred finals
- clusters violating the left-hand side of the relation 3.

Figure 5. Right-hand side of the relation 3

5.3.3.2. Graphic derivation of the left-hand side of the relation 3., i.e. $\text{sondis}(V, C_1) \geq \text{sondis}(C_1, C_2)$.

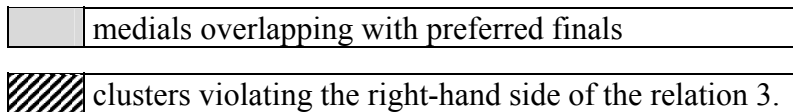
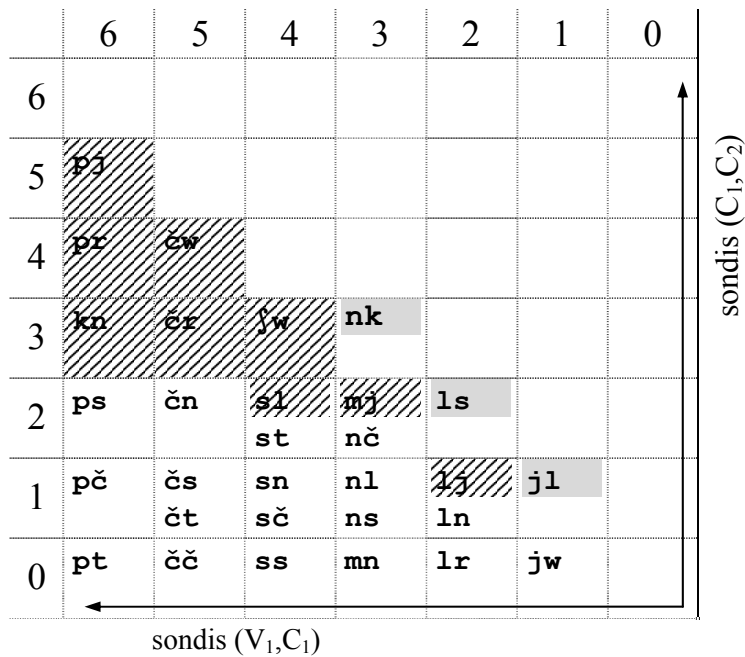


Figure 6. Left-hand side of the relation 3

In Figure 7 below, Figure 5 and Figure 6 are collapsed to show the preferred double medial clusters. Notice that the same clusters appear on both sides of the Y-axis, however, the coordinate values of some of the clusters on the abscissa differ. The difference reflects the fact that each of the two members of a cluster has a different sonority distance to its neighbouring vowel (e.g., in *-st-*, 4 vs. 6). For clarity, the right-hand side copies of the medial clusters are marked by italics. In 5.3.4., Figure 8 shows Cluster Space of all preferred double clusters.

	6	5	4	3	2	1	0	1	2	3	4	5	6
6													
5													
4													
3				nk									nk
2	ps	čn	st	nč	ls					čn	ls	nč	st
1	pč	čs	sn	nl	ln	jł			nl	ln	ns	sč	čt
0	pt	čč	ss	mn	lr	jw		jw	lr	mn	ss	čč	pt
	sondis (V, C ₁)							sondis (C ₂ , V)					

Figure 7. Cluster Space of preferred double medials

5.3.4. Cluster Space for doubles

	6	5	4	3	2	1	0	1	2	3	4	5	6
6													
5						jp		pj					
4					rp	wč		čw	pr				
3				nk	rč	wf		fw	čr	kn			nk
2	ps	čn	st	nč	ls	jm		mj	sl	čn	ls	nč	st
1	pč	čs	sn	nl	ln	jł		lj	nl	ln	ns	sč	čt
0	pt	čč	ss	mn	lr	jw		jw	lr	mn	ss	čč	pt
	sondis (V ₁ , C ₁)							sondis (C ₂ , V ₂)					

	preferred initials
	preferred finals
	medials overlapping with preferred finals
	preferred medials

Figure 8. Cluster Spaces of preferred double initials, finals and medials

5.3.5. Generalisations and implications concerning the phonotactics of double clusters

Generalisations:

- initials: $1 \leq \text{sondis}(C_1, C_2) \leq 5$
 $1 \leq \text{sondis}(C_2, V_2) \leq 3$
- finals: $1 \leq \text{sondis}(C_1, C_2) \leq 5$
 $1 \leq \text{sondis}(V_1, C_1) \leq 3$
- medials: $0 \leq \text{sondis}(C_1, C_2) \leq 3$ (preferably, < 3)
 $1 \leq \text{sondis}(V_1, C_1) \ \& \ \text{sondis}(C_2, V_2) \leq 6$

Implications:

- if $\text{sondis}(C_1, C_2) = 0$, a cluster can only be a preferred medial
- if $3 < \text{sondis}(C_1, C_2) \leq 5$, a cluster can only be a preferred initial or final (i.e., sonority distance 4 or 5 between consonants in a cluster)
- if $3 < \text{sondis}(V_1, C_1) \ \& \ \text{sondis}(C_2, V_2) \leq 6$, a cluster can only be a preferred medial (i.e., sonority distance 4, 5 or 6 between a consonant and a vowel)

5.3.6. Initial triple clusters

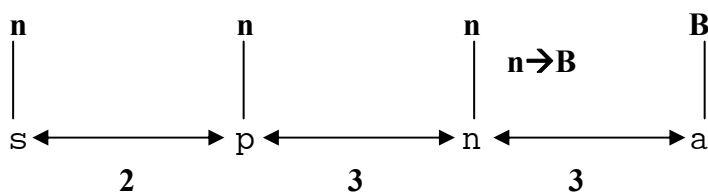
The preferred triple initials are defined by the following condition:

	$C_1C_2C_3V$:
	$ \text{son}(C_1) - \text{son}(C_2) < \text{son}(C_2) - \text{son}(C_3) \geq \text{son}(C_3) - \text{son}(V) $ i.e.: $\text{sondis}(C_1, C_2) < \text{sondis}(C_2, C_3) \geq \text{sondis}(C_3, V)$

The condition reads:

For word-initial triple clusters, the distance between the third consonant and the second consonant should be greater than or equal to the distance between this third consonant and the vowel, and greater than the distance between the second and the first consonant.

For instance, as in a sequence /spna/:



One can see that the initial triples contain the preferred initial doubles (cf. condition number 1 in section 5.3.1.). The graph (Figure 9) below illustrates the space of initial triples as well as shows the initial doubles again.

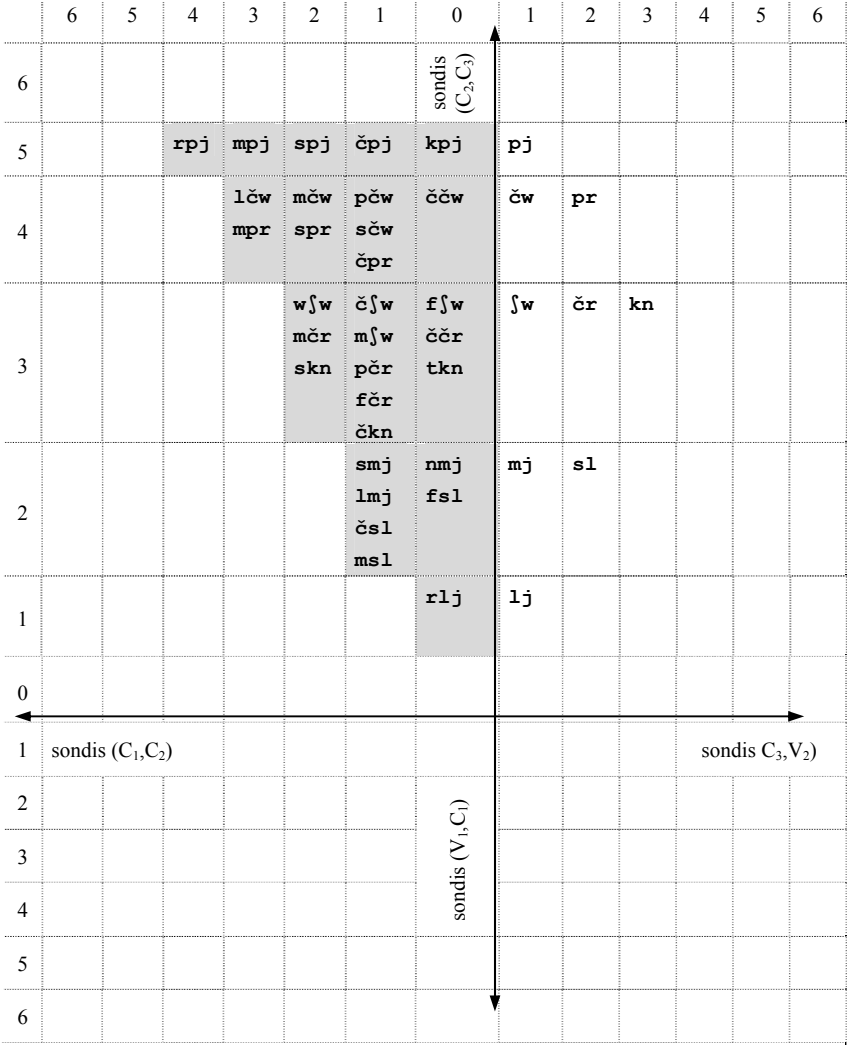


Figure 9. Cluster Space of the preferred initial triples (darkened area)

5.3.7. Final triple clusters

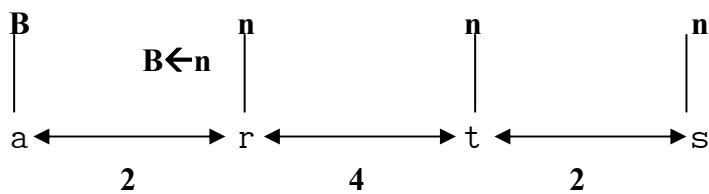
The preferred triple finals are defined by the following condition:

	VC₁C₂C₃:
	$ \text{son}(\mathbf{V}) - \text{son}(\mathbf{C}_1) \leq \text{son}(\mathbf{C}_1) - \text{son}(\mathbf{C}_2) > \text{son}(\mathbf{C}_2) - \text{son}(\mathbf{C}_3) $ i.e.: $\text{sondis}(\mathbf{V}, \mathbf{C}_1) \leq \text{sondis}(\mathbf{C}_1, \mathbf{C}_2) > \text{sondis}(\mathbf{C}_2, \mathbf{C}_3)$

The condition reads:

For word-final triple clusters, the distance between the first consonant and the second consonant should be greater than or equal to the distance between this first consonant and the beat, and greater than the distance between the second and the third consonant.

For instance, as in a sequence /arts/:



One can see that the final triples contain the preferred final doubles (cf. condition number 2 in section 5.3.2.). The graph (*Figure 10*) below illustrates the space of final triples as well as showing the final doubles again.

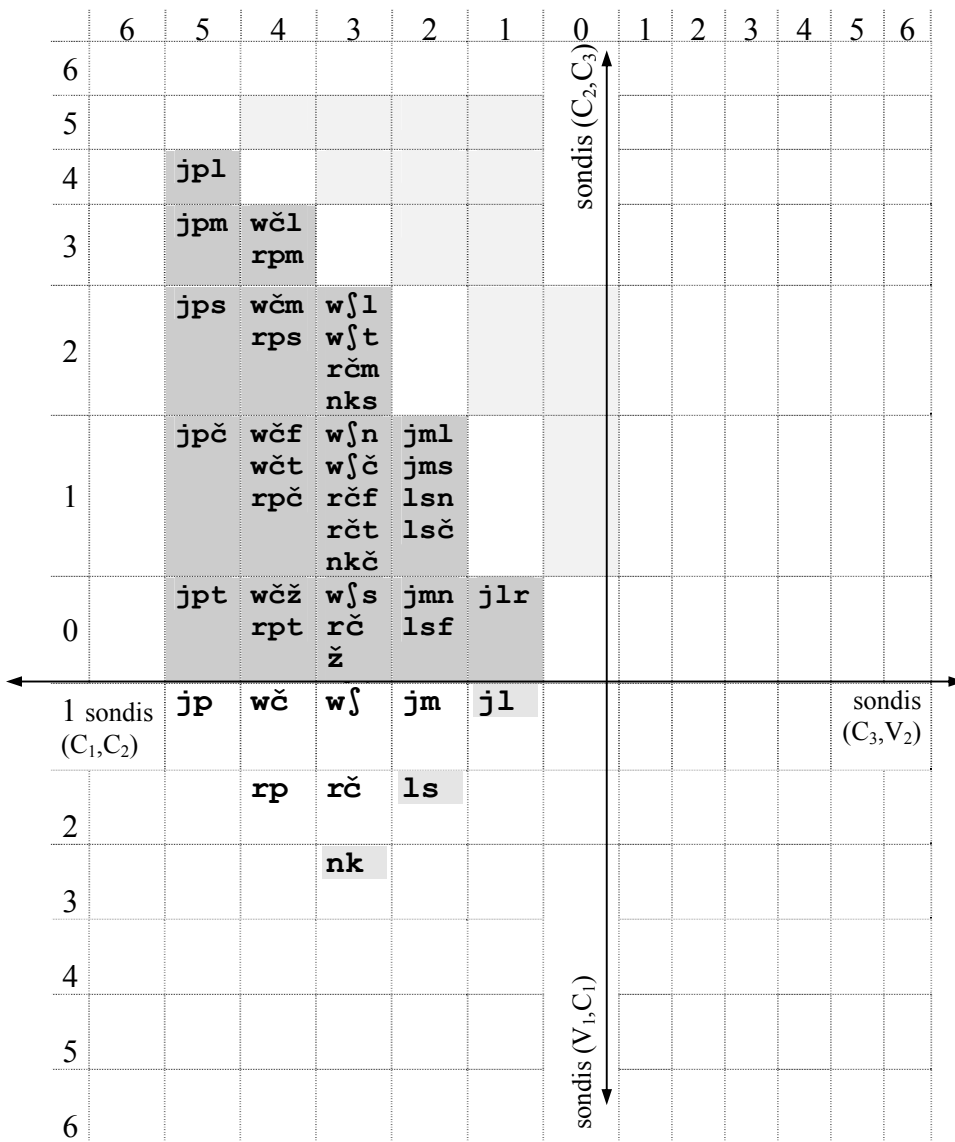


Figure 10. Cluster Space of the preferred final triples (deep darkened area)

5.3.8. Medial triple clusters

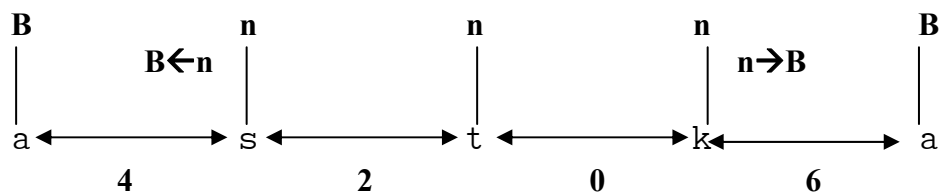
The preferred triple medials are defined by the following condition:

6	$V_1 C_1 C_2 C_3 V_2:$ $ \text{son}(V_1) - \text{son}(C_1) \geq \text{son}(C_1) - \text{son}(C_2) $ & $ \text{son}(C_2) - \text{son}(C_3) < \text{son}(C_3) - \text{son}(V_2) $ i.e.: sondis(V,C₁) ≥ sondis(C₁,C₂) & sondis(C₂,C₃) < (C₃,V₂)
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The condition reads:

For a word-medial triple cluster, the distance between the first and the second consonant should be less than or equal to the distance between the first consonant and the beat to which it is bound, whereas the distance between the second and the third consonant should be less than between the third consonant and the beat to which it is bound.

For instance, as in a sequence /astka /:



One can see that medials slightly overlap with finals (as in double clusters, cf. section 5.3.3.): this is due to the same three final doubles of the type: -j_l, -l_s, -n_k. The graph (*Figure 11*) below illustrates the space of medial triples as well as shows the medial doubles again.

	6	5	4	3	2	1	0		1	2	3	4	5	6	
6								sondis (C ₂ ,C ₃)							
5														wč	jp
4													wš	rč	rp
3												čn	ls	nč	nk
2												jm	ps		st
1											nl	ln	ns	sč	čt
0											jl	sn	čs	pč	
									jw	lr	mn	ss	čč	pt	
1	sondis C1,C2)						jl	jw	jwj	jlr	jln	jls	sondis (C ₃ ,V ₂)		
2				ls	ln	lr		lnl	lrl	ls	lss	lsč	lst		
3			nk	nč	nl	mn		mjl	mnl	n	nls	mnč	nt		
4			šw	st	sn	ss		šwl	šsl	snn	sts	stč	stt		
5		čw	čr	čn	čs	čč		čwl	črl	čsn	čss	čsč	čst		
6		pj	pr	kn	ps	pč	pt	pjw	pjl	psn	pss	psč	pst		
								prr	pjm	prn	prš	prč	prp		
								knn	kns	kns	kns	knč	knp		
								kns	kns	kns	kns	knč	knp		
								kns	kns	kns	kns	knč	knp		
								kns	kns	kns	kns	knč	knp		
								kns	kns	kns	kns	knč	knp		
								kns	kns	kns	kns	knč	knp		
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								kns	kns	kns	kns	knč	knp		
								kns	kns	kns	kns	knč	knp		
								kns	kns	kns	kns	knč	knp		
		</													

5.3.9. Cluster Space for triples

Figure 12a,b shows the preferred initial, final and medial triples together.

	6	5	4	3	2	1	0	1	2	3	4	5	6
6													
5			rpj	mpj	spj	čpj	kpj						
4		jpl		lčw mpr	mčw spr	pčw sčw čpr	ččw						
3		jpm	wčl rpm		wšw mčr skn	čšw mšw pčr fčr čkn	fšw ččr tkn						
2		jps	wčm rps	wšl wšt rčm nks		smj lmj čsl msl	nmj fsl						
1		jpč	wčf wčt rpč	wšn wšč rčf rčt nkč	jml jms lsn lsč		rlj						
0		jpt	wčž rpt	wšs rčž nkt	jmn lsf	jlr							

sondis (C_2, C_3)

Figure 12a. Cluster Space of the preferred initial, final and medial triples (continued on the next page)

5.4. Scopes of the phonotactic well-formedness conditions

The alternatives resulting from phonotactic well-formedness conditions 1 through 6 above are formally distinct in terms of relative sonority. In other words, they do not logically contradict one another, and thus do not produce inconsistencies. This can be readily checked if one runs all of them on a single sequence VCCCCV while gradually moving a potential word boundary (VCCCCV, V.CCCCV, VC.CCV, VCC.CV). VCCV is the only sequence that needs to be checked separately. The results of this cross-check are the following:

- exclusion: initial and final clusters are mutually exclusive, i.e. the same cluster cannot be a good initial and a good final at the same time;
- inclusion: double initials constitute a subset of triple initials (i.e., the former are included in the latter) and double finals constitute a subset of triple finals (again, the former are included in the latter);
- inclusion: medial triples must include medial doubles, since they cannot logically include initial or final doubles.

As far as the choice between the alternatives provided by phonotactic preferences 1 to 6 is concerned, they themselves imply that:

- a medial double VCCV is less marked than the respective initial or final cluster, since the double is a simple concatenation of VC and CV;
- a medial triple is less marked than the respective initial or final cluster, since it is a concatenation of a medial double and a VC or CV;
- doubles are less marked than triples, since they are nearer to single consonants.

Apart from the above predictions, additional criteria decide between alternative phonotactic scopes, such as:

- the preference for a better shape of a word-initial position, due to which good initial clusters are preferred over good finals.

5.5. On the potential of the presented model of phonotactics

The phonotactic well-formedness conditions presented above define the Cluster Space representing universally preferred distributions of clusters. The graphic representation of the Cluster Space helps illustrate that (a) the clusters defined as preferred in a given position in a word are not preferred in other positions (with the exception of a case of overlap between finals and medials); (b) the preferred clusters are preferred to a different degree, so that a direction from the least to the most preferred among the preferred can be established. Those two features of the Cluster Space clearly point to the fact that the conditions defining it have the nature of preferences, and *not* absolute constraints.

When a dispreferred cluster is selected (for example, a good initial functions as a medial), the “behaviour” of this cluster (in this particular example, when it behaves phonologically as if it were an initial) is predictable *solely* on the basis of the *Optimal Sonority Distance Principle*, i.e. the *same* principle in all cases. This is a substantial advantage in comparison to the phonotactic constraints based on the syllable, since in the latter case many different (and contradictory) syllabification principles are required in order to explain varying “behaviours” of clusters. For instance, in *atra*, a split of the cluster to *at + ra* as well as to *a + tra* is explicable by the *Optimal Sonority Distance Principle* (in both cases acting against a bad, i.e. dispreferred, medial *-tr-*). In syllable-based models, the first split may be dictated, for instance, either by Pulgram’s word-based syllabification rules or by stress-based

syllabification (if the first vowel is stressed). The second split, on the other hand, may be dictated either by maximal onset principle or by sonority sequencing principle.

Universal Cluster Space constitutes a matrix against which language-specific phonotactics can be described. More importantly, it also allows for the evaluation of a given language-specific phonotactics. In particular, more and less stable clusters can be distinguished, and thus predictions can be drawn as to their "behaviour" in language use, acquisition and change.

Universal phonotactic preferences (which are perceptually based) may be overridden by other preferences, for instance, speaker-friendly preferences (i.e. for articulatorily easy phonotactic sequences) or morphological preferences. As a consequence, it comes to conflict solutions among particular preferences which are most suitable within the system adequacy of a given language, since preferences "strive towards maximal benefits or expected utility" (Dressler 1999a: 392).

Universal preferences are best manifested in the changing systems. This concerns also the universal phonotactic preferences, thanks to which we can predict the development of clusters in language acquisition, their change in language history, their treatment in aphasia and casual speech, their rendering in extragrammatical phonology and morphology and in other areas of language use. Those areas, in turn, have the potential to provide evidence of universal preferences.

5.6. Advantages of the presented model of phonotactics over the Sonority Sequencing Principle

Phonotactic wellformedness conditions formulated in the B&B model are based on the Optimal Sonority Distance Principle, and *not* on the Sonority Sequencing Principle (or Generalization), formulated, for instance, by Selkirk (1984: 116) as follows¹¹²:

In any syllable, there is a segment constituting a sonority peak that is preceded and/or followed by a sequence of segments with progressively decreasing sonority values.

The weaknesses of the Sonority Sequencing Principle are the following:

(a) it does not differentiate between 'better' and 'worse' clusters among those that observe the sequencing, i.e. clusters like¹¹³ *pja, pla, tra, pra, fja, mja* etc. (which observe the B&B

¹¹² Sonority/consonantal strength as a criterion of syllabic organization has, of course, a long history, in modern times starting with Sievers' (1901) *Schallfülle* as a phonetic predecessor of phonological sonority. See Murray (1988: chapter 2) for a review of approaches to consonantal strength, Bethin (1992: 22-29) for generative and Polish approaches, and numerous other sources mentioned in Chapter 3 and Chapter 4.

¹¹³ This illustration takes an example of double initials. Other types of clusters described by particular phonotactic conditions are illustrated as follows:

Condition 2. *ajk, aws, ajm, alf, alp* etc. vs. *alm, amf, amp, afp, ast* etc. and *apw, apl, apn, aps, app, afl, aml* etc.

A variety of processes are applicable to the dispreferred clusters, i.e. consonantal-beat formation, epenthesis, weakening through assimilation or devoicing, or reduction.

Condition 3. *ampa, afka, aspa, anpa, alfa, ansa, asta* etc.

The preference ensures that the VC distance does not become greater than the CV one, as well as ensuring a balance among the three sonority distances. For instance, the distances in *alpa* are not well balanced, since the CC distance is much greater than the VC one (*alp, al* and *pa* are better), while in *atra*, the CC distance is bigger than CV (*tra* is a typical initial cluster). *amta* is better balanced than *atma*, although both undergo the preference.

Condition 4. *smja, psja, pxwa, psla, pxla, spla, spra, stra, spja, spwa, fpwa, zvja* etc.

Notice that among the preferred clusters one finds some notorious violators of the Sonority Sequencing Principle, e.g. *spra* or *stra*. This preference "prevents", among others, the distance C₁C₂ from being

phonotactic condition 1, cf. 5.3.1. above) and clusters like *m_la*, *s_na*, *f_na*, *k_na*, *t_sa*, *p_fa*, *p_sa* etc. (which mostly violate condition 1, or are the least preferred among those observing it); (b) it does not predict that the violators of the sequencing (i.e. clusters like *st_a*, *rt_a*, *ns_a*, *mn_a*, *x_fa*, *ss_a* etc.) may, under language-specific conditions, be more stable than the non-violating group mentioned above (*m_la*, *s_na*, *f_na*, *k_na*, *t_sa*, *p_fa*, *p_sa*).

The Optimal Sonority Distance Principle (in the case of double initials, phonotactic condition 1) predicts both (a) and (b). Evidence for the adequacy of the predictions comes from (i) diachrony: clusters of the *kn-*, *sn-* type tend to be unstable (ii) phonetics: clusters of the *ts-*, *pf-* type tend to become affricates, i.e. undergo fusion (iii) language-specific phonotactics: a language may have clusters like *rt-*, *st-* (the latter subtype is popular) i.e. of the type violating the Sonority Sequencing Principle, rather than *fn-*, *ml-* or *sn-* (iv) variation: in a popular pronunciation of It. *psicologia* 'psychology', the initial cluster becomes *sic-* or *pi(s)sic-*.

Another explanation why a language may choose *rt-* rather than *sn-* is based on the following reasoning: *rt_a* or *st_a* clusters are further (than *s_na*) from satisfying phonotactic preference 1. They become, therefore, subject to the most general preference for the **n**→**B** binding (in consequence, CV). As a result, one observes in these clusters processes like devoicing, epenthesis or assimilation which are, on the one hand, perceptually motivated (to get as near to the preferred CV as possible) and, on the other hand, lead to the improvement of a final phonetic effect also in the articulatory sense. Additionally, while clusters like *sn-* satisfy neither the preference 1 nor the CV preference, clusters like *rt-* or *st-* are, paradoxically, nearer to the latter since they already contain a prototypical **n**→**B** binding, i.e. an **n**→**B** binding enhanced by a maximal sonority distance: stop + vowel.

Such marked clusters may come into being, for instance, via deletions of beats, which are, for instance, due to phonostylistic, prosodic or morphological reasons (e.g. *potatoe* → *ptatoe*, *ratáta* → *rtata*; *leb*, *leba* → *lba*) or via metathesis of non-beats enhancing the **n**→**B** binding (e.g. *tsa* → *sta*, *tręć* → *rteć*).

A still further criterion in the differentiation of clusters is a distinction on the sonority scale between the class of sonorants and of obstruents. The intra-class sonority distance is perceived as less salient than the inter-class one. Thus, intra-class clusters are more susceptible to assimilations, simplifications and fusions, and generally tend more towards CV. Inter-class clusters, on the other hand, are expected to be more resistant to change. This qualitative difference between sonorants and obstruents works independently of the Optimal Sonority Distance Principle, and may influence the final fate of a cluster.

Generally, what contributes to the actual shape of a sequence are perceptual and articulatory preferences as well as rhythmical and lexical/morphological ones. Phonotactic preferences refer to a sequence of sounds as governed by sonority relations, which constitutes one aspect of phonotactics. Two other, closely connected, aspects are preferred word shapes and articulation-based correlational restrictions. The latter work as a filter for clusters favoured by

bigger than or equal to C₃V, which would lead to the formation of another beat (i.e. out of C₁ or C₂) and, thus, disintegration of a consonant cluster (as, for example, in *brn_a*, *lgn_a*).

Condition 5. *ajms*, *awst*, *arst*, *arts*, *ajks* etc.

Again violators of the Sonority Sequencing Principle come together with other clusters as preferred. Dispreferred, on the other hand, are e.g. clusters like *astr*, *altr*, *astm*, in which the last sonorant tends to get weakened or reduced, and *astf*, *apsk*, and longer clusters like *apstf*, *ampstf*, in which one or more consonants tend to get reduced.

Condition 6. *anspa*, *astka*, *astfa* etc.

astra, e.g., is not well balanced (*stra* is a typical initial cluster). Medial consonants of the preferred clusters tend to reduce phonostylistically (e.g. *astka* → *aska*, *aństfa* → *añsfá*), since the basic preference is satisfied anyway and the resulting clusters are better from the point of view of ease of articulation. *astra* does not reduce, since *asra* would not constitute an improvement.

phonotactic preferences and restrict them further. For instance, *ti* is better than either *ki* or *pi*, *bu* or *ku* are better than *tu*, *ri* or *li* are better than *ru* or *lu*, on purely articulatory grounds, according to Janson (cf. Section 4.2.4.), although they equally satisfy the CV preference.¹¹⁴ By the same token, a *tl*- cluster is articulatorily dispreferred, although it satisfies the phonotactic preference 1 (cf. 5.3.1. above).

¹¹⁴ I ignore here differences in sonority among vowels which would not, however, be helpful in comparing clusters with identical vowels.

PART II.

**INTERNAL LINGUISTIC EVIDENCE FOR
THE MODEL**

CHAPTER SIX

Language-specific phonotactics

In the present chapter I will examine selected aspects of the language-specific phonotactics of Polish, as well as, to a lesser extent, of English and German, against the background of the universal phonotactic preferences expounded in Chapter 5.

6.1. Polish

6.1.1. Generative phonotactics of Polish

Polish seems to be a language which notoriously violates the Sonority Sequencing Generalization (SSG). As Bethin (1992: 14) puts it: "Polish speakers tolerate extraordinarily complex consonant clusters except when they do not." Their paradoxical behaviour is commonly accounted for by the fact that the articulatory difficulty is dependent on the position of a cluster within the syllable (Bethin 1992: 14, 15). So, for instance, speakers would syllabify the word *warta* in the middle of the consonant cluster, but at the same time allow for the same cluster in word- and syllable-initial position, as in *rteć*. The latter represents a violation of the SSG¹¹⁵. There have been a few basic attempts at explaining this situation proposed by generative phonologists. Despite the fact that they represent different orientations within modern generative phonology, they share some basic strategic moves.¹¹⁶

First of all, there have been restrictions suggested with reference to Polish onset vs. coda. The Polish coda (or "post-nuclear rhyme constituent") is, generally, assumed to be more restricted: (a) a strong position is to claim that only sonorants are tolerated in the coda (cf. Gussmann 1991); (b) one of the more moderate positions is to state that the onset is preferably heavier than the coda (cf. Rubach and Booij 1990); (c) another moderate position is to maintain that a sonorant-coda requirement applies to an underlying representation (cf. Bethin 1992, who allows for any consonant in the coda at the word level of the derivation, and resyllabifications at the phrase level). The actual phonotactic sequences, full of undesirable clusters already at the lexical level, remain unaccounted for, however.

Interestingly, the proponents of positions (a) to (c) refer to native speakers' intuitions concerning syllabification as a basis for their claims about the structure of the Polish syllable.

¹¹⁵ A typology of such violations in Polish clusters is given by Rubach and Booij (1990: 122-3).

¹¹⁶ I do not wish to undermine the importance of principled differences among particular generative approaches and, consequently, the advantages some have against others. It is not so much the internal consistency of the generative approach that is liable to criticism here, but the validity of its basic principles judged from outside the model, from the point of view of Natural Phonology.

One can detect certain problem issues here, however. For instance, according to Gussmann (1992: 38), a predominant pattern of breaking words into syllables corresponds to V+sonorant C, e.g. *mo.kra.dwo*, *pa.stfi.sko*, *u.wzglen.dni*, *krnom.brny*. According to Rubach and Booij (1990: 126), already for clusters of more than two members the predominant parsing patterns are: VC.CCV, VC.CCCV, VCC.CCCV, where the C in the coda is any consonant. Which of the two parsings is observationally adequate?

As an explanation of the paradoxical behaviour of Polish speakers regarding their varied tolerance of clusters, Bethin (1992) suggests three levels of syllabification. This approach is self-contradictory, since, on the one hand, she refers to the syllable as a psychologically real unit supported by native speakers' intuitions, but, on the other, to the syllable as a conventional construct; native-speakers intuitions do not go so far as to reveal three abstract levels of representation of differently syllabified strings.

In fact, the very reference to native speakers' intuitions seems incompatible with the conventionalist nature of generative explanations, which are based on language-internal evidence and not on the actual use of language. For generative grammar, however, speakers' intuitions are also conventional and, thus, do not presuppose or reflect the variety of usage. Natural Phonology demonstrates that competence is the competence of performance, and what is language-external (and as such ignorable) for a conventionalist grammar is substantial and of essential importance for a naturalist grammar.

When developing from proto-Indo-European, Common Slavic is said to have demonstrated a conspiracy to create open syllable structure.¹¹⁷ Gussmann (1992: 38) takes it as background for the coda constraint in modern Polish as well as, in agreement with generative Slavic studies, for positing a vocalic segment at the end of words finishing in heavy clusters, so that phonologically, words have an open syllable finally. After the empty vowel has been deleted, the consonants remain unsyllabified. This is another abstract move of generative phonology, made in analogy to 'yers' (cf. e.g. Szypra 1992 for a review of literature).

Bethin (1992: 20) draws a parallel between the diachronic development of the syllable structure just mentioned and the synchronic derivation she proposes. She claims that the first cycle produces a structure similar to the structure of North West Slavic before the loss of weak yers i.e. CRVR (where: C stands for a consonant, R - for a sonorant, V - for a vowel), while the second cycle - the structure after the loss, i.e. CCVC. This analogy could work in the case of a morphophonological alternation with synchronic surface reflexes, but here constitutes another formal move imitating a complex phonological change. Since the most likely direction of change is towards the less abstract (unmarked; cf. Mayerthaler 1982) and towards the preservation of morphotactic transparency (cf. Dressler's Natural Morphology), one does not expect an earlier form to be preserved or get frozen at an abstract level for centuries. To support the abstract synchronic analysis one would need independent synchronic evidence, coming, for instance, from phonostylistics.

Another strategy to safeguard the exceptionless application of the SSG is to let part of the phonological material be extrasyllabic. In this way some segments are not seen by syllabification rules and the latter may thus observe the SSG as well as coda/onset constraints. At the end of the derivation the extrasyllabic consonants are adjoined in some way or another to the syllable or its constituent, to a word or phrase. For example, according to Gussmann (1991: 210), they are

¹¹⁷ Sound changes which took part in the Common Slavic conspiracy (cf. Dressler and Grosu 1972) were e.g.: the monophthongization of diphthongs, the metathesis of vowels and diphthongs, the prothesis of glides, the loss of final consonants (cf. Martinet 1952, Meillet 1924, Birnbaum 1975). By the end of Common Slavic new types of syllables appeared which formed the bases of various Slavic languages, of which Polish is particularly complex, while the South Slavic languages still show a very strong tendency for open syllables (cf. Bethin 1992: 20).

adjoined to the syllable by means of a mechanism of structure flattening, a formal move erasing the structure of the syllable when it is no longer needed for the purposes of derivation. In Rubach and Booij (1990: 123) one finds a hypothesis, originated by Fudge (1969) and entertained by many since then, that word-edge consonants are excluded from the SSG, which points to the difference between word- and syllable-phonotactics. However valid this difference is, it is expressed by means of a totally arbitrary constraint which, on the one hand, does not point to the background of the difference, and, on the other, renders sonority sequencing vacuous for the word-edge clusters which fully obey it.

There exists another way of looking at the phonotactic constraints of a language, i.e. by referring to co-occurrence restrictions between and within particular constituents of the syllable. The very existence of such collocational restrictions, and in particular the observation that they are more likely to exist between peak and coda than between peak or coda and the onset of the syllable (cf. the discussion in Selkirk 1982), has been taken as primary evidence for the constituent structure of the syllable. The latter is even better evidenced by languages like English, in which the strongest collocational restrictions obtain within the onset, peak and coda, while no restrictions exist between onset and peak (Selkirk 1982: 339). Thus, in order to state the well-formedness conditions on the syllable structure of a language, it is not enough to devise a syllable template for that language (cf. e.g. Selkirk 1982: 344 for English), but it is also necessary to supplement it with a statement of the collocational restrictions the language manifests (cf. Fudge 1969; Selkirk (1982) devises so-called auxiliary templates; for German cf. Hall, T.A. 1992).

A restriction of this kind claimed for Polish (Rubach and Booij 1990: 124 and 155, note 3) concerns codas: Polish is said not to admit codas of two sonorants, independently of the sonority constraint SSG. Words like *film*, *karm*, *szturm*, *farm*, *firm*, *urn*, *hymn*, *skoml* etc. apparently do not constitute counterexamples (most of them respect the SSG).

6.1.2. Descriptive phonotactics of Polish

After the short, critical sketch of the generative phonotactics of Polish, I would like to turn to the other extreme, i.e. to rather atheoretical descriptive phonotactics. I will report shortly on relatively new data on the frequency of consonant clusters in Polish, based both on running written texts as well as spoken samples.

Data concerning written texts (popular science and artistic prose) is taken from Dobrogowska (1990) for word-internal clusters and Dobrogowska (1993) for word-initial and -final clusters. I present frequency in text of particular clusters and the highest values of the ranking lists (i.e. the clusters quoted here are distinctly more frequent than the ones that follow them on the ranking list).

Word-initial clusters:

Table 1.

(1) Frequency in text		
CC-	20601	86,3%
CCC-	3072	12,9%
CCCC-	199	0,8%

Table 2.

(2) Ranking list								
CC-			CCC-			CCCC-		
1.	pš	3264	1,2.	ɛfj , zvj	280	1.	vzgl	85
2.	pr	1587	3,4.	str , zmj	188	2.	stfj	50
3.	st	1248	5.	fsp	182	16.	zdz bw	1
4.	vj	1163	6.	spr	172			
167.	nd	1	100.	nkr	1			

Word-internal clusters:

Table 3.

(3) Frequency in text		
-CC-	48164	85,11%
-CCC-	7265	12,84%
-CCCC-	1107	1,97%
-CCCCC-	49	0,09%

Table 4.

(4) Ranking list								
-CC-			-CCC-			-CCCC-		
1.	st	1682	1.	stk	261	stkj		60
2.	vj	1610	2.	str	144	stf, nskj , fskj , rstf , rskj , jskj, lskj , nstr, pskj etc.		
395 clusters of 163 ranks, ranging from 3.(925) to 395.(1), linear very gradual decrease in frequency			444 clusters of 61 ranks (159 clusters appeared once)			79 clusters of 20 ranks (39 appeared once)		

Word-final clusters:

Table 5.

(5) Frequency in text		
-CC	3045	95,5%
-CCC	110	3,4%
-CCCC	27	0,8%
-CCCCC	7	0,2%

Table 6.

(6) Ranking list							
-CC			-CCC			-CCCC	-CCCCC
1.	ɛtɛ	766	1.	nkt	42	ɲstf 15 rstf pstf	mpstf 7
2.	nts	761	2.	ntɕ	22		
3.	nt	418	3.	jɛtɛ	19		
4.	ɲtɛ	229	14 clusters				
5.	st	186					
80 clusters (23 appeared only once)							

All clusters:

Table 7.

(7) Frequency in text	
CC	85,8%
CCC	12,5%
CCCC	1,6%
CCCCC	0,07%
CCCCCC	0,001%

Dunaj (1985) supplies the data on consonantal clusters of spoken Polish. The total number of examples with clusters that he takes into consideration is substantially smaller (3,000 examples with word-initial clusters, 10,000 examples with medial clusters, and 1417 examples with final clusters; cf. respectively (1), (3), and (5) above) than that of Dobrogowska. Moreover, his ranking lists are construed for all types of clusters in a given word position together. Still, as far as the data are comparable, there is a substantial agreement between the results of both collections: I have indicated the overlapping clusters by bold type in the tables above. An undoubtable advantage of Dunaj's analysis is his adoption of a phonological rather than a lexical word as a domain of phonotactic constraints. According to Dunaj (1985: 10ff), a Polish phonological word can include a preposition, a negative particle or an enclitic.

6.1.3. Polish phonotactics and the universal phonotactic preferences

Let us have a look at the Polish clusters listed above from the point of view of the B&B model of phonotactics. As far as the complexity of clusters is concerned, although Polish is known as a cluster-rich language, in fact, 85,8% of all occurring clusters are double clusters only. Out of these, in absolute numbers, in 48,164 of cases the doubles occurred medially, 20,601 times -

initially, and only 3,045 times - finally. This relation (ca. 16 : 7 : 1) of medials : initials : finals is maintained also by all other, more complex clusters. These facts reflect very well the predictions of the model:

- a language is expected to prefer less complex clusters once it admits clusters at all;
- medials are the least marked, and initials are preferred over finals (cf. Chapter 5, section 5.4.).

Before we inspect the make-up of particular clusters according to B&B phonotactic conditions, let us shortly refer to a typology of the violations of the Sonority Sequencing Generalization by Polish clusters in word-initial and -final position presented by Rubach and Booij (1990: 122-123). If we look at the clusters in (2), (4) and (6) above against the background of this typology¹¹⁸, we notice that: (a) among CC clusters, the initial *st-* constitutes a violation of the SSG; (b) among CCC clusters, 5 of the 6 listed initial clusters are violators, and the more frequent one of the two listed finals is a violator; (c) all 4- and 5-member clusters violate the SSG. Additionally, one cannot estimate medial clusters without relying on some syllabification principle. Therefore, the SSG is not a reliable predictor of frequent phonotactic combinations in Polish.

Within B&B phonotactics, we shall see to what extent Polish phonotactics respects universal preferences. Inspecting the cluster space for doubles shows the following status of the frequent Polish double clusters:

Table 8. . Polish doubles vs. the universal cluster space for doubles (cf. Chapter 5, 5.3.4.).

	cluster space respected	not respected
initials:	pr- and vj-	pʂ- and st- (good medials)
medials:	-st-	-vj- (good initial)
finals:	-nt	-ɕtɕ, -nts, -ɲtɕ, -st (good medials)

We can see that some of the good medial clusters (pʂ and st) function as initials in Polish, while others (ɕtɕ, nts, ɲtɕ, st) as finals. All of them demonstrate some articulatory adaptations in connected speech: the former towards coalescence (monosegmental treatment, cf. also Gašiorowski 2000 for 'presigmatized stops'), the latter towards simplification (they are regularly reduced in casual speech, cf. e.g. Dunaj 1985). For instance, in the word *puść* /puɕtɕ/ 'let go', the cluster gets reduced in connected speech to give [puɕ]. However, it remains unchanged in the word-medial position in *puścić* /puɕtɕitɕ/ 'to let go', i.e. in another morphological form of the word concerned, in which it respects the cluster space. Thus, the clusters not respecting the universal space are directly controlled by the CV preference and the general preference against clusters. One good initial (vj-) appears also as a medial. It is therefore, predictably, treated as an initial in parsings (syllabifications) of the relevant words and sequences.

¹¹⁸ Rubach and Booij's typology includes CC, CCC, and a few longer clusters, word-initially and -finally. Among CCC clusters it lacks: fricative+obstruent+sonorant initially, sonorant+stop+stop finally.

Table 9. Polish triples vs. the universal cluster space for triples (cf. Chapter 5, 5.3.9.)

	cluster space respected	not respected
initials:	ɸfj, zvj, str-, zmj-, spr-	fsp- (good medial)
medials:	-stk-	-str- (good initial)
finals:	-nkt (also a good medial), -ntʂ (also a good medial) -jɕtɕ	

Almost all frequent triples clusters in Polish respect the universal cluster space, i.e. observe the universal phonotactic preferences. There is one good medial (fsp) which appears initially; however, it also tends to be simplified in connected speech (e.g. /fsp/ólczesny → [sp]ólczesny)¹¹⁹. A good initial (str) appears also medially, and thus is, predictably again, treated as an initial in parsings (syllabifications) of the relevant words and sequences.

Contrary to estimates of Sonority Sequencing Generalization as well as to the current opinion, Polish clusters of high frequency, and especially the more complex ones (triples), observe universal phonotactic preferences in the majority of cases (of the above considered clusters, 13 did, 9 did not) if estimated by the B&B model of phonotactics. Medial clusters are estimated according to the same criterion (OSDP) as the initial and final ones, without recourse to any parsing principle. Language-specific clusters found in a wrong place of the universal space are subject to the more general CV preference eventually working against any clusters. Last but not least, B&B phonotactics can predict ways in which clusters are going to be parsed in the phonological processing of sequences.

For example, one can predict the ways in which speakers will tend to parse phonological words when they are asked to do so or when speaking with emphasis and slowly, and in similar situations. When parsing, speakers produce "small" phonological words ("small", since shorter than the original) which obey word-initial and -final phonotactics. They hesitate if a word-internal cluster is, in fact, a preferred word-internal cluster and is thus not liable to any particular parsing, or if a cluster is mixed with reference to the phonotactic preferences. Let us have a look at the possible parsings of a few Polish words. In *mokradło* both /kr/ and /dw/ clusters qualify as word-initial clusters, therefore one can predict the parsings to follow accordingly. In *pastwisko* both /stf/ and /sk/ are preferred word-internal clusters. Therefore, a speaker will hesitate and either produce no clear parsing or, at best, parse according to CV preference. In *uwzględni* /ndn/ is satisfactory in a word-internal position, while /vzgl/ is mixed, since /gl/ qualifies as a good word-initial cluster, and the best a speaker can do is to reproduce it as word-initial (to the disadvantage of the word-final position, however). In *krynąbrny* /mbrn/ is satisfactory only word-internally. As one can see, a suggested V+sonorant syllabification of the above words (cf. 6.1.1.) is not derivable from the phonotactic preferences of the B&B model, since it constitutes too gross a generalization to be compatible with those preferences in principle. Neither can the parsing patterns based only on the position of consonants be derived from the phonotactic preferences. Parsings like VC.CCV, VC.CCCV, VCC.CCCV (cf. 6.1.1.) are blind to the quality of the consonants in question.

¹¹⁹ For a more detailed discussion of phonostylistic processes illustrating phonotactic preferences see Chapter 14.

6.2. English

6.2.1. Descriptive phonotactics of English

For data on English phonotactics I rely on a classic work by Trnka (1966). He examined clusters found in English morphemes within monomorphemic monosyllabic and disyllabic words (i.e. one-beat and two-beat words). I will here concentrate only on the most productive consonant clusters in the most productive words.

One-beat words

The following were found to be the most productive (in relative terms of productivity of types) mono-beat word-types in English: *a, ba, bba, ab, bab, bbba*. The following clusters were found to be most productive in one-beat words (in a descending order):

Table 10.

initials	st- , br-, kr- , gr-, fl-, kl-, sl-, tr- , sk- , sp- , bl-, dr-, str-, skr-, skw-	65% of all initial clusters
finals ¹²⁰	-st, -nt , -ŋk, -nd , -mp	43% of all final clusters

Two-beat words

The most productive word-types are: *babab, baba, babbab, babba, bbabab, bbaba*. The following clusters were found here to be most productive (clusters which overlap with the above ones are in bold type):

Table 11.

initials	tr- , pr-, st- , sk- , kr- , sp-	45% of all initial clusters
medials	-nd-, -st-, -mb-, -nt-, -ŋg-, -mp-, -ns-, ŋk-	40% of all medial clusters
finals	-nt -ks, -nd , -ns	71 of 156 } 78% 50 of 156

6.2.2. English phonotactics and the universal phonotactic preferences

All but three of the listed clusters are double clusters. Thus, the prediction of B&B phonotactics that a language is expected to prefer less complex clusters once it admits clusters at all is borne out in English, too.

Table 12. English clusters vs. the universal cluster space for doubles and triples (cf. Chapter 5, 5.3.4. and 5.3.9.).

	cluster space respected	not respected
initials:	br-, kr-, gr-, fl-, kl-, sl-, tr-, bl-, dr- str-, skr-, skw-	st-, sk-, sp-
medials:	-nd-, -st-, -mb-, -nt-, -ŋg-, -mp-, -ns-, ŋk-	---
finals:	-nt, -ŋk, -nd, -mp	-st, -ks, -ns

¹²⁰ Note that final clusters do not belong to any of the productive mono-beat word-types at all.

One can see that the vast majority of English clusters respect the universal cluster space, i.e. observe the universal phonotactic preferences. All but six double clusters are good clusters in their respective positions, and the three listed triples are also good (notice that they do not respect the Sonority Sequencing Generalization). The violators in the initial position are s+stop clusters, which demonstrate articulatory adaptations allowing for their monosegmental treatment (see above, section 6.1.3.). In the final position, alveolar stop in -st tends to get reduced (e.g., in *must*, *past*), alveolar fricative in -ks may function in analogy to the morphological suffix {-s}¹²¹, and the cluster -ns is typically broken by an alveolar stop, which results in a good final cluster -nts, e.g. in *prince*.

6.3. German

6.3.1. Descriptive phonotactics of German

The data on German phonotactics quoted below are taken from Ortmann (1991). I will concentrate on the tables of text frequency of consonant clusters in word-initial, -medial and -final position calculated on the basis of the list of 7,994 word-forms (cf. Ortmann 1991: 185-203). The presentation here will be limited to the clusters of text frequency higher than 0.1 % for word-initials and -finals (calculated respectively from: 6,942,006 words for word-initial clusters and 7,578,447 words for word-final clusters) and to the clusters of frequency higher than 0.5 % for word-medials (calculated from 5,261,720 words).

Table 13.

initials	ʃt, fr, gr, gl, tr, <u>tsv</u> , br, pr, bl, kr, kl, dr, ʃl, ʃv, ʃp, ʃr, ʃpr, fl, ʃtr
medials	nd (rank 8!), rd, nt, lç, lt, st, çt, rt, <u>nts</u> , rx, rl, <u>rts</u> , ʃt, rf, rg, rb
finals	nt, çt, st, rt, ls, lt, rn, ns, rç, kt, ft, xt, pt, <u>tst</u> , <u>nts</u> , lpst, rs, rst, <u>çts</u> , mt, nst, <u>rts</u> , rk

6.3.2. German phonotactics and the universal phonotactic preferences

Also in German, the majority of the frequent clusters are doubles (there are only two initial triples listed above, no medial triple, and two final complex clusters - a triple and a quadruple), which shows the avoidance of complexity.

¹²¹ While the -ks cluster may also result from reductions of triples, e.g. in next -kst → -ks; phonostylistic clusters were not taken into account by Trnka, though.

Table 14. German clusters vs. the universal cluster space for doubles and triples (cf. Chapter 5, 5.3.4. and 5.3.9.).

	cluster space respected	not respected
initials:	fr, gr, gl, tr, br, pr, bl, kr, kl, dr, \int l, \int r, fl \int pr, \int tr	\int t, \int sv, \int v, \int p
medials:	nd, nt, lç, st, çt, n <u>ts</u> , rx, rl, \int t, rf	rd, lt, rt, r <u>ts</u> , rg, rb
finals:	nt, rt, ls, lt, rç, rs, mt, r <u>ts</u> , rk	çt, st, rn, ns, kt, ft, xt, pt, <u>tst</u> , <u>nts</u> , <u>çts</u> rst, nst (lpst)

Most initial clusters observe the universal phonotactic preference; the only ones which do not are again (see Polish and English) fricative + stop¹²² or obstruent + obstruent clusters which are prone to phonetic adaptations and are thus liable to monosegmental interpretation. Both listed triples respect the relevant preference.

Among the medial clusters listed (all of them doubles), all but six respect the universal phonotactic preference for doubles. The violators are all liquid + stop clusters (in one case liquid + affricate), which qualify as good word-final clusters. A reason for treating them as medials may lie in *Auslautverhärtung*: the clusters containing a voiced stop would not be able to contrast with those containing a voiceless one in word-final position. Word-medial position allows for parsing them according to, respectively, **B←n** and **n→B** binding.

Among the final clusters, 9 respect the relevant preference, i.e. the one describing final doubles. A complex cluster /lpst/ tends to reduce to /lps/ (e.g. in *selbst*) which is a good final cluster. The other 13 clusters from the ones listed above are violators of the phonotactics of final clusters. All of them would be good medials. In most cases they contain a /t/ as the second element, or else /s/ and /ts/, in one case a non-obstruent /n/. When these clusters appear in the final position in words, the second obstruent element tends to get reduced, the more so since the clusters appear in words of very high token frequency, as e.g. in *und, ist, jetzt* etc. On the other hand, the final /t/ is often a grammatical marker and may need to be maintained for morphological purposes, unless there is enough redundancy in an utterance, e.g. *gibt, liegt, kommt* etc. On the whole, word-final position in German is the most tolerant with respect to universal conditions on clusters while, at the same time, clusters in this position tend to get 'repaired'. This status of a word-final position is predictable on the basis of the semiotic principle of figure-and-ground in relation to the shape of the word.

6.4. Processes "repairing" phonotactics

There are processes which apply (in phonostylistics and, ultimately, in diachrony) to language-specific clusters violating universal phonotactic preferences or to those respecting the preferences to a lesser extent, or, finally, to any clusters. There are at least four types of such processes: formation of a consonantal beat, epenthesis, weakening (through devoicing or assimilation) and reduction (including elision)¹²³.

¹²² Additionally to the articulatory accounts of such clusters already given, one can argue that an initial fricative articulated within an alveolar region constitutes the most balanced beginning of a word-initial cluster from the speakers's point of view. It is balanced in the sense that the speaker starts a word from the most neutral position of articulators without the effort of a particular articulatory movement.

¹²³ See also Chapter 14 on phonostylistics.

A consonant is likely to become a beat when it appears in a phonotactically dispreferred cluster and it will, as a beat, contribute to the creation of either an **n→B** or an **B←n**. For example, *r̥* in *atr* contributes to the creation of a new **n→B** binding, in *rta* - a **B←n** binding, while *r* does NOT become a consonantal beat in *art* *{**BBn**} or *tra* *{**nBB**}. These conditions, however, are not sufficient for any consonant which fulfills them to necessarily become a beat: so, e.g. in Polish 100% of *-dw* clusters in Dunaj's data of spoken Polish (Dunaj 1985: 33) undergo reduction *-dw* → /d/ (which gets devoiced to [t]).

The form of epenthesis (prothesis or anaptyxis) is predictable on the basis of the strength relation between bindings: **n→B** preferred over **B←n**, e.g. in a (phonotactically dispreferred) sequence *apl* we expect the creation of a cluster *pV* rather than *lV*, i.e. *apl* → *apəl*. In a sequence *amp* (which, by the way, already respects the preference for final doubles), however, we expect *amp* → *ampə*. E.g. Lat. *poculum* 'mug' < *poclom*; Serb., Croat. *fakat* vs. Russ., Pol. *fakt*.

There is a tendency for a regressive assimilation in voicing and place in stop+consonant clusters towards an affricate as an output (possibly resulting in a fusion), e.g. *tʂa* → *tʂa*, *tʂa* → *tʂa*, *atr* → *atr̥*, *atm* → *atm̥*.

Clusters are likely to simplify through elision of a consonant so that the stronger binding (**n→B**) remains unchanged or the only binding in a cluster is maintained, e.g. (Dunaj 1985) *kna* → *na*, *zna* → *na*, *ɕz̥* → *ɕ*, *ast* → *as*, *ant* → *an*, *adw* → *ad*, *alka* → *aka*. A specific realization of elision depends both on the status of a cluster (i.e. a degree of its goodness) and its position in a word. For example, *prV* and *knV* both respect the cluster space for doubles, but *knV* to a much lesser extent. As can be observed, *prV* reduces to → *pV* while *knV* reduces to → *nV*. The figure-and-ground principle for the word contributes to this difference: *p* in *prV* is and remains the figure against the ground of the word since the initial cluster fully respects universal phonotactics, e.g. Sanskrit *prajnā* 'knowledge' > *paññā*, *srotas* 'stream' > *sota* (Vennemann 1988a: 15). In *knV*, on the other hand, a *knV* → *nV* change is expected, e.g. Grm. *Nest* 'nest' vs. Russ. *gniezdo*; English *knee*, *gnome*, *gnat* vs. German *Knie* /kni/, *Gnom* /gnom/, *Gnatze* /gnatse/ (Vennemann 1988a: 19).

Clusters tend to get reduced or assimilated even when they respect the preferences, which is motivated by ease of articulation, but simultaneously improves perception, e.g. in Polish: *aska* → *aska*, *aɲza* → *aza*, *arfʂa* → *arʂa*. Indoeuropean **oktō(u)* 'eight', due to the articulatory difficulty of *-kt-*, changed e.g. to *acht* in German, *ocho* in Spanish, *otto* in Italian etc. (cf. Serébrennikow 1975: 198). Other examples: Lat. *summus* 'highest' < *supmos*, It. *fatto* 'done' < *factum*, Fin. *maassa* 'on the side' < *maasna*; Russ. *mylo* vs. Pol. *mydło* (cf. Serébrennikow 1975: 199).

CHAPTER SEVEN

Phonological processes

It has traditionally and repeatedly been claimed that certain phonological processes cannot be accounted for without recourse to the domain of a syllable. Hereafter, I will refer to two such processes, namely the so-called *Auslautverhärtung* and a process of stress assignment, in this order. When discussing the processes, I will, firstly, present a common, syllable-based interpretation of both of them respectively and, secondly, a syllable-less interpretation within the Beats-and-Binding model.

7.1. *Auslautverhärtung*

7.1.1. What is *Auslautverhärtung*?

Auslautverhärtung belongs to the family of devoicing processes and consists basically in the devoicing of a domain-final obstruent, where the domain is constituted by a word, but possibly also by a word-internal constituent, such as a syllable or morpheme¹²⁴. The term itself means "strengthening of a coda" and as such implies a change of a consonant from lenis to fortis, i.e. devoicing together with strengthening. A possible variant of the process is pure devoicing without the change in strength, which results in a voiceless lenis consonant. Anyway, in both cases, the resulting consonant is different from lenis voiced. In English terminology, one talks about final obstruent devoicing, with a notorious lack of an explicit referent for "final" - implicitly, one most often means a word. The family mentioned also comprises other syntagmatic devoicings, which belong to progressive and regressive voicing assimilations¹²⁵. The preference for obstruents to be voiceless is also a paradigmatic preference and has an aerodynamic phonetic basis. Therefore, when talking about *Auslautverhärtung*, we are dealing

¹²⁴ I will not be concerned with domains larger than a word here.

¹²⁵ See, e.g., Barry (1989) on sonorant devoicing in Russian, Lew (1997) on voicings and devoicings in Polish, Słowiacek & Dinnsen (1985), Słowiacek & Szymanska (1989), Jassem & Richter (1989) on word-final devoicing in Polish.

simultaneously with a syntagmatic assimilation, paradigmatic preference, phonetic adaptation and, possibly, a morpheme structure constraint.

In the terminology of Dressler (1985), obstruent devoicing is a natural process type. As a context-free process it is responsible for the priority of voiceless obstruents over voiced ones in the systems of the languages of the world (cf. Dogil and Luschützky 1990). As a context-sensitive process it is a phonetically motivated coarticulatory phenomenon (assimilation to a pause or a voiceless sound) driven by the ease of articulation principle.

It has traditionally been assumed (cf., e.g., Siebs 1969) that in a prescriptive German standard obstruent devoicing applies not only in a word-final position (as in many other languages, e.g. Polish or Russian), but also in a "syllable-final position", e.g. in: *täglich* 'daily' *Redner* 'speaker', *Wedler* 'a skier', *Lobmeyer* 'a name', *Bildnis* 'a portrait', *loblich* 'laudible' etc. As can be observed in the above words, a context for the devoicing of an obstruent is phonetically unmotivated: the following consonant is voiced. This implies that obstruent devoicing may not be a purely phonological process. Additional evidence comes from the observation that it is suppressable, which is impossible in the case of a purely phonological process. The suppression is demonstrated by abbreviations (also acronyms) in German: *Log* [log] for 'logarithm' vs. *Lok* [lok] for 'locomotive' (Dressler 1985: 93).

According to Stampe (1979: 29) the devoicing process in German is "morphophonemic", i.e. it neutralizes an underlying distinction, and this makes it a candidate for becoming a morphological rule, for which neutralization is a constitutive property (cf. Dressler 1985 for the criteria). A possibly "morphophonemic" status of obstruent devoicing is, however, disputable: there exists some phonetic evidence for the non-neutralizing nature of the process. It has been found that languages maintain a distinction between phonologically voiced and voiceless obstruents in the supposed neutralizing context at the phonetic level by means of: (a) a longer period of voicing after the offset of the preceding vowel, (b) a shorter duration of an obstruent and /or (c) a longer duration of the preceding vowel (for phonologically voiced obstruents). Evidence for at least one of the above types of incomplete neutralization has been found for German (cf. Port, Mitleb and O'Dell 1981, O'Dell and Port 1983, Charles-Luce 1985)¹²⁶, for Polish (cf. Slowiaczek and Dinnsen 1985), for Russian (cf. Chen 1970, Pye 1986), and less convincingly for Catalan (cf. Dinnsen and Charles-Luce 1984)¹²⁷.

The universal characteristics of obstruent devoicing as a phonological process do not, however, exclude a potential, language-specific, at least partial or gradual morphologization of the process. Among other reasons, the reluctance to admit this resulted in the introduction of a syllable boundary as a traditional phonological context for the process in the absence of a phonetically natural context (i.e. a pause or a voiceless consonant). However, a functional account of final obstruent devoicing at both the segmental AND morphological levels has already been proposed, for instance by Brockhaus (1990, 1991, 1992). At the segmental level voiceless stops are perceptually easier to identify than their voiced counterparts. This property, she argues, is employed as a boundary signal for the hearer, to whom morphological structure becomes more accessible through devoicing.

7.1.2. *Auslautverhärtung* in B&B phonology

Couched within the Beats-and-Binding framework, the process of *Auslautverhärtung* is accounted for without direct recourse to any particular domain.

¹²⁶ Although compare some counterevidence in Fourakis and Iverson (1984).

¹²⁷ See also a discussion of the issue of incomplete neutralization in Pye (1986), Nolan (1986), Brockhaus (1992).

- *The conditioning factor for the process to apply is the lack of the **n→B** binding of the obstruent concerned.*

That is, the obstruent will be liable to devoicing, if it is followed by a pause or by another consonant (there is no binding between consonants)¹²⁸. This condition covers word-final position as well as a context of another consonant (no matter whether voiced or voiceless!) word-medially. If the condition were lifted, the obstruents concerned would naturally assimilate to their right-hand environment, i.e. either remain voiced or become voiced in the voiced context, and remain voiceless or become voiceless in the voiceless context.¹²⁹ The lack of the **n→B** binding is characteristic of a consonant in word-final position (single or before (an)other consonant(s)) and in word-medial position after a vowel and before another consonant. This is what the consonants in those two positions share. Thus, one can expect some similarity in the phonological behaviour of the two: the word-medial one tends to get devoiced in analogy to the word-final one, and it is difficult to maintain voicing in word-final position (cf. Dinnsen 1980). One accounts for both contexts of the process in a unanimous fashion, by means of one common condition. There is yet another feature those two consonants have in common: they may also lack the other, **B←n** binding, if preceded by a consonant, e.g. in *Wand*, *mündlich*. At this point one must note that a consonant may lack both bindings also in the word-initial position, e.g. Pol. *mdleć* 'to faint'. Still, there is an essential difference: if a consonant lacks the **n→B** binding in the word-initial position (and this is the condition of *Auslautverhärtung*) it also necessarily lacks the **B←n** binding. In fact, word-initial consonants ALWAYS lack the **B←n** binding. Thus, the three positions in a word form a hierarchy with respect to the occurring bindings:

Table 1. Potential occurrence of bindings within a word

	n→B	B←n
word-initial	YES/NO	NO
word-medial	YES/NO	YES/NO
word-final	NO	YES/NO

The hierarchy clearly shows the word-final position as the most preferred context for obstruent devoicing, since the specified condition is always satisfied. Word-medial position is the second likely context, since here there are already competing forms (cf. *Tage* - both bindings present, *Hunde* - **n→B** binding present). Word-initial position qualifies as the worst context, and is disqualified in German which maintains voicing in the case of a permanent lack of the **B←n** binding (which otherwise could be a potential source of voicing, but word-initial position logically excludes this). Otherwise, no initial cluster in German could start with a voiced obstruent.

The word-medial context, being predictably less preferred than the word-final one, requires additional specifications. Firstly,

- *The phonotactic make-up of the medial cluster influences the application of Auslautverhärtung.*

¹²⁸ Note that the case of a consonant followed by a sonorant word finally is different: most often, this sonorant functions language-specifically as a consonantal beat. Therefore, the consonant which precedes the sonorant is bound to it (cf. e.g. Barry 1989). Otherwise, there is a vowel in between the two, or the sonorant gets desonorized.

¹²⁹ This is, for instance, the case in Austrian German or in Polish spoken in the western part of Poland.

On the basis of phonotactic preferences it can be predicted that the more a medial cluster qualifies as an initial, the less likely is devoicing to apply. Additionally, language-specific phonotactics may amplify or override universal phonotactic preferences. Let us inspect a number of examples from this perspective. The examples¹³⁰ come from Northern German standard pronunciation (so-called "reine Hochlautung" according to Siebs 1969¹³¹).

Table 2. *Auslautverhärtung in German "Hochlautung"*.

ü:blə	o:brən	ɛpma	e:pən
a:tlər	vandrər	vitmən	re:tnər
re:gluŋ	vaigrə	zekment	re:knən

All clusters in the above examples qualify as good initials according to the universal preference for initial doubles. However, they take different positions in the cluster space as far as the degree of preferability is concerned. Thus, stop+liquid clusters are preferred by two degrees over stop+nasal ones (the latter are actually the least preferred of the initial clusters). This difference in degree is precisely reflected in the susceptibility to devoicing of the stops involved in the clusters: all stops in bm, dm, gm, bn, dn, gn are devoiced, while in the clusters bl, dl, gl, br, (n)dr, gr, all but one resist devoicing. The only exception is dl, which becomes tl¹³². Since initial dl is not allowed by language-specific phonotactics of German, the latter overrides the universal preference. The stop+nasal clusters bm, dm, bn, dn also do not occur initially in German, while gn and gm very rarely. In this case, language-specific phonotactics reinforces the universal preference, which results in devoicing. The same can be said about the stop+liquid clusters: since the clusters do occur in German (with the exception of the already discussed dl), language-specific phonotactics reinforces the universal preference, which results in maintaining voicing.

Secondly,

➤ *The morphological make-up of the word influences the application of Auslautverhärtung.*

A morphological boundary following the consonant concerned reinforces the word-final-like status of the consonant and thus conspires to trigger devoicing while at the same time devoicing enhances the transparency of the boundary. This is a clear case of an overlap or conspiracy of phonological and morphological criteria: morphology reinforces a phonological process, phonology enhances a morphological structure, as in, for example, *trag#bar*. Morphology may also override phonology (in accordance with the semiotic precedence of the former over the latter), as in e.g. *täg#lich* which differs from the above [re:gluŋ] by the presence of the morpheme boundary.

¹³⁰ I owe the examples to Elke Ronneberger-Sibold (manuscript and personal communication).

¹³¹ There are other German standards, to which I am not referring at the moment. One needs to analyse each of them separately with reference to *Auslautverhärtung*, since the application of the process varies across varieties of German. In standard Austrian German, for instance, there is no word-internal *Auslautverhärtung*, while in a word-initial position a voiceless lenis sound predominates.

¹³² But (Dressler, pers.comm.) *Adler* has [dl] in Austria (among others), because diachronically it comes from older *Adel#Aar*, cf. *ad(e)lig*, *Edler*.

The morphological function of the process is particularly well demonstrated by such pairs as e.g. *erb* # *lich* 'hereditary' vs. *er* # *blich*, past form of *erbleichen* 'to fade'; *folg* # *lich* 'so, therefore' vs. *ver* # *glich*, past form of *vergleichen* 'to compare', in which the placement of a morpheme boundary decides about the presence versus absence of devoicing in identical clusters.

Another illustration is the pronunciation of the words *Handlung* and *handlich*. In both words, the cluster concerned is *dl*. The latter word appears in the German standard discussed above always as [hant # liç], i.e. with devoicing at the morpheme boundary (and in agreement with language-specific phonotactics). The former word, however, appears either as [handluŋ] or [hantluŋ]. There is no morpheme boundary to trigger the final result. The pronunciation without devoicing respects universal phonotactics, the pronunciation with devoicing respects the language-specific phonotactics, as discussed above in the case of [a:tlər].

Recapitulating, B&B phonology proposes three conditions for the application of *Auslautverhärtung*:

- *The conditioning factor for the process to apply is the lack of the n→B binding of the obstruent concerned.*
- *The phonotactic make-up of the medial cluster influences the application of Auslautverhärtung.*
- *The morphological make-up of the word influences the application of Auslautverhärtung.*

While the first condition is a necessary one, the second is subordinate to the third one.

7.2. Stress assignment

7.2.1. Italian

7.2.1.1. Syllable approach

A general accentuation rule of Italian formulated within a syllable approach states that a heavy penultimate syllable attracts accent, i.e. prevents accent from being placed further to the left. So, for instance:

Adólfo, *adúlto* 'adult' vs. *ídolo* 'idol', *capítolo* 'chapter'

Ansélmo vs. *ángolo* 'angle', *ángelo* 'angel'

Albérto vs. *álbero* 'tree'

bastárdo 'bastard' vs. *bárbaro* 'barbaric'

Orlándo, *Rolándo* vs. *Cándido*, *Stéfano*

Clotilde vs. *Dávide*

The rule as formulated above does not exclude a light penult being accented, so that beside *ángelo* 'angel' one finds *Barólo*, beside *álbero* 'tree' - *intéro* 'entire', beside *Cándido* and *Stéfano* - *Befána*.

The above is not, however, a complete picture of Italian accentuation. In the cases of intervocalic consonantal clusters of **muta cum liquida**, one traditionally identifies two different syllabifications which are supposed to be responsible for two different accentuation patterns (or, the other way round, one draws conclusions about different syllabifications on the basis of the occurring accentuation patterns). One class of examples consists of words in which both a stop and a liquid syllabify to the right, which makes the penultima light and does not prevent the shift of stress to the antepenultima. Examples include Italian words of Greek and/or Latin origin, e.g.: *Péricle*, *Pátroclo*, *Sófocle*, *ánatra* 'duck', *íntegro* 'integral', *múltiplo* 'multiple', *chilómetro* 'kilometer', *pedómetro* 'foot measure', etc. In the other class of words, a stop is

claimed to syllabify to the left, which makes the penultima heavy and thus lets it carry stress, e.g. in: *Cleopátra*, *Meleágro*, *psichiátra* 'psychiatrist', *poliédro* 'polyadic', etc. Also words containing geminates belong to this group, e.g. *tarócco* 'a card game', *midóllo* 'marrow', *bidélllo* 'janitor' (and never *CVCVttV).

There exists also a set of lexical accents of the sort found in *ancóra* vs. *áncora* 'anchor' (cf. Lichem 1970: 126-130). Italian also demonstrates morphoprosodic accentuations, resulting from a diachronic grammaticalization (cf. Hurch 1996). For example, in *abbandoneró* 1 PERS.SG.FUT 'I will give up', the primary accent location is morphoprosodic, while the overall accent pattern follows the regular prosody, i.e. *àbbandòneró* (Hurch 1996: 83-85). In *genericaménte*, the morphoprosodic accent matches the prosodic principles. One can observe that the prosodic accentuation constitutes a superior principle to the morphoprosodic one, since the putative forms contradicting prosody, e.g. **genericámente* (Hurch 1996: 85), are unpronounceable.

7.2.1.2. The B&B approach

Within the Beats-and-Binding model, the main stress assignment rule of Italian involves two conditions:

- *binding condition*: stress falls on a penultimate beat if it *necessarily* binds a consonant to its right, i.e. in is involved in a **B←n** binding; otherwise, it moves left to an antepenult
- *phonotactic condition*: if a relevant cluster following a penultimate beat is a universally preferred initial (cf. **muta cum liquida**), stress will be preferably assigned to the antepenult; if the cluster is a universally preferred medial or final, stress will fall on the penult; if a cluster is a geminate, stress will necessarily fall on the penult.

The two conditions interact. The **B←n** binding is necessarily maintained between a vowel and the following consonant if it belongs to a geminate (cf. *tarócco*), a good final cluster (cf. *Albérto*, *Orlándo*) or a good medial cluster (cf. *Ansélmo*). Among these, a geminate has priority over the other clusters, since it is universally expected not to be word-initial. The *binding condition* may fail in competition with the *phonotactic condition* in the case of a good initial cluster following the penultimate beat concerned (cf. *Péricle*, *íntegro*). This competition between the two criteria leads to variation in stress assignment, and thus we have both *ánatra* and *psichiátra*.

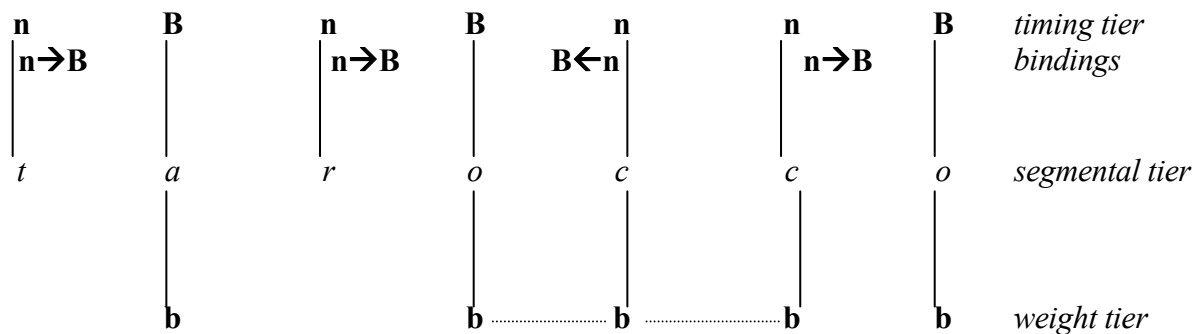
One more case is left to be considered, the case of a single intervocalic consonant between the penult and the last vowel, as in *ídolo* and *intéro*. Although in most cases quoted above, stress falls on the antepenult in such cases (*ídolo*), there is also some variation possible (*intéro*). According to B&B rhythmic preferences, Italian has been classified as having non-prototypical beat-timing (cf. Chapter 4, 4.2.6.). One of the features of this type is the lack of stability of the **B←n** binding: there is no evidence for this binding in CVCV sequences. It is, therefore, much less likely for a penult to attract stress in such a sequence. The reason for penultimate stress here will be rhythmic: stressed penult guarantees a trochaic foot as a result.

Reviewing again the proposed conditions for stress assignment in Italian, one must notice that both the binding condition and, in consequence, the phonotactic condition, imply the importance of quantity beats (**b**'s) in the language, and thus let it be classified as a quantity-sensitive one (cf. Chapter 4, 4.2.). A **B←n** binding is guaranteed if there is more than one quantity beat (**b**) following the timing beat (**B**) (unless the phonotactic condition interferes).

Thus:

- *quantity condition*: a penultimate timing beat **B** is stressed if not less than two¹³³ quantity beats (**b**'s) follow it up to the next **B**

e.g.



The *quantity condition* depends on the *binding condition*, it is not the latter's universally necessary consequence, however. The *quantity condition* is at work in quantity-sensitive languages. The *binding condition* itself competes with the *phonotactic* one, with language-specific results.

7.2.2. Latin

7.2.2.1. Syllable approach

In Latin a long penultimate syllable was accented, both when it was **syllaba natura longa** and **syllaba positione longa** (e.g. *inimīcus* 'hostile', *pepērcī* 'spared'). If a penult was short, the antepenult received the accent (e.g. *sólidus* 'solid', *tácitus* 'silent, tacit') (cf. e.g. Allen, W.S. 1973: 155).

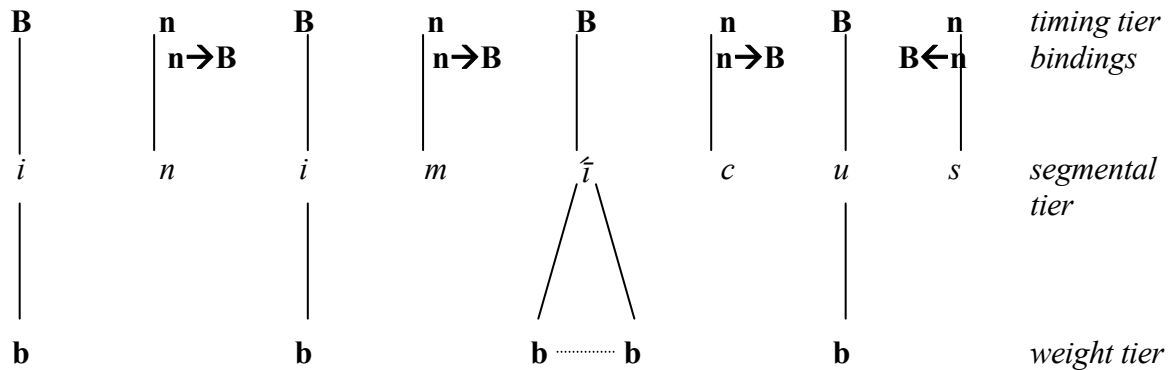
7.2.2.2. The B&B approach

"Long by nature", in Beats-and-Binding terms, means a single timing beat **B** which counts as two quantity beats (**b**'s). Thus,

- a penultimate beat **B** in Latin was accented when it involved two quantity beats **b**'s, and so counted as heavy.

¹³³ In a **BnB** sequence, the single **n** potentially enters two bindings; in a **BnnB** sequence it is guaranteed that none of the two **n**'s enter two bindings simultaneously. Each **n** is involved in its respective binding. In this case, **if phonotactics doesn't intervene**, they can freely count as quantity beats (**b**'s), which are a direct consequence of the bindings: a singly-bound consonant will count as a **b** in a quantity-sensitive language; a doubly-bound consonant will be treated language-specifically. The formulation "not less than two", thus, guarantees heaviness.

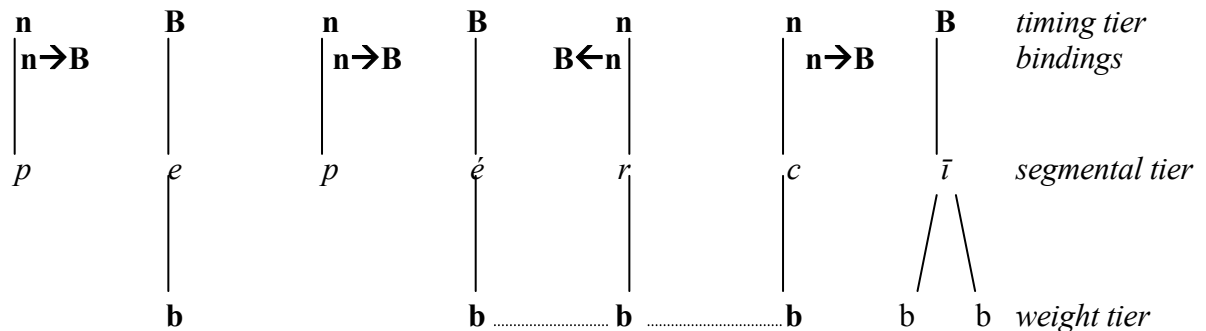
This is illustrated below with the example of the word *inimīcus*.



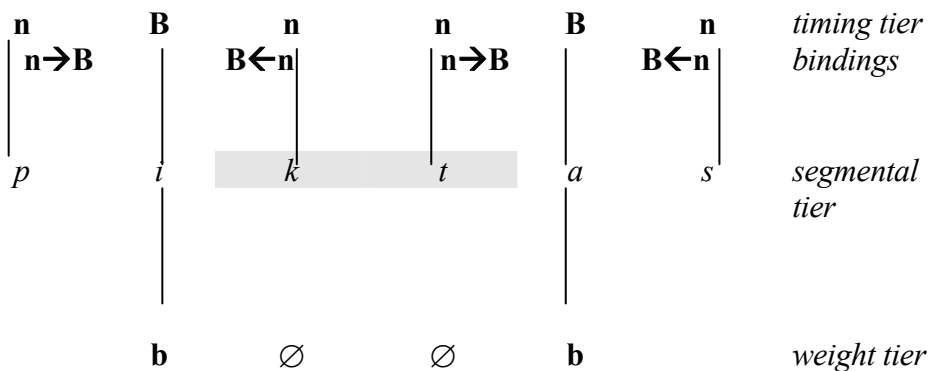
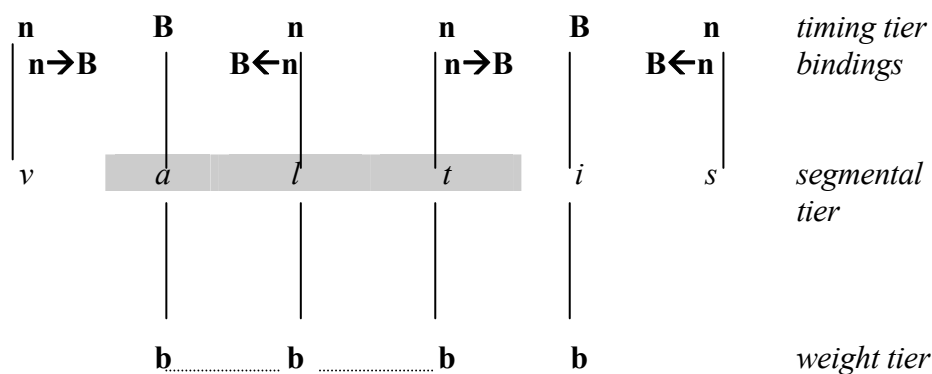
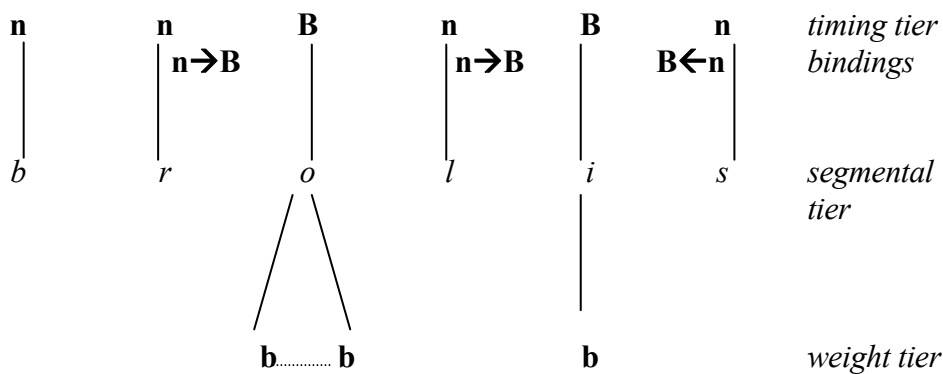
"Long by position", in Beats-and-Binding terms, means a beat which binds a non-beat to its right, i.e. participates in a **B←n** binding. As already discussed above in 7.2.1., a guarantee of a **B←n** binding comes from a cluster of consonants following a vowel which in this case can count as quantity beats. Thus,

- a penultimate beat **B** in Latin was accented when it was followed by not less than two quantity beats **b**'s up to the next **B**

This is illustrated below with the example of the word *pepércī*.



In the case of a vowel preceding a **muta cum liquida** cluster, the accent in classical Latin fell on an antepenult. In this case, the phonotactic condition was at work (cf. above 7.2.1.2.): **muta cum liquida** clusters, which are universally good initials, were treated as such, so that the **B←n** binding of the penult was not seen by the stress rule. E.g.: *ténebrae* 'darknesses', *íntegrum* 'untouched', *múltiplex* 'multiple'. In Vulgar Latin, however, the quantity condition took over, and the penult was stressed, e.g. *intégru*.



7.2.4. German

7.2.4.1 . Syllable approach

Among the many generalizations about German stress (cf. a thorough review by Jessen 1994), Vennemann's (1992) three generalizations about stress in morphologically simple words predict stress assignment on the basis of syllable structure. Here are the generalizations:

1. "The three syllable rule: Only the last three full syllables can be accented." (Vennemann 1992: 406)
2. "The penult rule: The accent does not retract beyond a heavy penult." (Vennemann 1992: 407) Heavy is implemented, however, unusually in the tradition of a heavy/light distinction, only by closed syllables (including diphthongs, in which the off-glide is the closing element,

and lax vowels closed by ambisyllabic consonants) and not by open syllables with tense vowels. E.g.: *Kommándo*, *Veránda*; *Poséidon*, *Thesáurus*; *Lamétta*, *Madónna* vs. `Alibi, *Känguruh*.

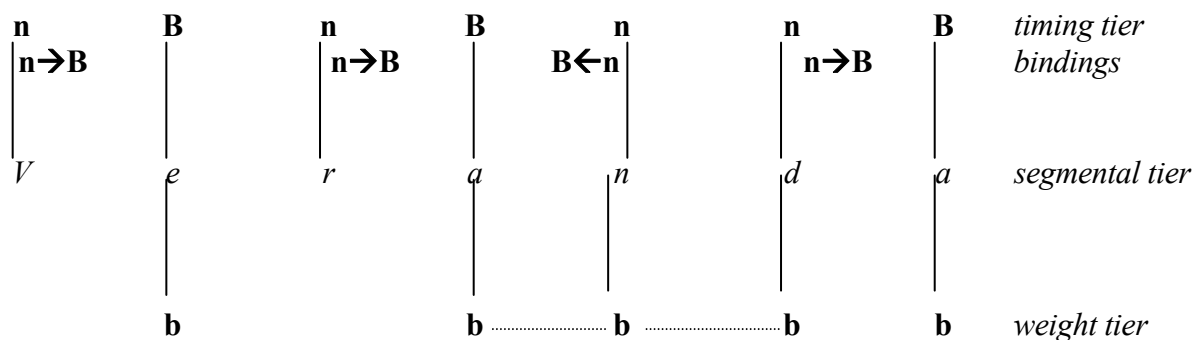
3. "The reduced syllable rule: A covered reduced ultima arrests the accent on the last full syllable." (Vennemann 1992: 406) E.g.: *Heléne*, *Melóne* vs. *Státue*, *Erínnye*.

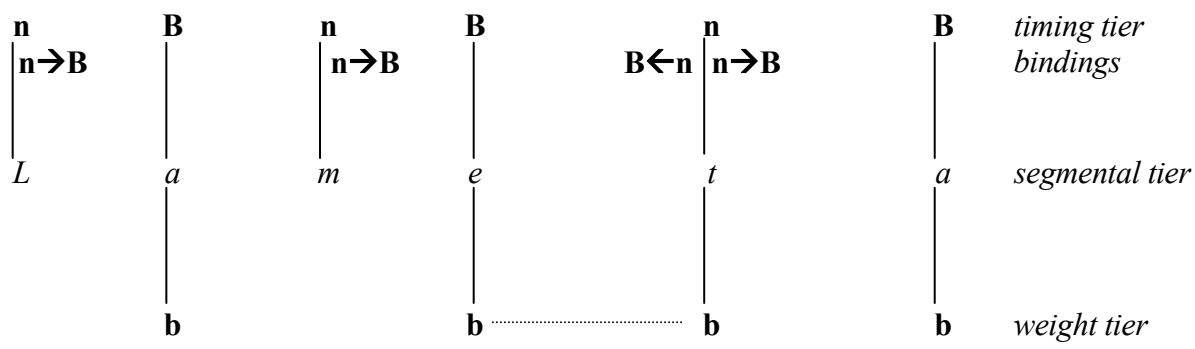
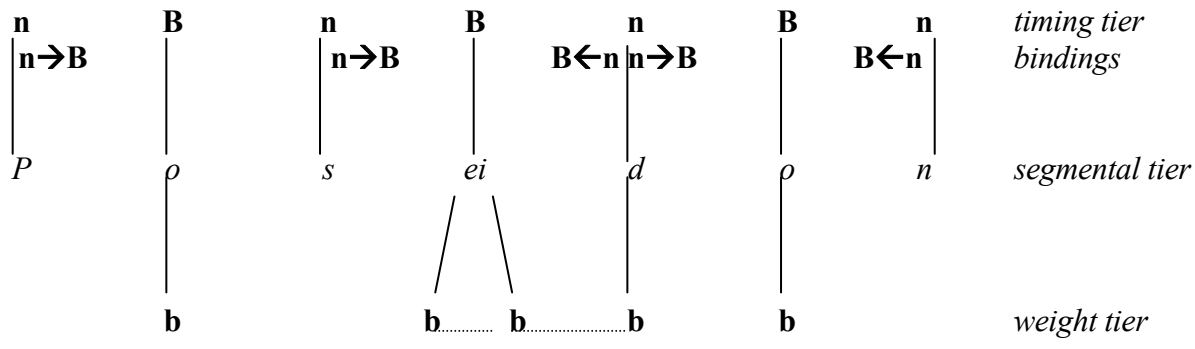
Generally speaking, there is agreement among phonologists that stress in a morphologically simple word in German is predictable on the basis of the syllable structure as inspected from the right edge of the word. The ultimate syllable receives stress if it is super-heavy, i.e. either has a tense vowel and a consonant or a lax vowel and two consonants.

7.2.4.2. The B&B approach

Let us interpret the above generalizations in terms of Beats-and-Binding phonology.

- The main stress in morphologically simple words in German falls on an antepenultimate beat **B** unless:
 - a penult **B** receives stress since the foot it begins counts not less than two **b**'s, because (a) it is involved in a **B←n** binding with the following consonant of a cluster (*Veránda*), (b) it is a diphthong (*Poséidon*), (c) it is involved in a **B←n** binding with the following single consonant (which is also bound to the following beat **B**) (*Lamétta*)
 - an ultimate beat **B** receives stress since it equals three **b**'s, because (a) it is a long vowel (=2 **b**'s) involved in a **B←n** binding (+1 **b**) (b) it is a short vowel (=1 **b**), but followed by a cluster of two consonants (+2 **b**'s).





7.3. Conclusion

Summing up we can say that in all the processes discussed above three major criteria play a role: a binding criterion, a phonotactic criterion and a morphological criterion. The latter may override the other two due to the semiotic precedence of morphology over phonology. Within phonology, the two bindings form a skeleton of representation, which gets modified by: (a) universal phonotactics, (b) language-specific phonotactics, (c) language-specific sensitivity to quantity.

CHAPTER EIGHT

Phonology-morphology interface

8.1. Introduction

In classical Natural Phonology (cf. Chapter 2, 2.1.) a clear-cut distinction was made between processes and rules. Processes were understood as purely phonological and inborn, while rules as belonging to learned morphology or morphonology. A later-developed view (cf. Chapter 2, 2.2.) is that of a continuum between phonology and morphology via morphonology. This view essentially implies a smooth transition between things phonological and things morphological, which has two major consequences. Firstly, a process may move historically from phonology via morphonology to morphology, i.e. morphologize. This change of status from phonological via mixed to morphological is unidirectional, which in turn implies the second major consequence mentioned above: morphology has precedence over phonology, and as such may override phonological criteria. In this chapter I will shortly remind the semiotic criteria of precedence of a morphological sign over a phonological one, which have already been discussed in Chapter 4 (4.2.7.) as well as the processes of Chapter 7, to which such criteria have applied. Next, an issue of a conflict between phonological and morphological markedness will be illustrated with an example from Polish. Finally, an interplay of phonology and morphology in the process of first language acquisition will be considered.

8.2. Semiotic criteria of precedence

As already stated (cf. section 4.2.7.), there is a scale of precedence of higher-order grammatical units over lower-order grammatical units, while a semiotic principle of figure and ground determines the saliency relations within the same class of units as well as within the units themselves. Priority of lexical units over morphological units, and in turn, over phonological units implies:

- (d) a preference for a word-initial CV sequence (and thus the $n \rightarrow B$ binding) and a word-final VC sequence (and thus the $B \leftarrow n$ binding);
- (e) a privileged status of word onset which may come into conflict with and override other preferences, e.g. the phonotactic ones;
- (f) a priority of morphological structure over phonological binding and phonotactic preferences;
- (g) relative saliency of particular types of morphemes.

8.3. Morphological conditioning of phonological processes

In the previous chapter (Chapter 7) we have observed that both the process of *Auslautverhärtung* in German as well as the processes of stress assignment in a number of languages involve some morphological conditioning. Since these processes are thus not purely phonological, they cannot be classified as prototypical phonological processes, but rather as partly phonological, partly morphonological.

In the case of obstruent devoicing in German, a morphological boundary following the consonant concerned either:

- (a) conspires to trigger devoicing while at the same time devoicing enhances the transparency of the boundary (cf. *trag#bar*)
- (b) overrides phonological criteria (cf. *täg#lich* vs. [re:gluŋ])
- (c) decides about the presence versus absence of devoicing in identical clusters (cf. *erb # lich* 'hereditary' vs. *er # blich*, past form of *erbleichen* 'to fade')
- (d) its lack leads to variation (cf. *Handlung* either as [handluŋ] or [hantluŋ]).

As far as the process of stress assignment is concerned, Latin showed some influence of morphology. An intervening grammatical boundary influenced the binding of **muta cum liquida** clusters: they were no longer treated as initial clusters, but were bound to their respective beats on both sides of the boundary, e.g.: *áb lēnōne* 'by the mediation', *áb-ripī* 'to be taken away' (7.2.2.2.), which made stress actually fall on the vowel preceding the cluster.

In the case of stress assignment in Italian and Lithuanian, morphology has less to say: rather than showing precedence, morphological criteria appear to run in parallel with the phonological ones, and are much less general. In Italian, prosodic accentuation constitutes a superior principle to the morphoprosodic one, since the putative forms contradicting prosody, e.g. **genericamente* (Hurch 1996: 85), are unpronounceable (cf. 7.2.1.1.). Lithuanian has a lexical stress system with accentually marked morphemes. The realization of the accentual morphemes is quantity-sensitive, i.e. phonologically conditioned. Stress in German was discussed with reference to monomorphemic words.

8.4. Phonological vs. morphological markedness

The way to demonstrate the phonology/morphology interface is to study the interplay between morphological and phonological parameters of naturalness. Some examples of this interplay were shown in the previous section (8.3.). Let us examine an example from Polish, juxtaposing a parameter of morphotactic transparency and phonological parameters of naturalness.

- Consonant-final prefixes and *w-* and *z-* prefixes added to verbs trigger an epenthetic vowel when a verb begins with a consonant cluster, e.g. *wbiec* [vb-] 'to run into' vs. *wetknąć* 'to stick' (cf. *wtykać* [ft-], Imp.), *zdać* [zd-] 'to pass' vs. *zebrać* 'to collect' (cf. *zbierać* [zb-], Imp.). In the case when the verb begins with respectively the same consonant (i.e. *w-* or *z-*), the resulting complex word begins with a geminate, e.g. *wwieść* [vv-] 'to bring up, in', *zsypać* [ss-] 'to pour'.
- Consonant-final prepositions and *w-* and *z-* prepositions preceding nouns generally do not require an epenthetic vowel before a cluster, thus *w biegu* [v b-] 'on the run' and *w tkaniu* [f tk-] 'in weaving', *z Danią* [z d-] 'with Denmark' and *z bronią* [z br-] 'with weapon'. However, when the noun begins with the same consonant, i.e. respectively, *w-* or *z-*, followed by another one in a cluster, an epenthetic vowel is triggered, e.g. *wę Wrocławiu* 'in Wrocław', *ze złotem* 'with gold'. In the context of a noun-initial single *w-* or *z-*, geminates result, as in the case of the prefixes, e.g. *w Warszawie* [v v-] 'in Warsaw', *z sobą* [s s-] 'with oneself'.

Most of the initial clusters (double and triple) and initial geminates resulting from the above morphological operations are phonologically marked. Geminates, however, are relatively more marked than other clusters in this position (cf. the universal phonotactic preferences, Chapter 5). Still, geminates seem to be tolerated better than other clusters, although in the case of prepositions, clusters are also tolerated (with the exception of those triples which would start with a geminate, if it weren't for the epenthesis, as in *wę Wrocławiu*). Interestingly, geminates are also worse from the point of view of morphology, since the boundary between a prefix or preposition and a base word following it is blurred in them. This results in the decrease of morphotactic transparency. The geminate-initial structures are thus relatively marked both in phonology and morphology. In the pronunciation of Poles in the case of the second operation (i.e. in preposition+noun structures) many speakers epenthesize a vowel in *wę Warszawie*, *zę sobą*. This variation shows that markedness is not tolerated by everybody and that the structure is marked, in the first place. It is marked on the parameter referring to biuniqueness, since the allomorphy *w-/we-*, *z-/ze-* conflicts with the principle of biuniqueness (and distorts uniformity). Interestingly, prefixed structures are not “corrected” (on the one hand, *wwieść* must be kept different from *wywieść*, still **węwieść* could be used, in analogy to *wę Warszawie*, but is not). Thus, markedness is tolerated better across a word-internal morphological boundary than across a clitic boundary, although both structures are phonological words. This is because the transparency of clitic words (and word boundaries) is more important than the transparency of affixes (and affix boundaries). It also points to the priority of morphological naturalness over phonological naturalness, in accordance with natural linguistic predictions (cf. 8.2. above).

8.5. Phonology and morphology in first language acquisition

The interdependence between phonology and morphology is first manifested in the acquisition of mother tongue. This section of the present chapter is cross-referenced to the later chapter on first language acquisition of phonology (Chapter 10; see also Chapter 2, section 2.3.).

8.5.1. Stages in the acquisition of morphology

In the acquisition of morphology the following stages are distinguished (Dressler and Karpf 1995):

- (a) PREMORPHOLOGY, when morphological operations occur (extragrammatical as well as precursors of later grammatical ones), but no system of grammatical morphology has yet dissociated from a general cognitive system. The latter is evidenced in the violations of the principles of grammatical morphology by premorphological operations (their outputs must therefore belong to the lexicon).

Examples¹³⁶ of extragrammatical morphological operations: reduplications, e.g. *koki koki*, *dudi dudi* (word repetition), *lala*, *baba* (reduplication of CV's constituting words), *ciuch ciuch*, *fufu*, *kra kra* (onomatopoeic reduplications); back-formations, e.g. *bap* < *babuś*, *koł* < *kołko*; truncations, e.g. *ciuch* < *ciuchcia*, *kloo* < *klocki*, *ko* < *kolko*; surface analogy, e.g. *kufka-tufka*, *pudynie-matenie*; blends, e.g. *mabusie* < *mama+babusia*, *bama* < *baba + mama*, *taja* < *tak + aja*.

- (b) PROTOMORPHOLOGY, when the system of morphological grammar and its subsystems start to develop, according to the principles of Natural Morphology, without having reached the status of modules and submodules. It is predicted that non-prototypical categories (e.g.

¹³⁶ All examples quoted here stem from two Polish children, Zosia and Filip, whose data will be used in the present chapter and in Chapter 10.

diminutives as a non-prototypical representative of derivational morphology) should emerge early, that they should be even less prototypical than later in the development, and that they are likely to preserve some properties of extragrammatical operations.

- (c) MORPHOLOGY proper, when the subsystems of inflectional, derivational and compounding morphology start to develop and pass their initial stages, which marks the end of the protomorphological stage. In this stage language-specific system adequacy appears.

8.5.2. Stages in the acquisition of phonology

Parallel to the assumption of the three stages in the acquisition of morphology, I assume three respective stages in the acquisition of phonology:

- A. PRE-PHONOLOGY: Physiological restriction is still present (cf. the differences between the infant's and the adult's vocal tract described in Chapter 10), general cognitive principles are applied (like the figure-and-ground principle), while the two main functions of phonology (ease of articulation and clarity of perception) are not respected. It is the stage of extragrammatical, non-prototypical phonology: onomatopoea, marked sounds and sound sequences.
- B. PROTO-PHONOLOGY: A phonological system starts to develop, but is still mainly equipped with universal natural processes, also non-prototypical ones (e.g. consonantal and vocalic harmony), which tend to be unbalanced and irregular in their application. The system may also manifest lack of the application of some universal processes. Consequently, the produced forms manifest transitional organizations and reorganizations of the system, some of them incompatible with the ultimate language-specific phonology. Underlying representations are stored, but they still diverge from the adult ones (language-specific perception starts). Extra-grammatical properties (e.g. of reduplicative babbling) are preserved in first words.
- C. LANGUAGE-SPECIFIC PHONOLOGY: The beginning of this phase marks the onset of "order" in the application of language-specific phonological processes, i.e. the development of language-specific phonological module.

8.5.3. Predictions of the interdependence between phonological and morphological development

Extragrammatical phonology and extragrammatical morphology may be difficult to distinguish, as demonstrated by the examples above (8.5.1.(a)). For instance, is truncation only phonological or also morphological? The reason for this is that neither extragrammatical phonology nor morphology is handled by grammar, i.e., respectively, phonology or morphology, and therefore neither of them dissociates to become a separate module. It is the system of language-specific phonology that starts to dissociate from both extragrammatical phonology and morphology. This marks the onset of the stage of proto-phonology. Therefore, the extragrammatical forms of a protophonological stage are morphological rather than phonological, although some types (such as reduplication and truncation) can easily be seen as both morphological and phonological. Phonology needs to modularize first, since, predictably, the existence of phonological signantia constitutes a prerequisite for any morphological or syntactic manipulation. Thus, we can foresee the following staging for the development of phonology and morphology in L1:

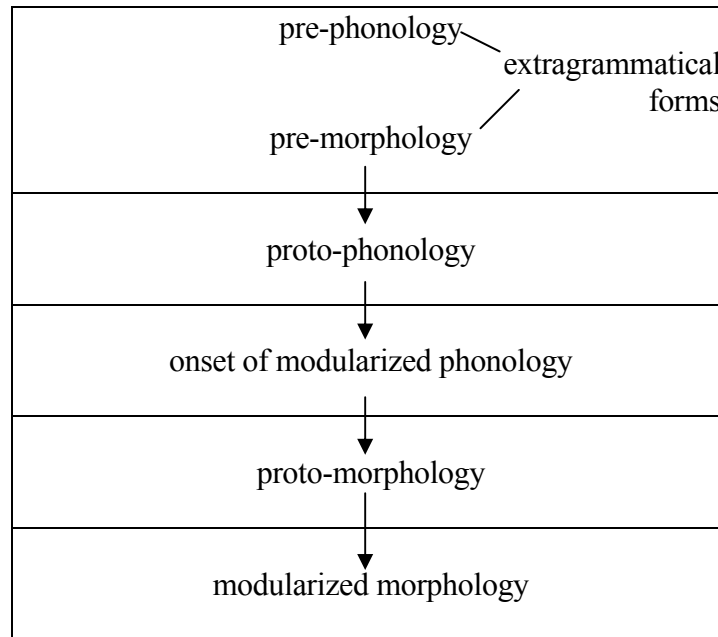


Figure 1. Development of phonology and morphology in L1.

On the one hand, symptoms of the shift from pre- to proto- and then to modular morphology can be deduced from theoretical assumptions concerning morphology itself. On the other hand, they are also deducible on the basis of the necessary unidirectional relationship between phonology and morphology in early language development. Phonological means are necessary to express morphological meanings on the surface. Morphological meaning, however, may be present in a given form underlyingly before phonological means to express it develop: in this way underdeveloped phonology blocks morphological expression. When language-specific phonotactics establishes itself, it establishes also the limits of morphological expression. Thereafter, morphology is "sufficiently equipped" to manifest its semiotic priority over phonology (e.g. by feeding or bleeding phonological processes, cf. morphonology). Thus, the unidirectional relationship between phonology and morphology necessarily exists and manifests itself in the surface output produced by the child, whereas underlyingly this relationship may be hypothetically more complex.

8.5.4. Phonological means for the acquisition of morphology

Let us briefly inspect phonological means necessary to "realize" morphology in Polish. For instance, the following phonological material appears to be necessary:

- (a) final consonants to realize inflectional suffixes;
- (b) nasalized vowels to realize inflectional suffixes - although they get replaced by oral vowels or VC-combinations and can themselves appear later (in modular morphology);
- (c) consonant clusters, e.g. to realize infinitives;
- (d) palatalization - e.g. to realize diminutives like *stos ~stosik* [s ~ ø];
- (e) some phonotactic constraints, e.g. the one triggering PL. -i after velars [k,g + i] and Pl. -y after dentals [t,d + ĩ];
- (f) voice agreement in consonant clusters to realize partly analytic inflection, e.g. *w + N, z + N*, aspectual prefixes etc.;
- (g) prosodic features, e.g. feet longer than binary ones, to realize more complex forms like verbal PL. inflection (cf. a frequent mistake **umią* instead of *umieją*).

The examples below illustrate some of the above-predicted interdependencies in the speech of Filip¹³⁷. It is a phase in the development of Filip's speech in which pre-morphology starts evolving towards the proto-morphological stage due to the parallel evolution of proto-phonology.

- Starting with 1;1.18 (the beginning of recordings) no unit-final consonants appeared in F's speech, the only exceptions being a few rote-learned verb forms, e.g. 1;4.28 daj IMP.2P.SG of *dać* 'to give'. From 2;3.29 some C-final words appear (dom, kam, miś, pan, siam), but still the tendency to reduce them is observed (ode < odejdz). In the same period dam 1P.SG.FUT of *dać* appeared: Filip noticed the 1P.SG form of this verb exactly at the time phonological, non-rote-learned, unit-final consonants entered his system.
- The initial verb forms finish with the prototypical vowel /a/, leading towards Macroclass IV KOCHAĆ¹³⁸ (after the first rote-learned verb gra 3P.SG of *grać* 'to play'); this class enables Filip to maintain a-final forms by analogy. Filip demonstrated in the whole period up to 2;3.29 exclusively vowel-final noun forms; after 2;3.29 an increase in nouns was observed, correlated with an increase of word-final consonants.
- At 2;2.6 Filip says: siam, sama 1P.SG.FEM. of 'myself' instead of the masculine form sam, due to the lack of unit-final consonants. This form persists irrespective of corrections by parents until 2;4.15. At 2;4.15 Filip says: ja siam 'I myself'.

Filip's development clearly shows some dependence of morphological development on phonology: he expresses himself but has not enough phonological means yet to build on, and is therefore forced either to choose forms according to the available phonological gestalt or adapt forms to it (e.g. selects Macroclass IV of verbs or a feminine suffix). The above examples of Filip's speech illustrate point (a), i.e. unit-final consonants are a prerequisite for the realization of morphological suffixes.

8.6. Conclusion

The "Splendid isolation" of phonology from morphology and other components of grammar has never been claimed in the theory of Natural Phonology. This chapter has highlighted some aspects of the relationship and interdependence of phonology and morphology. A clear conclusion for the purposes of phonology is that a possibility of a morphological conditioning of a phonological phenomenon under inquiry must always be taken into account.

¹³⁷ Filip, a Polish boy, had been recorded at ten-day intervals since the age of 1;1.18 for the purposes of the international project on "The acquisition of pre- and proto-morphology" supervised in Vienna. Filip's speech has been recorded and transliterated by Filip's parents, as part of the Poznań contribution to the project, coordinated by the present author. Filip was born healthy and is a normally developing child.

¹³⁸ For the classification of Polish morphological classes according to the principles of Natural Morphology see Dressler and Dziubalska-Kołaczyk, in collaboration with Małgorzata Fabiszak (1997).

PART III.

**HISTORICAL LINGUISTIC EVIDENCE FOR
THE MODEL**

CHAPTER NINE

*Diachronic change*¹³⁹

One of the most vexing problems of historical phonetics is syllabification in old languages. Seeing that scholars cannot agree on syllabification in modern languages, the chances of solving this problem for Gothic, Old Icelandic, or even Middle English are small.

(Lieberman 1992:77)

9.1. Introduction

Early Middle English (EME henceforth) vowel quantity changes traditionally receive a syllable-related interpretation. Both lengthenings and shortenings of vowels are referred to the domain syllable, either in the sense of referring to the syllable structure, boundaries and/or weight, or the number of syllables, i.e. syllable counting. In this chapter I will argue for a Beats-and-Binding interpretation of these quantity changes. First, I will briefly present the traditional account of EME vowel quantity changes. Second, I will report on the criticism of the traditional account, still within a framework assuming the syllable, along the lines of one of the newer analyses available, i.e. that of Ritt (1994) as well as with reference to some other existing analyses (e.g. Jones 1989; Stockwell and Minkova 1992; Lahiri 1992; Ogura 1987; Lieberman 1992). Third, I will attempt to reanalyze the changes within the framework proposed in this book. The aim of this particular endeavour is to demonstrate that, contrary to the common belief, Middle English vowel quantity changes do not constitute evidence in favour of the syllable as a phonological unit.

9.2. Middle English vowel quantity changes

Familiar handbook descriptions (cf. e.g. Luick 1914/21, Jordan 1974, Berndt 1960, Fisiak 1968, Reszkiewicz 1973) refer to four different quantity changes which affected English vowels in between the 9th and 13th century: Homorganic Lengthening, Shortening before Consonant Clusters, Trisyllabic Shortening and Open Syllable Lengthening.

Homorganic Lengthening is described as a process lengthening short vowels if they were followed by clusters of two (approximately) homorganic consonants, as in the following examples: **go:ld**, **wo:rd**, **cli:mban**, **behi:ndan**, **si:ngan**, **e:orl**, **mu:rnan** (Ritt 1994: 81ff and Appendix II). The process is assumed to have taken place 400 years before the so-called ME

¹³⁹ I would like to thank Wolfgang U. Dressler for his thorough discussion of the content of this chapter, as well as Nikolaus Ritt and Jacek Fisiak for their helpful comments and bibliographical hints. Naturally, responsibility for the final outcome is mine.

Open Syllable Lengthening (cf. diacritics for length in Anglo-Saxon manuscripts in words like the above ones).

The second change, Shortening before Consonant Clusters, affected long vowels before consonant clusters of more than one consonant (except for homorganic clusters and those that could function as syllable onsets), as in: **kepte, brohte, softe, dust, mist, bledsian, wisdom, siknesse** (Luick 1914/21: 324ff, 392); (cf. also Ritt 1994: Appendix III, which shows the scarcity of examples)¹⁴⁰.

The third process, the so-called Trisyllabic Shortening, is believed to have applied to long vowels in antepenultimate syllables of words. Luick's examples are, for instance: **heafodu pl, linenes gen dat, 'rende, deorlingas pl, othere acc** etc. (Luick 1914/21: 328f, 392f; cf. also Ritt 1994, Appendix IV).

Finally, the fourth change, Middle English Open Syllable Lengthening (MEOSL), according to the generally familiar textbook descriptions, affected short stressed vowels in open, i.e. unchecked, syllables in disyllabic words when there was only one intervening consonant between the stressed and the unstressed vowel (unless it was a cluster of the *st, sp, sk* type). For example: **ma:ken, we:ven, ho:pen, a:le, be:ver, cha:ste, de:ne, ga:me, ha:ste, ta:ken, va:por, bla:d, co:l, ca:f, ho:l, la:c** etc. OSL propagated southwards in the years between 1200 and 1400¹⁴¹.

In what follows I will concentrate on the two lengthenings (although shortenings are naturally taken into account in unification approaches such as the one by Ritt to be sketched below), because of their prominent position in studies of historical English phonology, and for the reasons of space.

9.3. Review of selected approaches

9.3.1. Minkova (1982, 1984)

Even a brief look at the traditional account produces doubts concerning the formulation of the environments of the particular processes as well as the validity of the generalizations involved. Take, for instance, MEOSL: formulated as above it appears to have a lot of exceptions, e.g. **manig** 'many', **cetel** 'kettle', **sadol** 'saddle' etc. Various proposals of how to deal with these exceptions have been critically reviewed e.g. by Minkova (1982). Her own proposal consists in reformulating the environment of the process to apply unfailingly only before unstable syllables, i.e. when the second syllable of the words concerned is lost due to final schwa deletion in ME (Minkova 1982: 42)¹⁴². Thus, lengthening affects a short vowel in a weak

¹⁴⁰ Among Luick's examples for Shortening before Consonant Clusters there are some with geminates e.g. **mette, lÆdde, hydde**, and even more interestingly, **mÆdd, fÆtt**, although geminates are not included by Luick in the context which triggers shortening. According to Kurath (1956: 435ff, quoted after Berndt 1960: 146ff) already in late Old English (ca 1000) the only context in which a quantitative consonantal contrast appeared was after a short stressed vowel, e.g. **bannan** (ModE **ban**) vs. **banan** (ModE **bane**); **sunne** (ModE **sun**) vs. **sunu** (ModE **son**). The contrast was gradually (earlier in the North, later in the South) lost, predominantly due to the Open Syllable Lengthening which made the consonantal quantity contrast redundant, as well as due to the reduction of the final schwa in the VCC \emptyset sequence e.g. **sunne, sitte(n), frogge** > **sun, sit, frog**. Thus, at the time of Shortening before Consonant Clusters there should have been no phonetic geminates available as a shortening context after long vowels. One possible explanation for such examples as the above quoted **mette, lÆdde** etc. is of course to treat the geminates therein as a graphic representation of the shortened vowel. There is no space here to go further into that matter.

¹⁴¹ An apparently accompanying change of vowel quality will not be discussed here, but cf. e.g. Lieber 1979, Ritt 1994.

¹⁴² Minkova (1984) presents argumentation for schwa deletion as a natural continuation (through generalization of environment) of metrical elision, the latter best exemplified in Ormulum. Important arguments for the likelihood of cooccurrence of elision in the poetry and spoken language at the time of Orm are the functions of the process: avoidance of hiatus and optimalization of rhythmic organization. I think that Luick does not deserve

syllable followed by C-e#. Due to the acquisition of additional rhythmic weight by the foot-initial light syllable, the overall weight of the word is preserved. The motivation of the lengthening lies, therefore, in the rhythmic weight compensation principle (cf. below for a brief discussion of similar claims by other authors).

The above formulation, based on a comprehensive (and not selective) list of word forms susceptible to the process, constitutes an improvement in comparison to the traditional formulation. It is still, however, far from being exhaustive. Firstly, there are aspects of the OSL which are not present in Minkova's structural description. Secondly, her description, like many others, for that matter, misses a possibility of generalization by not referring the MEOSL to other vowel quantity changes in Middle English.

9.3.2. Ritt (1994) vs. Jones (1989), Minkova and Stockwell (1992), Reszkiewicz (1973), Liberman (1992)

The temptation to supply a unified account of the four lengthening and shortening changes of EME is clear to any linguist outside the Neogrammarian "sound-law" tradition¹⁴³. Ritt's (1994) unification approach to the vowel quantity changes of Early Middle English constitutes an attempt in this direction. He is able to incorporate all the conditioning factors of both the lengthening and shortening of vowels within a single formula thanks to (a) the comprehensive scrutiny of the available data on ME and its comparison to Modern English data and (b) the concept of statistical tendency (Ritt 1994: 41) which allows him to talk about degrees of change rather than exceptionless laws. He gives a prosodic account of the changes, using the syllabic rhyme-branching conventions of non-linear phonology. Thus, the weight of the syllable is counted in morae(s) whereby ambisyllabic segments count as half-mora, thus, e.g., the first syllable of **ma[k]en** has 1.5 moras, of **re[st]en** - 2 moras, of **plan[t]en** - 2.5 moras.

A general formula for OSL itself (cf. Ritt's 1994: 75) predicts that the branching of the nucleus of the foothead (i.e. the lengthening of a vowel) is proportional to:

- (a) the degree of stress on it;
- (b) its backness;
- (c) coda sonority (before unstable syllables).

and inversely proportional to:

- (a) its height ;
- (b) syllable weight;
- (c) the overall weight of the weak syllables in the foot.

This means that it is a stressed, rather back, non-high, and rather light vowel (i.e. 1.5 moras > 2 and more moras) followed by a rather sonorant coda and an unstable syllable that is expected to be lengthened. The coda sonority criterion does not account for the fact that liquids and nasals block nucleus lengthening (cf. **a:l(e)** but **alum** vs. **be:ver**), since the lengthening does take place if a sonorant is followed by a stable syllable and is the result of the special status of sonorants in syllable structure. The latter receives the following explanation from Ritt: sonorants are part of a branching nucleus and as such may vocalize to produce a long vowel followed by a consonantal trace. However, in the case of a V+sonorant nucleus followed by another (stable) syllable (as in **alum**), a sonorant cannot vocalize since it also serves the function of the (consonantal) onset of

Minkova's (cf. p. 63-63) criticism of his quite revealing sociolinguistic remark about the generalization of elision in casual speech: his "Beschleunigung des Redetempos" (Luick 1921: § 452) sounds very much like today's often used, although underspecified term "rapid speech".

¹⁴³ It was obvious already to Luick, and yet he himself formulated the four separate rules. He talked about the dependence of vowel quantity on (a) the number of syllables in a word, and (b) the number of consonants following a vowel, i.e. the adjustment of the vowel's quantity to its prosodic environment (cf. Ritt 1994: 2ff).

the following syllable. At the same time, however, it remains a branch of the nucleus node, so the V does not lengthen.

It is worth digressing at this point and mentioning that Jones's (1989) account of the **alum**-type of "exceptions" to MEOSL differs considerably from the rather formalistic explanation offered by Ritt. Noticing that the words concerned tend to finish in [ləm], [lən], [lər] or [rən] clusters, Jones suggests a *vocalic prominence weighting* criterion for the distribution of vocalicness across syllables and words: speaker's perceptual intuition about the preferred distribution of vocalicness within a syllable or word does not allow him to apply vowel lengthening to an already vocalically overloaded sequence. Plausible as it sounds, the criterion is not operationalized (cf. below for further discussion).

Ritt demonstrates next that Homorganic Lengthening can be subsumed under the above general formula with the effect that both changes simply constitute ME vowel lengthening. Simultaneously, he proposes solutions for particular detailed problems connected with this unification. One such solution seeks to explain why the first syllable of **bindan** (before the lengthening) does not block vowel lengthening, although, according to the above proposed counting, it should count 2.5 moras and thus block the process. Phonetically homorganic nasal+stop clusters (like /nd/) tend to simplify to prenasalized stops. Therefore, the first syllable of **bindan** (before the lengthening) weighs, in fact, only 1.5 mora, [ʰnd] being ambisyllabic, and thus allows for the lengthening to **bi:ndan**.

Let us digress briefly from presenting Ritt's views in order to have a look at other accounts of Homorganic Lengthening. First of all, there are discrepancies between the structural descriptions of the process by different authors. According to Jones, the process was "confined to words of a single syllable" (1989: 98). Other accounts concentrate on the consonantal context only, without explicitly specifying whether the lengthening took place in "mono- and/or disyllables" (e.g. Minkova and Stockwell 1992), while still others state both domains ("mono- & disyllabic" words) explicitly, e.g. Reszkiewicz (1973: 85ff) who adds that the lengthening was blocked when a third consonant followed, e.g. **cildru** (pl), **lambru** (pl), **hundred** (or the vowel concerned was unstressed: **and**, **under**). Jones's restriction may be (unless one finds examples to the contrary, i.e. two-syllable words with two intervocalic consonants and no lengthening) a special case of Reszkiewicz's three-consonant restriction.

Explanations of Homorganic Lengthening offered in the literature are also divergent. A summarizing account of them is given by Minkova and Stockwell (1992). I would like to mention only two examples, namely a compensatory lengthening account by Liberman (1992, and forthcoming, as quoted by Minkova and Stockwell 1992) and a phonetic account by Minkova and Stockwell. The former is part of the major holistic trend in explaining the quantitative changes discussed, which consists in assigning to lengthening a compensatory function triggered by the loss of a vowel or consonant in the neighbourhood. For instance, words like **wylf** > **wylif**, **burh** > **burug**, **myln** > **mylen** (examples from Jones 1989: 170) developed a svarabhakti vowel, while in "tight" homorganic clusters this was not possible, so the original vowel lengthened instead. The latter, phonetic account by Minkova and Stockwell, casts doubt on the assumed generality of Homorganic Lengthening (before 9 homorganic or near-homorganic clusters). The authors supply statistical evidence approving only of lengthenings before **-nd** and **-ld**, and they propose a phonetically-based explanation only for the latter ("late breaking")¹⁴⁴.

Coming back to Ritt's (1994) account: he shows finally that both lengthenings and shortenings are manifestations of a single tendency: Middle English Quantity Adjustment (Ritt

¹⁴⁴ Also the quality of a vowel plays a role here: high vowels are lengthened before **-nd**, back nonhigh vowels - before **-ld** (cf. my discussion of that point below).

1994: 96). His general formula allows for the prediction that there exist environments which will equally favour both lengthening and shortening. An example may be an **st** cluster for which the only decisive criterion appears to be the vowel height, i.e. high vowels tend to get shortened e.g. **dust, fyst, mist** while low vowels get lengthened e.g. **ha:ste, ta:ste, cha:ste**.

One might well ask for some justification of the choice of parameters which controlled EME quantity adjustments as well as for an explanation of its temporal restrictedness. With reference to the former, Ritt suggests a rhythmical and phonetic explanation, for the latter - an explanation based on the interplay of phonology with morphology¹⁴⁵.

9.4. A critical note

In his "bird's eye view" (cf. Liberman 1992) on Open Syllable Lengthening and Homorganic Lengthening Lieberman suggests two causes for vowel lengthenings in the Indo-European languages¹⁴⁶: compensation and analogy. Lengthening (MEOSL)¹⁴⁷ was caused by the substitution of schwa for full endings, as a result of which the root vowel became bimoric (while previously the root vowel + the ending vowel constituted two vocalic morae) (e.g. Liberman 1992: 71, 83). The term Open Syllable Lengthening is a misnomer also because its phonetic environment was not an open syllable, but the context of a weak vs. strong consonant (cf. Liberman 1992: 77ff for an explanation of this distinction). Although Liberman talks about compensation in terms of morae and phonetic context in terms of consonant strength, the way in which he understands morae and strength is not necessarily compatible with that of other authors (cf. e.g. Stockwell and Minkova 1992, Lahiri 1992, or Vennemann 1988a, Murray 1988).

The overall idea of a functional compensatory change is popular among the various interpretations of Middle English vocalic quantity changes, although it appears under different author-dependent disguises. For Ogura (1987), for instance, OSL is a compensatory change in the articulation of the first vowel of a disyllabic word in response to the reduction of the second vowel: the first vowel is perceived by the hearer as long, and thus, consequently, produced as long (Ogura 1987: 126). The motivation of OSL she supplies is based on Lehiste's (1971 as quoted by Ogura; cf. also Lehiste 1970) temporal compensation hypothesis in the production of disyllabic words in English as well as on Ogura's own investigation of the perception of disyllabic words in English (Ogura 1987: 118ff).

Jones's (1989) view on lengthenings can be also subsumed under the label "compensation". He attributes to the speaker perceptual intuitions as to the preferred, optimal structure of syllables and words according to the three criteria: accent distribution (or accent balance), durational loading (or vowel duration ratio) and vocalic prominence weighting (Jones 1989: 116, 119). I believe that these criteria potentially possess great explanatory power which can be put to work if a few weak points in their presentation are overcome: (a) one needs to decide whether they are all same level criteria, i.e. what status they have within the phonology/phonetics of language (b) one needs to state what is universal and what is language-specific about them (c) one needs to operationalize them and decide to which units they refer (syllables, words, feet?).

¹⁴⁵ These explanations are compatible with the framework of Natural Phonology.

¹⁴⁶ Liberman draws parallels among all West Germanic and Scandinavian languages as well as pointing to possible solutions for untypical behaviour, e.g. a stage of free apocope in Swedish, Icelandic and Faroese, which underwent OSL and then returned to full endings, cf. p. 72ff.

¹⁴⁷ The way compensation worked, according to Lieberman, in Homorganic Lengthening was mentioned in 9.3.2.

Lahiri (1992) argues against treating OSL of Middle Dutch and Middle English as compensatory lengthening. Her argumentation hinges upon the concept of the Germanic foot¹⁴⁸ which became opaque at the Middle period for a number of reasons (cf. Stockwell and Minkova 1992 for a discussion), which led to a bisyllabic foot being transformed to a bimoraic monosyllabic foot. As a consequence, stressed open syllables were lengthened, but not for compensatory reasons, since (a) the foot was already bimoraic; (b) final schwa loss was independent. Stockwell and Minkova (1992) diverge from the above line of argumentation (in their discussion of Dresher and Lahiri 1991) in saying that the loss of the final unstressed vowel, although not causal, created (among other processes) unfavourable circumstances for the preservation of the Germanic foot. As a consequence, both the #(C)VC# and #(C)VVC# structures could (and, in fact, did) develop from the late OE Germanic foot structure #(C)V.Cə#. The authors state that "the creation of a bimoric syllable peak as in OSL is in no way mandated by the well-formedness of the resulting foot structure, since both post-schwa deletion structures are well-formed feet" (Stockwell and Minkova 1992:12), but note themselves that items of the *beck*, *drop* etc. type were very rare (less than 5% of the disyllabic Germanic-foot-type words of late OE). In my opinion, the fact that in the vast majority of cases the bimoric structure was developed shows a strong preference for that structure which could easily create a functional ground for the application of vowel lengthening. Also final schwa deletion forms, indirectly (since it had an independent morphological motivation), such a ground, due to its symbiosis with the retreat of the Germanic foot. Understood in the above sense, the process of OSL can still be interpreted as compensatory: not as a durational compensation for the lost vowel, but as a weight compensation within a foot.

While the above-exemplified accounts, either of a "moraic balance" or "compensation" type, aim at generalized explanations of the data, an account of Homorganic Lengthening given by Minkova and Stockwell (1992) is an example of a phonetically oriented, detailed account of the data with no intention of phonological generalization. What one needs is a unification of these approaches within the framework of a functionalist, non-conventionalist theory, which would predict a change in the preferred direction as well as allowing for dysfunctional change.

One of the reasons for problems with unification of the EME quantity changes has been the multifacedness and disputability of the unit syllable itself. For example, since the criterion of syllable openness fails to explain so-called OPEN SYLLABLE lengthening, one refers to syllable weight instead. One allows not only for ambisyllabic consonants (and counts them as half-mora), but also for *fully* (**ha**[st]e , **a**[pr]il) and *partially* (**plan**[t]e) ambisyllabic clusters. Additionally, while **nt** in **plante** is partially ambisyllabic, **nd** in **bindan** is a fully ambisyllabic prenasalized stop. Moreover, **l** in **alum** is also ambisyllabic, but blocks lengthening, while otherwise more rather than less sonorant ambisyllabics favour it. Already the ambisyllabicity distinctions themselves seem ad hoc, while they do not suffice to account for all aspects of the changes either. Also the observation that sonorants both favour and disfavour the processes remains unaccounted for. The evidence concerning EME vowel quantity changes is believed to support the notion of syllable weight. I will present an alternative account of the changes in the Beats-and-Binding framework.

9.5. Reanalysis of the discussed processes in B&B phonology

An interpretation of Early Middle English quantity adjustments in Beats-and-Binding phonology refers to a number of hierarchically ordered domains of quantity changes:

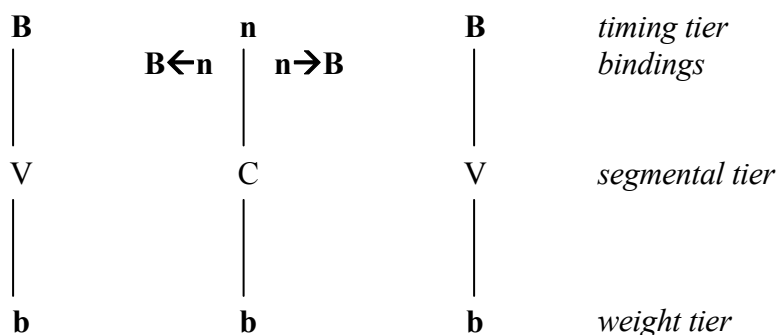
¹⁴⁸ The foot of early Germanic, described as a resolved bimoric trochee whose head must dominate at least two moras (cf. Dresher and Lahiri 1991; Stockwell and Minkova 1992).

- rhythmical domain (encompassing both rhythm and quantity);
- listener-friendly, perceptual domain, governed by binding preferences;
- phonotactic domain;
- domain of articulatory conditioning and implementation.

This hierarchy is compatible with the ordering of processes in Natural Phonology, i.e. fortitions before lenitions (listener-friendly before speaker-friendly), as well as with the types of preferences which define phonological structure in B&B phonology, i.e. rhythmical preferences (including quantity-sensitivity), binding preferences, phonotactic preferences and articulatory preferences. In each of the above domains, the structures concerned are subject to the domain-specific preference AND to the preferences of the higher domains.

9.5.1. Rhythmical and quantitative criteria of vowel lengthenings and shortenings

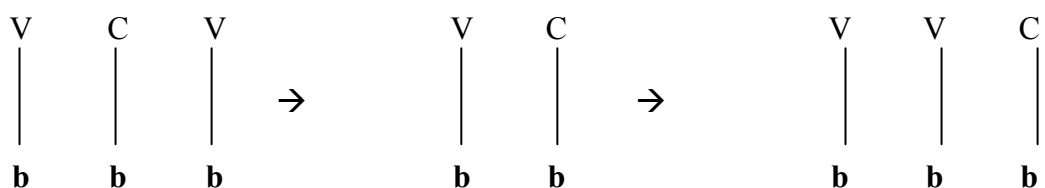
In the rhythmical domain, universally there is a preference for a trochaic foot, i.e. for a trochaic foot-timing as the best realization of foot-isochrony (cf. 4.2.1.2., 4.2.6.). Typologically, in so-called quantity-sensitive languages, there is a preference to keep the number of quantity beats in a foot equal. A /VCV/ sequence is a minimal segmental realization of a trochee: it consists of two rhythmic beats **B** and it counts 3 in terms of quantity beats **b**:



If the two preferences (for a trochee and for quantitative stability of feet) combine, it is predictable that the feet will tend to be neither too light nor too heavy. In terms of a number of **b**'s, this means not less than three quantity beats, but also not much more. This provides the general motivation behind both the lengthenings and the shortenings of vowels in ME.

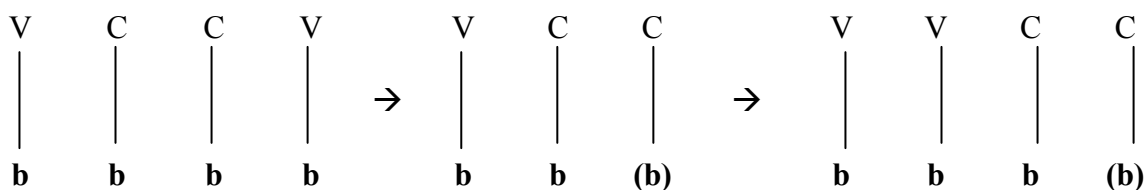
In the case of lengthenings, the initial step is made by the speaker, who reduces the binary foot (i.e. deletes a schwa), therefore compensation of quantity within a foot (i.e. of the number of quantity beats within a foot) follows:

(a) /VCV/ → /VC(V)/ → /V:C/ e.g. *ale* 'ale'



Lengthening took place also in some words containing a medial double cluster:

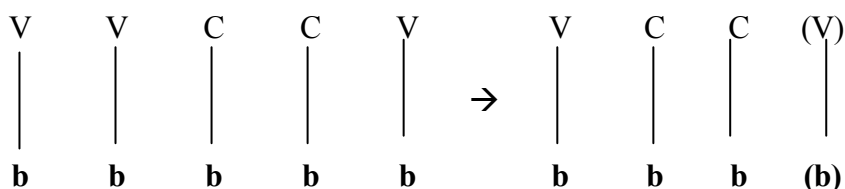
(b) /CVCCV/ → /CVCC(V)/ → /CV:CC/ e.g. *climban* 'climb'



In this case, the loss of the final vowel leaves the second consonant of a cluster without any binding: as such, it may or may not count as a quantity beat. Therefore, a compensation by means of vowel lengthening may take place.

A reverse case is that of a shortening whereby a "negative compensation", i.e. a reduction of a number of **b**'s takes place:

(c) /CV:CCV/ → /CVCCV/ e.g. *softe* 'soft'



In (a) and (b), the resulting number of **b**'s was 3 to 4, in (c) it was 4 (or 3, if the final vowel was deleted). This clearly demonstrates the preference for foot isochrony via equalizing the number of quantity beats **b**'s within feet (either by adding or reducing **b**'s).

9.5.2. Binding criteria of vowel lengthenings and shortenings

In a **BnB** sequence, a single non-beat in the medial position participates in two bindings (except in prototypical beat-timed languages), i.e. the **B←n** binding and the **n→B** binding. As we remember, the **n→B** binding should be preferably stronger than the **B←n** one. This relation may be enhanced by the sonority value of the intervocalic consonant. Enhancement of the strength of the **n→B** binding, e.g. by an obstruent, creates favourable circumstances for a potential lengthening of the first vowel (whose **B←n** relation with the consonant is then less preferred). Thus, we can motivate the following cases of ME vowel lengthenings:

(a) Lengthening tended to take place before sonorants if an unstable schwa followed, e.g. **a:l(e)** vs. **alum**.

In **alum**, the above-mentioned enhancement does not take place; nor does lengthening. In **a:l(e)**, the higher order motivation explains the lengthening in the first place (***al** would be 2 **b**'s only, i.e. below the minimum, cf. 9.5.1. above). However, the question remains why should a sonorant trigger the lengthening more often than an obstruent (cf. **bla:d**). Due to the deletion of the schwa, there is no **n→B** binding at all in the words concerned, so there is no question of the balance of strength between bindings. One can still propose a perceptual motivation of length determination in those cases. If a VC sonority distance is big, it means that the contrast between a vowel and a consonant is easy to perceive, there is no need and no possibility to enhance it any more and, thus, the speaker can move fast from V to C (there is no need for vowel lengthening). If the distance is small, the contrast is less well perceived at the end of a word, thus the speaker may choose to prolong the transition between V and C (which results in a

/V:C/). Thus, a decision to compensate for the loss of a quantity beat taken in the rhythmical domain may be either confirmed or verified.

(b) Before stable schwas (i.e. in CVCV sequences - less than 20% of all), vowel lengthening was blocked before liquids and nasals, e.g. **alum** vs. **ma:ken**, **be:ver**.

Before obstruents, the enhancement of the strength of the **n**→**B** binding does take place, and the lengthening takes place as predicted.

9.5.3. Phonotactic criteria of vowel lengthenings and shortenings

In a VCCV sequence, the phonotactic status of the intervocalic cluster may influence the quantity of the first vowel. If a cluster is a preferred double final, it may enhance the loss of the second vowel, and thus also the lengthening of the first. If the cluster is a preferred medial, it will enhance the stability of the following vowel, and thus rather trigger the shortening of the first.

The above may explain homorganic lengthening and shortening before consonant clusters in ME. The lengthening contexts were predominantly the clusters **nd** and **ld**, which indeed are preferred finals (cf. 5.3.2.)¹⁴⁹. The shortening contexts were consonant clusters of more than one consonant except for homorganic clusters and those that could function as syllable onsets: indeed, the preferred medials (cf. 5.3.3.).

9.5.4. Phonetic criteria of vowel lengthenings and shortenings

The last domain of influence on any process is that articulatory implementation. Representations arrived at due to the complex conditioning of all the domains mentioned above, may get modified according to the needs of the speaker and his/her articulatory apparatus. In ME quantity adjustments, details of articulatory adaptation also played a role.

It has been observed (cf. Minkova and Stockwell 1992:197ff) that the only vowels lengthened before **nd** are the high vowels /i/ and /u/, while before **ld** predominantly back, non-high vowels /o/ and /ɑ/ lengthened. /i/ and /u/ are the most coloured, and thus the most consonant-like vowels, which makes them stand slightly nearer to /n/ than to /l/. Additionally, /n/ and /d/ share all articulatory features apart from nasality. /o/ and (especially) /ɑ/, on the other hand, are velar, which makes them close to /l/ (assumed to have been dark, cf. Minkova and Stockwell 1992: 199). A possible motivation of such adaptations could come from the "rich-get-richer" principle: enhancing the already present features, this time by lengthening.

Before **st**, both lengthening and shortening took place. The decisive criterion appeared to be the vowel height (cf. above, 9.3.2.): high vowels shorten while low vowels lengthen in the same context. This again seems to be a result of the "rich-get-richer" strategy: low sonority is enhanced by shortening in high vowels, high sonority is enhanced by lengthening in low vowels. This has also a perceptual effect.

9.6. Concluding remarks

Summing up, ME quantity adjustments constituted a complex set of changes predominantly aimed at maintaining foot structure stability which was in danger of imbalance due to changes in the morphological structure of words. The eventual outputs were defined by criteria

¹⁴⁹ Other clusters which supposedly triggered Homorganic Lengthening were **mb**, **rd**, **ng** - also preferred finals, and **rl** and **rn** (medials, but relatively much less preferred than the obstruent medials, cf. 5.3.3.).

stemming from altogether four hierarchically ordered domains of phonological conditioning, i.e. rhythm and quantity, bindings, phonotactics and articulation.

One more argument in favour of the hierarchical conditioning of quantity changes is the pattern of their development in those other Germanic languages which also went through quantity adjustments of a generally similar type. Those were, similarly as in English, connected with a morphological loss of inflection. For example (cf. Liberman 1992), Danish, English and German all underwent the lengthening of the **ma:ke(n)** type, but apocope on a large scale occurred only in English. For Swedish, Icelandic and Faroese a stage of free apocope has been suggested, since they underwent the lengthening too, while full endings remain to this day. In Swiss dialects, finally, no wide scale lengthening was observed. The above sketched developments point to the potential of choice, according to the universal preferences, on the part of particular languages, dialects or speakers. On the basis of that choice a typological differentiation becomes possible.

PART IV.

**EXTERNAL LINGUISTIC EVIDENCE FOR
THE MODEL**

CHAPTER TEN

First language acquisition

10.1. Introduction

First language acquisition is the first source of external evidence I will examine in order to find support for Beats-&-Binding phonology. Data on child language have repeatedly been claimed to provide evidence for the vital role of the syllable in the process of the creation of first language phonology, and, therefore, for its role in phonology in general. In this chapter I will discuss some of these claims and propose an alternative interpretation. Simultaneously, some evidence for the self-organization hypothesis of language acquisition will be provided.

10.2. Models of first language phonological acquisition and the syllable

The aim of reviewing selected models of first language acquisition in this place is twofold: on the one hand, for the purpose of identifying the role they assign to the syllable in the acquisition of phonology, on the other, in order to provide a bridge theory (cf. 2.2.7.) mediating between the substance of acquisitional data and the principles of the phonological theory which draws on the data as well as accounting for it¹⁵⁰.

10.2.1. Approaches to the ontogenesis of speech

Models of language acquisition necessarily refer to the origin of language in a child, i.e. the ontogenesis of language. In this respect, acquisitional literature traditionally distinguishes four major types of approaches which refer to theories of speech perception as well as theories of speech production. The first of those approaches is driven by behaviourist psychology, the other three by nativism. The *behaviourist* theory branches into the perceptual learning theory and articulatory learning theory. The infant is born with virtually no perceptual or articulatory ability for speech, so s/he is capable of making no distinctions outside the learned language-specific ones and of producing speech sounds heard in the environment. The idea of learning is that of imitation and reinforcement (cf., e.g., Skinner 1957, Winitz 1969). The theory predicts that the infant's babbling should sound different from language to language and no non-native sounds should occur since these do not get reinforced. The first of the nativist theories is the *attunement/refinement* theory which assumes both for infant perception and articulation a preliminary or basic set of speech sounds to build upon, which grows due to experience with the linguistic environment (cf., e.g., Oller 1980, 1981). The second nativist theory proposes an extreme version of innateness: the *universal* theory. The infant begins with the ability to

¹⁵⁰ The task is made easier in Natural Phonology, since child phonology constitutes one of the foundation stones of the classical theory (cf. 2.1., 2.2.2., 2.3.).

articulate and perceive all human speech sounds, but then loses those that do not occur in the ambient linguistic environment (cf. Jakobson's (1941) abrupt discontinuity between babbling and first words). Finally, according to the *maturational* theory, the onset of human speech sounds as well as of the ability to perceive them will be gradual and proceed in accordance to a biological predetermined program. Infants in all linguistic environments will show the appearance of specific sounds at the same approximate ages (i.e., independently of the language-specific environment). No accommodation to the adult system takes place until the child reaches the systemic stage of phonological acquisition (after the first 50 words are in use). Accordingly, babbling is expected to be the same in all linguistic communities (cf., e.g., Locke 1983).

10.2.2. Early units of production and perception

All the above models necessarily make reference to theories of speech perception and production. For the purposes of the present discussion we need to concentrate on the question of the basic unit of production and perception in the child's speech. **Words and gestures** are identified as units in Michael Studdert-Kennedy and Elisabeth Goodell's *gestural model of early child phonology* (cf. e.g. Goodell and Studdert-Kennedy 1991; for the gestural model itself cf. e.g. Browman and Goldstein 1989) which claims that (Goodell and Studdert-Kennedy 1991: 166; cf. also the references they supply):

- (1) there exists evidence for a continuous development from a pre-linguistic stage, through babbling up to early words
- (2) the units of linguistic contrast in a child's early speech are not phonemes and features, but words, or formulaic phrases, consisting of one or a few syllables
- (3) the initial units of articulatory organization are gestural routines extending over a word or phrase
- (4) phonemes and their featural descriptors emerge from syllables by gradual differentiation of consonantal and vocalic oral gestures.

The authors supply experimental evidence for the hypothesis that consonants and vowels come under stable articulatory control in the child's speech "by differentiation of the closing and opening gestures of the **canonical syllable**" (Goodell and Studdert-Kennedy (1991: 169).

According to Peters (1993), the early productions of many children provide evidence that **syllables and feet** are naturally extractable units (cf. also Echols and Newport 1992), the ones which are prosodically salient. Infants seem to find syllables and feet as the first, most accessible units within the speech stream. Children reproduce syllables rather than morphemes when phonological and morphological boundaries do not coincide (the examples provided show a reproduction of word-medial CVs or word-final CVCs). One may differentiate between *syllable-reducing children*, who are likely to omit unstressed syllables, and *syllable-maintaining children*, who keep the number of syllables unchanged and use fillers and reduplications to approximate the unstressed ones. Another differentiation is between the following groups: *syllable-level producers*, i.e. children who seem to reproduce the most salient syllable of a word or utterance and omit others. Very often the production of this syllable involves consonantal harmony, which applies within the unit's boundaries, e.g. duck → [gak]. The next group are *foot-level producers*, i.e. children who choose for their production a salient foot (carrying primary stress or the final one of an utterance), including weak syllables. The last group are *accent-group producers*, who reproduce more feet, again including unstressed syllables. Additionally (Peters and Menn 1993, Peters 1997), segmentability in child speech is claimed to be influenced, on the one hand, by the morphological characteristics of a language and, on the other, by its rhythmic character, i.e. whether a language is stress- or syllable-timed. For example, babies growing up in an English-speaking environment become aware of the trochaic structure of English words by the age of 0;9 (nine months).

Allen and Hawkins (1980) showed evidence for a **trochaic bias** in production. They investigated universal traits in first language acquisition of rhythm as well as the L1 acquisition of rhythm by English children. Generally, the rhythm of speech of very young children seems syllable-timed. Their speech consists of polysyllables composed largely of reduplicated forms with unreduced nuclei¹⁵¹. By the age of 4 or 5, the rate of speech and the number of reduced nuclei increases, and the speech sounds more and more stress-timed. In the speech of English children, for instance, first, initial weak syllables are not produced, e.g. [banə] for *banana*, [we: , wei] for *away*, [gep] for *escape*, which points to the falling accent characteristic of English (also the first reduplicated doublets are trochaic). In this connection they suggested "an overall rhythmic constraint for English speaking children, specifically, that their speech tends to be trochaic" (1980: 242). The idea comes back in later research as well (e.g. Gerken 1994), showing for instance children omitting function words if they appear in the weak position of an iamb. As a result, one talks of a universal trochaic bias: in general, falling accent seems to be easier to produce and perceive for children, which is evidenced by the predominance of trochaic words in children's early vocabulary in many languages. However, Vihman et al. (1998) showed "almost bipolar distribution of the children's productions of trochaic versus iambic patterns" (Vihman et al. 1998: 946) in English and French, so "little evidence of a trochaic bias (in either perception or production) that would operate above and beyond the children's individual attentional strategies and word-production templates developed under the specific influence of the language they are hearing and attempting to reproduce" (Vihman et al. 1998: 947).

The **stressed syllable** itself as a perceptual category in child speech was identified, e.g., by Stephany (1994): in her data stressed syllables, final syllables, and first of all final stressed syllables were most salient perceptually. Also according to Waterson's prosodic theory (1971, 1981) stressed syllable is perceived and reduplicated; firstly, however, the child perceives words or utterances in the form of units (prosodies) having particular features (e.g. nasality or friction), which are not yet localized within these units.

According to Studdert-Kennedy (1981), speech signal can be segmented into acoustic groups corresponding to phonetic segments only by an organism that already knows that phonetic segments are there to be found. The newborn learns to discriminate: 1. sound from silence 2. voices from other sounds 3. his mother's voice from others 4. intonation from monotone. At this, however, the process of differentiation ends: it is not phonetic segments but **CV's** which get imitated since only CV's come to be perceived. Phonetic segments are abstract control processes that emerge as the links between **acoustic syllables** and their corresponding gestures.

In the "Frames then Content" hypothesis (MacNeilage 1998, also MacNeilage and Davis 1999, Davis et al. 1999, etc.) Frame applies to the rhythmic regularity of mandibular oscillation cycles resulting in listener-perception of **syllable-like** and therefore speech-like output. Close and open phases refer to no neuromuscular activity other than the movement of the mandible, which results in no sub-syllabic organization of Content elements. Although the authors talk about syllable-like output, they actually refer to close and open phases of **CV's**.

In the *phonotactic constraints model of acquisition* (cf. Menn 1986 and references there) a child learns sequences rather than segments, which in psycholinguistic terms means that a child learns articulatory programs for the execution of **canonical word** forms (monosyllabic first). Such a program contains a set of parameters, e.g. of opening and closing the mouth. "Acquisition, in this model, becomes a matter of concatenating programs to make polysyllables and learning to set more parameters within a program" (Menn 1986: 244).

¹⁵¹ Allen and Hawkins suggest that the reduplicated sequences consist of heavy syllables, and that children develop stress-timing when they acquire the ability to produce light ones.

Generally, in the models mentioned above, reference to a syllable as a developmental unit in language acquisition is frequent.

10.2.3. Ontogenesis of speech and self-organization

Self-organization (cf. Chapter 2, 2.3.2.) can be adopted as an explanatory principle for the emergence of a linguistic system and subsystems. It has been used for simulations of emerging phonetic structure (cf. Lindblom, MacNeilage and Studdert-Kennedy 1984; MacNeilage and Davis 1999, Davis et al. 1999), where segments and features, rather than being primes, were assumed to derive implicitly in a self-organizing manner as a deduction from the independently motivated principles (perceptual salience vs. articulatory effort). Out of a CV space, due to the speaker-based and listener-based constraints, a preference for certain CV's arose, whose interaction was expected to result in further structuration. In this view of the phonetic structure emergence, "the child might be a partly random, partly stimulus-controlled sampler of the universal phonetic space in the presence of performance constraints" (Lindblom et al. 1984: 200).

Self-organization has been applied in the analysis of first and second language acquisition of morphology (Karpf 1990, 1991, 1993), with an intention of unifying its explanatory potential with that of the theory of Natural Morphology (Dressler and Karpf 1995) which proved its predictive and explanatory power in accounting for morphological universals, typology and system adequacy already independently (Kilani-Schoch 1988, Dressler et al. 1987, Dressler and Merlini 1994).

Patterns in the self-organization of micro- and macrosystems are formed by means of the following processes (Karpf 1993):

- context-dependent categorization;
- separation of figure and ground;
- segmentation of the input into groups;
- extraction of features;
- discovery of rules and categories;
- organization of function-dependent hierarchies.

In combination with the theory of chaos, transition stages between the initial one and modularization have been suggested (Karpf 1993):

	initial state (inhomogenous clustering)
	quasi stable state
onset of chaos.....	turbulent state (desynchronized part)
onset of dissipation.....	intermittent state (clustering)
	partially ordered state
	ordered state
	coherent state (large coupling strength)

The above processes and stages should serve as guidelines in an attempt to adopt the idea of self-organization to the acquisition of phonology.

Self-organization can serve the analysis of acquisition of phonology only if it is compatible with some available psychomotoric model(s) of early speech perception and production. Reviewing the classical models (cf. 10.2.1.above), among the nativist-oriented theories one finds the attunement theory (Oller 1986) the closest to the idea of self-organization. The theory assumes the innateness of "basic sounds" and the development of the whole system

due to experience. Among new models, it is a dynamic interactive developmental view of early speech and language production (cf. Mitchell 1995 and references therein) which appears to be best compatible with the self-organizing view. The dynamic interactionist developmental view is consistent with the constructivist approach which believes that knowledge is constructed out of dynamic interactions between an individual and his/her environment. The features of the dynamic models correspond very well with the idea of self-organized individual development on the one hand and multifunctional explanations of the naturalist framework on the other.

One of the aspects emphasized in the dynamic developmental models is the importance of timing. Rhythmicities in motor behaviour are thought to represent a transition between uncoordinated and coordinated action (Thelen 1981, Mitchell 1995). Among others, rhythmic motor stereotypes of the limbs, torso, neck and fingers between 6 and 10 months of age parallel the emergence of repetitive babbling. Variegated babbling already marks the differentiation of CV's as units of articulation (Davis and MacNeilage 1990, Mitchell 1995). Another important aspect of the developmental models is the interaction within and between domains. There is evidence for the interaction between lexical, phonological and speech motor organization, for instance: words are further differentiated by the child into gestures and segments (Waterson 1971, Goodell & Studdert-Kennedy 1993); repetitive babbling persists in early vocabularies (Kent 1984, Mitchell 1995); children use phonological criteria in the selection of words when they avoid the words containing phonemes which they do not yet produce (Schwartz & Leonard 1982, Mitchell 1995). On a higher, cognitive-motor level of interaction, behaviour is softly assembled from interacting components which may be stable or unstable, and their loss of stability is necessary for the organism to shift into a new form of behaviour - a phase shift (Thelen 1993, Mitchell 1995; cf. the self-organizational idea of differentiation into modules, as well as the idea of order emerging from chaos stemming from the chaos theory).

10.3. The B&B model and self-organization : predictions for early phonology

Equipped with the self-organization hypothesis for the acquisition of phonology on the one hand, and the Beats-and-Binding model of phonology on the other, one can draw predictions concerning the development of speech in a child from both these perspectives. According to the self-organizational view, one would predict for early speech: (a) the lack of application of certain natural phonological processes, (b) the occurrence of forms which manifest transitional organizations and reorganizations of the system, some of them incompatible with the ultimate language-specific phonology, and (c) interindividual variation in the acquisition paths.¹⁵²

Parallel to the assumption of the three stages in the acquisition of morphology (Dressler and Karpf 1995), I assume three respective stages in the acquisition of phonology (cf. also Dziubalska-Kořaczyk 1997, 1998, Dressler and Dziubalska-Kořaczyk 1997):

- A. PRE-PHONOLOGY: Physiological restriction is still present (cf. the differences between the infant's and the adult's vocal tract¹⁵³), general cognitive principles are applied (like the figure-and-ground principle), while the two main functions of phonology (ease of articulation and clarity of perception) are not respected. It is the stage of extra-grammatical, non-prototypical phonology: onomatopoea, marked sounds and sound sequences.

¹⁵² For attempts to evaluate the explanatory potential of the self-organization hypothesis cf. Knapp 1995, which is the first empirical work on this topic in the area of first language acquisition, as well as Zborowska 1997 for second language acquisition.

¹⁵³ "The infant vocal tract has a broader oral cavity, a shorter pharynx, a gradually sloping oropharyngeal channel, a relatively anterior tongue mass, a closely approximating velum and epiglottis and a relatively high larynx." (Kent 1992: 69)

- B. **PROTO-PHONOLOGY:** A phonological system starts to develop, but is still mainly equipped with universal natural processes, also non-prototypical ones (e.g. consonantal and vocalic harmony), which tend to be unbalanced and irregular in their application. The system may also manifest lack of the application of some universal processes. Consequently, the produced forms manifest transitional organizations and reorganizations of the system, some of them incompatible with the ultimate language-specific phonology. Underlying representations are stored, but they still diverge from the adult ones (language-specific perception starts). Extra-grammatical properties (e.g. of reduplicative babbling) are preserved in first words.
- C. **LANGUAGE-SPECIFIC PHONOLOGY:** The beginning of this phase marks the onset of "order" in the application of language-specific phonological processes, i.e. the development of a language-specific phonological module.

The table below¹⁵⁴ presents the parallel between the psycho-physiological development of an infant and the construction of his/her intermediate phonological representations due to self-organizational processes. The staging in the acquisition of phonology into pre-phonology and proto-phonology has been incorporated into the self-organization column of the table. Onsets or transitions between stages have been indicated as spans of time relative to the development of the psychomotorics, perception and speech abilities of an infant.

¹⁵⁴ The following sources were consulted when compiling the table: Smith et al. (1995), Bohn & Polka (1995), Clement & Koopmans-van Beinum (1995), Kuhl & Meltzoff (1995), Kuijpers (1995), Davis (1995), Studdert-Kennedy (1981), Kent (1992), Werker & Pegg (1992), Jusczyk (1992), Wode (1994).

Table 1. Early development of phonology: production, perception and self-organization

AGE	MOTOR DEVELOPMENT & PRODUCTION	PERCEPTION	SELF-ORGANIZATION: PREDISPOSITIONS / REPRESENTATIONS
0-2m reflexive phonation	cry cough grunts & sighs	[s] /other sounds /voices, mother/others, intonation/monotone (silence/sound)	physiological restriction, discovering the vocal tract perceptual domains difficult to distinguish
2-4m control of phonation (1-4m cooing)	cooing sounds V-like & C-like sounds syllabic [n] nasalized V C-like sounds at tongue- palate contact (→ back Cs) strings of vocalizations vocal learning	3-5m - vocal imitation based on auditory EXTEROCEPTION (hearing ambient language) & PROPRIOCEPTION (hearing own language) of Vs articulatory movement & sound - related visual imitation (of facial movements)	at 4m - the vocal tract starts assuming more adult-like form stored representations (since infants able to improve their production) AUDITORY-ARTICULATORY MAP evidenced (v. preliminary categorization)
5-6m expansion vocal play (3-6m expansion)	increased coordination of articulation & phonation (front C's → visual imitation) short/long sounds marked sounds & sequences possible (since the beginning) onomatopoea	up to 5.5m - v. few differences between NH (normally hearing) & HI (hearing impaired) after 5.5m - auditory feedback influences production (more)	phonological functions not served yet (rather: vocal & perceptual gymnastics) EXTRAGRAMMATICAL phonology ↑ PRE-PHONOLOGY ↓ FIGURE & GROUND principle listener-friendly function
7-9m canonical babble (5-10)	reduplicated babble, repetitive CV's CV CV CV CV (CV)... mandibular oscillation cycles: close & open phases CV's - articulation place dependent general propensity for rhythmical movement	perception of close & open phases → CV's perceived & imitated (still UNIVERSAL PERCEPTION) hand-waving ←→ leave- taking formula	ease of articulation (speaker-friendly function)

<p>10-14m variegated babble & first words</p> <p>(10-18m meaningful speech)</p> <p>14m -> first 50 words</p>	<p>b d (preferred stops) m n j w h left-quadrant V's</p> <p>complex babble trochee</p> <p>segmental & prosodic features of babble preserved in early words</p> <p>variability in word- production</p> <p>b (preferred among stops)</p> <p>words: CVCV, CVC, (CVC+CVC→) CVCCV(C), (CV)CCV(C) etc.</p> <p>(phonemic perception & production start (?))</p>	<p>7-11m - infants perceive SC (silent centre) /dVt/s (German)</p> <p>ca. 1 year - language-specific perception starts</p> <p>(4-and 6-year olds still have problems with phonemic categorization)</p>	<p>↑ onset of PROTO-PHONOLOGY ↓</p> <p>SEGMENTATION OF INPUT INTO GROUPS (feet, words)</p> <p>vowel harmony [centr]</p> <p>C-harmony [labial]</p> <p>trochaic rhythm [stress]</p> <p>EXTRACTION of features/gestures of CV's, later - also for VC's: FORTITIONS (language-specific phonotactics)</p> <p>LENITIONS - make articulation of the above easier, e.g. ke → kje</p> <p>language-specific development of rhythm</p> <p>(segments ↔ writing "knowing" about phonetic segments)</p> <p>***</p> <p>overproductivity of lenitions fluctuations (unsystematic application of processes) variability (intra&inter)</p> <p>onset of phonology proper: language-specific phonology starts dissociating from extragrammatical phonology & morphology</p> <p>regularization ("order") (function-dependent hierarchies of processes)</p>
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Let us in turn consider how the model of Beats-and-Binding phonology maps itself on the above scenario of the rise of phonology in a child and whether the notion of the syllable appears to be vital in the description of this process. Most of the models reviewed in 10.2.2. above assign some role to a canonical syllable in early processing of speech. At the same time, it seems legitimate within the same models to understand the term canonical syllable as a cover term for the primary articulatory ability of an infant to alternate between close and open phases of mandibular oscillation as well as the infant's ability to perceive a basic salient contrast between those two phases. In B&B phonology this corresponds to the acquisition of the **n→B**

binding, which is preferably realized by a CV structure. Thus, the child starts with the **n→B** binding, realized in reduplicated CV's. The first phonological unit emerging from those CV sequences is a foot. In early acquisition, a foot constitutes the only functional unit of speech. A binary {**nB**} {**nB**} foot preferentially develops a falling accent, i.e. it acquires a trochaic pattern (but see Vihman et al. 1998). Foot-timing develops. The next step is the differentiation of words and of the other, **B←n**, binding. At this stage, words with a final consonant appear (CVC, CVCVC), the latter participating in a **B←n** binding. Only then does a **B←n** binding also function intervocalically, e.g. in CVCV. If the child already uses some CVC "words" before this stage, they are either rote-learned or onomatopoeic. Finally, longer words also develop, not limited by the size of one foot any more and involving consonant clusters. The order of emergence of clusters is expected to result from universal phonotactic preferences (cf. Chapter 5).

This order of acquisition is compatible with the models discussed in 10.2.2. above which all assume that children begin with sequences from which gestures and eventually segments differentiate themselves. In the present model, the acquisition of bindings is a prerequisite for the differentiation of consonants and vowels from the stream of speech.

Naturally, language-specific phonology conditions the details of the above-sketched development. For instance, at the trochee-stage, the unstressed vowel may also later remain unreduced, which will exclude the development of prototypical stress-timing. If **B←n** binding does not develop at all, a language is a prototypically beat-timed one. Lexical stress and tone also develop in accordance with a language-specific pattern. Whichever language-specific phonology develops, however, universal preferences for a particular order of acquisition will be observable. This is independent of which of the two natural hypotheses of language acquisition is to be espoused: the strong or the weak one (cf. Chapter 2, 2.3.), although the development of first language phonology as predicted by the Beats-and-Binding model points rather in the direction of a modular approach.

10.4. Analysis of L1 acquisition data in view of the predictions for early phonology¹⁵⁵

Below I am going to analyze data of three different types: first, data coming from a regular observation of my two daughters' speech (M. and K.) in the time span from 8 weeks up to 2 years 8 months (2;8) of age and random observation later. Regular observation consisted in tape-recordings at monthly intervals and notes whenever any new development was observed.¹⁵⁶ Second, the data of F., a Polish boy, who was recorded at ten days intervals since the age of 1;1.18.¹⁵⁷ Third, data concerning the acquisition of consonant clusters in Polish, English and Italian, coming from three Polish children (my two daughters and a girl Z., recorded

¹⁵⁵ Specified in 10.3.

¹⁵⁶ Elder daughter M., younger daughter K., 2.5 year difference in age. I will indicate the source of examples by their initials (M. and K.). I ignore an undeniable influence of the elder one's speech on the acquisition process of the younger one as well as the mutual influence of their speech on each other. I assume a facilitative effect for the younger daughter without, however, any change in the predicted order, not having any data which disprove this assumption.

¹⁵⁷ The data have been collected for the international project on "The acquisition of pre- and proto-morphology" organized by W.U. Dressler. The international cooperation has so far been funded by the Österreichische Akademie der Wissenschaften and by the Hochschuljubiläumsfonds der Gemeinde Wien. The languages so far involved are: Basque, Croatian, Dutch, English, Estonian, French, German, Greek, Hebrew, Huichol, Hungarian, Italian, Korean, Lithuanian, Polish, Russian, Slovene, Spanish, Swedish, Thai, Turkish, Ukrainian, Yucateco Maya. F.'s speech has been recorded and transliterated by F.'s parents, as part of the Poznań contribution to the project, coordinated by the present author. F. was born healthy and is a normally developing child. His mother is a secondary school graduate (did not work at the time of the recordings referred to in the present paper), his father has an MA in agriculture.

since the age of 1;7 for the purposes of the project mentioned above), five English-speaking children in a systematic study of babbling and early words from ca 7-36 months of age conducted by Jakielski (1998), and from one Italian child, a boy C., in an age span 2;0 - 2;6, also collected for the purposes of the already mentioned project by Sabrina Noccetti¹⁵⁸.

10.4.1. Early phonology in M. and K.

(a) Both M. and K. start with a CV, i.e. representing the primary binding **n→B**.

8 weeks M.&K.: le le, la, wa, g^je

0;6 M.: p^ha, ba, p^hu, bu; K.: ble ble ble, da da da, ne

(b) Then, a two-beat foot of the shape CVCV or VCV appears as a result of a combination or sequencing of two (the only available) **n→B** bindings or a beat and an **n→B** binding.

0;7 K.: dada, tata, ata, ada, adʒa

0;8 K.: mama, m:am:a, at^ha, at^he

0;11 M.: tati, kaka, nana, mama

This foot is not yet systematically of a trochaic stress pattern, but the tendency to stress the first beat is observable. Once a trochaic foot pattern gains on regularity, it remains for long enough to be audible e.g. in the regularization of abbreviations towards a trochee, as in:

1;11: K.: [ˈbengu] for *BMW* [be em vu], [uˈesa] for *USA* [u es a], [ˈpego] for *Peugeot* /peˈzɔ/.

(c) Next comes a word which has the shape of a two-beat trochaic foot (with reductions of consonants towards a CVCV).

0;11 M.: wawa *Mikołaj*

1;0 M.: towa *Mikołaj*, mma *nie ma*

1;1 M.: tsʰita *czytaj/ć*, kaka *lalka*, bowa, powa *książka*

1;2 M.: baji *balon*

Simultaneously, when CVC words are attempted, they are still rendered without a **B←n** binding.

1;1 M.: ta: *tak*

1;3 M.: du di du di, du du du *daj*

1;4 M.: mʉni, mʉni *miś*

Gradually, words and phrases longer than a binary foot also appear, still involving only an **n→B** binding.

1;2 M.: koti da *kotki dwa*

1;4 M.: tʉe towa *gdzie Mikołaj*, kawa mma *kawy nie ma*

(d) Next comes a word which is a two-beat trochaic foot and contains a **B←n** binding word-finally.

¹⁵⁸ I'm grateful to Sabrina Noccetti, who recorded and transcribed C.'s speech, for having analyzed the data from a phonological perspective and letting me use her results.

¹⁵⁹ Double symbols like *dʒ* refer to monosegmental affricates in Polish.

1;5 M.: tatuf *tatuś*, kodon *dokąd*, po:tam *proszę*, bo:dan *Bogdan*, dzidzɔɛ *dzidzius*
1;6 K.: jajok *jajko*

(e) Only now do one-beat words appear containing a **B←n** binding, which constitute indirect evidence for a word-internal {Bn}-binding in two-beat words like the ones listed in (d).

1;6 M.: maɲ *pan* (maɲi *pani* already at 1;5), ɲoɲ *stoń*, peɲ *pięć*, peθ *pies*, haj *mama*
hi mama.

K.: daj to *daj to*, paɪɔ *spać*, nok *nóż* (but: ta: *tak*)

Also longer words (three-beats long, i.e. rhythmically a beat + a trochee) with a final consonant occur more and more often.

1;5 M.: kokodij *krokodyl*

1;6 M.: papatam *przepraszam*, kokowaj *Mikołaj*, popotan *hipopotam*

(f) At this stage, words containing a CC medially appear: intervocalic double consonant clusters are already legitimate, since they are "licensed" by a **B←n** and an **n→B** binding respectively. No initial or final clusters appear yet.

1;6 K.: pijdzie *przyjdzie* (notice that an initial CC is simplified)

1;7 K.: pujka *pilka*, fefwo *krzesło* (again, initial cluster simplified), bojki *bombki*

1;8 K.: ofutɔ *otwórz*, palku *parku*

1;9 M.: damki *trampki* (notice initial cluster reduction to one consonant and medial cluster reduction to two consonants)¹⁶⁰

(g) Much later come words also containing CC- initially. They start appearing, first very seldom and generally with a slow increase in the number of cases, after four/five months of the use of word-internal clusters, i.e. around 1;10-1;11¹⁶¹.

1;10 M.: pɕɪɕet *przyszedł*

K.: stalɪ *stary*

1;11 M.: mju:t *miód*

K.: bluga *bluza, bluzka*, but deɲtɔɛ *zdjęcie* with a reduced initial but maintained internal cluster, tɔɲpklɔ *śrubka* where all bindings are retained while the initial cluster is reduced at the expense of the medial position.

Also word-final clusters start to appear, e.g.

1;11 K.: golk *Golf*, kibolk *keyboard*

As predicted (cf. 10.3. above), the stronger binding appears to be acquired before the weaker one, i.e. **n→B** before **B←n**. The above-observed order of the acquisition of consonant clusters is also predictable within the Beats-and-Binding model (cf. also some more discussion below, section 10.4.3.). The intervocalic, word-internal two-consonant cluster is acquired first, since in this position both consonants participate in bindings with respective beats. Word-initial clusters are acquired before word-final ones due to the saliency of word-initial position, which makes the child more aware of the initial segments. This saliency, however, is at the same time

¹⁶⁰ Notice a later development of word-internal clusters in the elder daughter's speech. This slower stage, however, was followed by an outburst of words with the clusters concerned (around 1;9 - 1;10).

¹⁶¹ K. had one initial CC- cluster already at 1;8: ɔfeka *świeczka*.

responsible for reductions in initial position, in which listener-friendly processes operate to regain a preferred **n→B** binding. Word-final position, being less prominent for the listener, may tolerate more clusters but is simultaneously subject to speaker-friendly processes of simplification (cf. the predictions formulated in Chapter 5, especially 5.4.).

The universal preference for a trochaic foot has also been confirmed by the data. The two Polish children prefer a trochee, although this may be partly due to the fact that Polish has a lexical penultimate stress.

During the period before the appearance of consonant clusters, universal preference for a CV in the form of alternating sequences of consonants and vowels finds full support in the data. Numerous cluster simplifications in the form of reductions, assimilations, substitutions, coalescences or metatheses all have the same teleology: to maintain, within a foot or within a phonological word, in the first place, **n→B** bindings, and, secondarily, **B←n** bindings. Here are some examples of the above mentioned simplifications:

bowa <książka>, kuka <książka>, papatam <przepraszam>, jeje <jeszcze>, jajok <jajko>, kako <ciastko>, fufu <siusiu>, pa t ɔ <spać>, dʒe <gdzie>, maga <Magda>, kulika <kuleczka>, guka <gumka>, puka, pika <piłka>, miko <mydło>, me:ko <mleko>, mika <miska>, taki <kwiaty>, baja <Baba Jaga>, papo <spadło>, vos' <włos>, potet <poszedł>, pojeje <pojechał>, pujaja <pojechała>, takok <kwiatek>, tak <kwiat>, dugi takek jet ɔ <drugi kwiatek jest>, lalola <Gwiazdora>, fifinka <dziewczynka>, papety <skarpety>, atobu <autobus>, mokika <motylek>, podut <samochód>, taki <ptaki>, buka pada <głupia Magda>, moto pi: <mocno śpi>, pekek <przecież>, beduty <zepsuty>, t ɔ ukle f poɲeni <klucze w spodniach>, t ɔ ɛba pogagogat ɔ pelik'ɛm <trzeba posmarować kremikiem>.¹⁶²

Later on, when more complex phonotactics was emerging, the binding preferences could still be observed, e.g. 5;0 M.: mɪʒsa, mʒsa <msza>, pleɔ <pleśń>, xuxu <Uhu>, xedit <Edith>, 3;6 K.: ɪmgwa, emgwa <mgła>, 4;4 K.: doknie <dotknie>, 4;10 K.: ʒktawt <kształt>, up to ca. 5;0 K.: gjazda <gwiazda>, kjatek, fkʃjatek <kwiatek>.

10.4.2. Early phonology in F.

I have used the first four months of the recordings of F.'s early phonology for this analysis (1;1.18 - 1;5.7). Since the recordings start in between the 13th and 14th month of F.'s life, one would expect to observe in his speech the manifestations of variegated babble and first words or, possibly, still of a transition period between canonical babble and variegated babble. Indeed, this is what one finds: variegated babble and onset of first words, still full of onomatopoea, but almost (already?) devoid of universally marked sounds or sound sequences (1;2.14 [s'fxa] is one of the exceptions).

CVCV(CV) sequences are segmented into CV's, i.e. the latter are identified as units of articulation. Consequently, variegated sequences begin to appear. The extraction of features starts, as a result of which feature-based non-phonemic underlying representations begin to be formed (cf. below). Initially the most frequent sounds are: (at 1;1.18) [b] 25 tokens, [k+k^j] 20

¹⁶² Out of many cases of consonant harmony (e.g. 1;7 K.: gugigi *guziki*), two examples in the data would traditionally be analyzed as intrasyllabic, i.e.

K. 1;9 pijajka *piżamka*

K. 1;11 golik *golf*.

While the latter is simply word-marginal, the former takes care of the bindings of the most prominent beat, while the other two **n→B** bindings remain unchanged.

(8+12), [t] 19, [d] 18, [j] 11. These sounds persist as frequent during the time studied. Most common CV-sequences are the ones like: [ji, je, ti, di, ki, k^je, dʒi, wu, bu] etc. F.'s choice of first words is influenced by these articulatory preferences: in the period discussed he uses only four words with clear reference and often, i.e. *gdzie* (from 1;1.28), *dzidzia* (from 1;1.28), *kura* (from 1;3.26) and *dziura* (1;4.28). The discovery of optimal syntagmatic combinations of features in CV's is driven by ease of articulation. F. starts with a preference for palatal sequences like [ji, je], so his first two words include them (*gdzie* and *dzidzia*). Later (from 1;3.6) he indulges also in labial sequences like [wu, buwa, buwuwu], and adds two words (*kura* and *dziura*, pronounced with [uwa]).

Parallel to the palatality preference, F. manifests the use of such CV's like: [ke, kɛ̃, gɛ̃, dɛ̃, tɛ̃] without palatalization of the consonant. So, F.'s phonology demonstrates, simultaneously, a lenition in the context of front vowels i.e. palatalization, e.g. $k \rightarrow k^j / _ i, e$ and a fortition - depalatalization: $k^j \rightarrow k$, which, however, never happens before [i]: the vowel [e] is the overlapping environment for both processes. The fact that two processes of opposite functions apply unsystematically in the same environment, as a result of which a fortition is not permanently ordered before a lenition, speaks against the strong hypothesis as formulated by Stampe. Language-specifically, Polish prefers, for a velar [k] the lenition before [e], with the non-palatalized [k] occurring in a number of words of foreign origin and before a nasalized version of [e]. Polish phonotactics also dispenses with a sequence velar $C + y$ (unless in loan words, e.g. *kynologia*), whereas [tɛ̃, dɛ̃] remain. As to the dental stops, F.'s phonology allows for their "surface", one-step palatalization before [i] as well as for their "deep", two-step palatalization resulting in [tɕ, dʒ], whereas [ɕ] appears in the absence of [s] or [sʲ]. Again, the processes apply in an unsystematic and unordered fashion in F.'s early phonology, while adult Polish "erases" the result of the one-step palatalization from the phonetic surface (with the exception of loan words, like *sinus*, *tir*, *dinozaur* or *Zinn*). The workings of the above palatalizations are illustrated with the history of the words *gdzie* and *dzidzia* throughout the four months studied (all encountered types are listed): *gdzie* [k^je - g^je - dʒe; g^je - g^je]; *dzidzia* [dʒa - dje, di - didi - dʒija, dʒidʒa - dije - dʒija, didia].

There is not enough evidence to suppose that the underlying representations of these two words in F.'s phonology are of the adult form. Rather, the processes and forms listed above point to the representation /kje/ of *gdzie* and the evolving representation of *dzidzia*: /di/ → /didi/ → /didia/. As to the former, the velar appears first as voiceless and later gets voiced due to the process voicing velar stops, manifested independently e.g. in an onomatopoeic *kra*, pronounced by F. as [ga, gra], as well as by the fact that in the first recording (1;1.18) [k] outnumbers [g] (20 vs. 3 tokens). A single form [dʒe] (1;2.14) constitutes a short-term-memory based imitation of the last heard CV of *gdzie* (at the same time, Filip also says [g^je] for *gdzie*, and [didi] for *dzidzi/a*). The same remark about imitation refers to the single initial form of *dzidzia* - *dzia*. All other forms listed above are gradually derivable from the representations suggested by the two processes palatalizing dentals. Even if we imagine F.'s representations in terms of phonemes, there is no evidence his perception is phonemic: it is rather in terms of feature-combinations or gestures extending over a CV sequence, since this is what F.'s perception seems to be sensitive to (cf. below: "waves" of preferences).

The fact that a process voicing velar stops was mentioned above points to some differences across places of articulation with respect to voice in F.'s early phonology. Indeed, there seems to be evidence for the fortitive paradigmatic devoicing, manifested in a hierarchical order by [k], [t] and [p]. Initially, a velar appears only as voiceless, a dental has both values and a bilabial is predominantly voiced. This can be explained, firstly, by the phonetic difficulty of maintaining voice in velar stops, a difficulty which decreases the further from velar the place of

articulation is. Secondly, the lenitive context-sensitive voicing process is at work which first of all voices bilabials, secondarily dentals, and only thirdly velars.

An interesting observation concerns the lack of unit-final devoicing in three cases throughout the studied months: [kob], [bab] and [tadt] (while [-k] and [-t] appear finally otherwise). Notice that this is compatible with the hierarchy discussed above: the voiced bilabials and a dental result from an overgeneralization of voicing in the three sequences quoted, and there is no evidence as yet to posit the process of devoicing and respective representations in F.'s phonology¹⁶³. Another paradigmatic fortition observed in F.'s phonology and as yet not counteracted by any lenition is the denasalization of vowels.

F. seems to demonstrate the "waves" of preference for a particular feature (or gesture), mirrored in his attempts at words, as already shown for palatality and labiality. A voiced velar, once it appears, is exercised in one-token attempts at (1;2.14) *stoń* → [gu], *lew* → [gle], *kotek* → [gy], *klocki* → [gkgle].

In the last recording analyzed here (1;5.7) F. makes a series of single-token attempts at a number of words which all manifest consonantal harmony, e.g. *siusiu*, *baba*, *koko*, *kaka*, *ciototota*, *dada*, *koga*, *dzidzio*. This is interpretable as a case of a non-prototypical phonological process still intervening in the developing phonology. Another common feature of these words is a universal preference for a trochaic foot. In two recordings before the above attempts, i.e. 1;4.17 and 1;4.28, F. produced much longer stretches of sound sequences, which might be interpreted as beginning of a turbulent stage in acquisition, out of which, already within three weeks, some more coherent outcomes start arising.

Recapitulating, it is possible to conclude that the above analysis of F.'s early phonology appears to have been well-guided by the criteria provided by the self-organizational model. In particular, the processes assumed to be responsible for pattern-formation in the self-organization of micro- and macrosystems are compatible with those processes whose outputs are manifested in F.'s phonological productions. Additionally, there are phenomena in F.'s output which speak against the strong acquisition hypothesis. On the other hand, the analyzed material is also compatible with B&B predictions about the priority of **n**→**B** binding (and thus CV) and a trochee.

10.4.3. L1 acquisition of consonant clusters

On the basis of the phonotactic preferences and relations among them, certain expectations can be formulated with reference to the acquisition of clusters by children (some already discussed in 10.4.1. above). (1) Firstly, the earliest clusters to appear should be from among the preferred ones, while the dispreferred ones should undergo cluster reduction. (2) Secondly, less complex clusters should appear before more complex ones. (3) Thirdly, the first clusters should be medial, arising as a result of combining the sequences VC and CV. Only then should initial and final clusters be able to dissociate (unless a medial is a preferred one and there is no need to). To test these predictions, data from typologically different languages is needed. Below I will juxtapose some observations on the acquisition of Polish with selected data from English and Italian.

¹⁶³ In fact, it is only due to the learning of morphonological alternations (and orthography) that the child discovers the adult representations of word-final obstruents in Polish.

10.4.3.1. Polish

Table 2. Clusters in Polish L1

	M.	K.	Z.
first cluster	VCCV	VCCV	
CCV	10	3	25%
pref.	5	3	
VCCV	25	13	60%
pref.	14	2	
VCC	2	1	15%
pref.	1	1	

In M.'s speech, the first cluster was a dispreferred medial [-ŋg-] (a potential preferred final). This was the only cluster from 0;11 to 1;8. From 1;9 to 1;10 three more (non-medial) clusters appeared. Then, a rapid growth of medials 1;10 - 2;1 took place, with only infrequent non-medials. In the time span 2;1 - 2;8 medials still predominate, while initials begin to be more frequent. In K.'s speech, the first cluster was also a dispreferred medial [-jdz-] (a potential preferred final). Early medials, while almost alone, were mostly of the dispreferred types. They improved when initials and finals started to appear. Also Z. shows the predominance of medial clusters over initial ones, and these in turn over the final ones.

Reductions showing precedence of medials: M. sw`ɔptɛ → fɔptɛ; M. ʒɔtkj`ɛfka → ɔtkj`ɛfka; M. ɔstʃ`ɪtʃka → ɔstʃ`ɪtʃka; K. pʃ`ɪjdzɛ → p`ɪjdzɛ.

Substitutions showing improvement according to phonotactic preferences: kfj- → fkj-, an improvement according to the preference for initial triples; lv- → vl-, gv- → gj-, a change from dispreferred to preferred according to the preference for initial doubles; kf`adrat → kr`advat (kf- → kr-, -dr- → -dv-), a change from dispreferred to preferred of both an initial and medial cluster according to the respective preferences.

10.4.3.2. English

Table 3. Clusters in English L1

	babbling (0;8→)	early words (1;4 →)
initial	30%	45% (esp. stop+glide)
medial	56%	22% (esp. nasal+stop)
final	13%	33% (esp. nasal+stop, stop+fricative)
generally preferred constituents	stop+nasal nasal+stop nasal/stop+glide	stop, nasal, fricative, liquid (both orders) C+glide

Table 3 demonstrates different tendencies for clusters in babbling and in early words: medials predominate among early clusters, later on initials gradually take over. The data also showed that monosyllables were preferred among early words, that increased cluster complexity co-occurred with decreased cluster productions, that cluster elements were derived primarily from the singleton phonetic inventory, that contiguous segments in babbling clusters varied by manner more often than place and that the majority of clusters in both babbling and words were homorganic. As far as the influence of the ambient language on clusters was concerned, no strong influence was evidenced in babbling, whereas it evidently showed in early words. Moreover, the cluster types in words demonstrated continuity and expansion of the types in babbling.

10.4.3.3. Italian

C. showed a definite preference for a structure CVCCV, which started to appear systematically at 2;3, after VCV and CVCV (sporadically VCCV) had already developed. For example: *cesca* (*francesca*), *ostre=giostre*. As the main cluster reduction strategy C. employed assimilation resulting in gemination: *altri* → *atti*, *questo* → *etto*, *aspetta* → *appetta*, *tanti* → *tatti*, *banki* → *bakki*, *talpa* → *tappa*, *orso* → *osso*, *ritorna* → *tonna* etc. All geminates are preferred medials, according to the preference for double medials. Other reductions also occurred, e.g. reductions via a preferred initial: *dentro - tro* → *dento*, *zebra - bra* → *ba*, *sopra - pra* → *sopa*, or reductions leaving only a medial cluster of a word, and thus pointing to its precedence, e.g.: *brutto* → *butto*, *spengo* → *pengo*, *scuola* → *cola*, *etola*, *scritto* → *itto*.

10.4.3.4. Discussion

Of the three predictions specified at the beginning of this section (cf. 10.4.3.), the third one about the priority of medials appears to be fully confirmed by the above data. The earliest clusters were indeed medial and they prevailed for a substantial period in the discussed children's speech. Their precedence was also supported by reductions of other clusters but

medial within a word. The English data distinguished between the tendency for medials (of the dispreferred types) in babbling which gave rise to initials of the most preferred type (stop+glide) in first words. The order 'medials before initials' is compatible with the order in Polish and Italian. It may be that the English-speaking children developed initials earlier due to the demonstrated preference for monosyllables in early words.

The second prediction concerned the expected growing complexity of clusters. The data confirmed this prediction as well. Clusters grew more complex not only in terms of number of segments involved (there were very few more complex ones than doubles in the data), but also in terms of articulatory variety of the segments themselves. The English data was systematically analyzed in this respect and showed the homorganicity of clusters, and this tendency is also discernible in Polish, e.g. in nasal+stop clusters, and in Italian in geminates.¹⁶⁴

The first prediction, hypothesizing the universal 'goodness' of the early clusters, was only partly confirmed. The Italian gemination produced the best possible medials. Many of the Polish medials were of the dispreferred types at first and improved only when the peripherals started to develop. In the English data the medials were predominantly bad (i.e. dispreferred) at the start, but as such created material for good (i.e. preferred) initials (esp. stop+glide) and finals (esp. nasal+stop). Thus, first (medial) clusters are random combinations of simpler structures VC and CV, which constitute a necessary stage in the creation of the preferred types of initials and finals. However, the phonotactic preferences did manifest themselves explicitly in the improvements of the target clusters according to the well-formedness conditions. Also, the early clusters (esp. in the English babbling) varied by manner rather than place, which points to the developing perceptual sensitivity in children which is the basis of the phonotactic preferences.

Generally, both the idea of self-organization as well as the order of acquisition predicted by the Beats-and Binding model itself provide useful guiding principles for the explanation of early stages in the acquisition of phonology.

¹⁶⁴ The preference for homorganicity is also discernible in the data quoted by Vihman (1980: 311ff): clusters preserved most often by the investigated Slovenian, Estonian, Czech, Spanish and English children were: nasal+stop, fricative+stop, stop+fricative, and lateral+stop.

CHAPTER ELEVEN

Second language acquisition

11.1. Introduction

In this chapter I will consider the role of the syllable and, consequently, the treatment of clusters in second language acquisition. It has repeatedly been claimed in psycholinguistic literature that speakers can syllabify, i.e. they are able to divide words into smaller chunks which correspond in size to units called syllables. Such segmentation is expected to observe, on the one hand, universal principles of syllabification (e.g. sonority sequencing) and, on the other, language-specific syllable structure constraints. In a second language, first language interference is additionally expected. Learners of foreign languages are expected to share some strategies of dealing with clusters of a foreign language, no matter how complex their native phonotactics is. The question remains, however, what it is exactly that they share and what is transferred from their native language.

Natural Phonology originated from the study of first language acquisition. Predictions concerning the acquisition of a second language in Natural Phonology will be derived from its view on first language acquisition and from universal principles and preferences. A detailed make-up of the process of SLA itself is to be specified by Beats-and-Binding phonology and its model of phonotactics. Thus, a psycholinguistic model of first language acquisition will serve as a bridge-theory for the analysis of second language data: specifically, this will be the model of self-organizing processes (cf. Chapter 10). There is no space here to review current models of SLA stemming from the research area itself, such as the Speech Learning Model (SLM) by Flege (1991), Perceptual Assimilation Model (PAM) by Best (1996), an exemplar-based model by Pisoni (1996) or Perceptual Magnet model by Kuhl (1996). The reader is referred to comprehensive reviews by Leather and James (1991) and Strange (1996).

For a child the model of self-organization predicts that s/he is born with predispositions to acquire phonology and other components of grammar rather than with an innate system. S/he overcomes difficulties through experience, often choosing “blind alleys” and retreating from them. Gradually, via the processes of selection and differentiation, a language modularizes, and phonology, morphology etc. become dissociated.

An adult in SLA, however, has a different starting point: apart from universal preferences, which are always available, an adult is equipped with the system of L1 and developed cognitive capacities. Adults can suppress the L1 interference by means of the meta-knowledge of their L1 as well as consciously learned knowledge of L2. This cognitive activity

is helpful in the self-organization of a new system. Adults may vary¹⁶⁵ as to the ways in which they construct it.

11.2. Syllable-based explanations in SLA and B&B phonology

Before I proceed to a description and analysis of the data, I will shortly review the role the syllable has played in explaining the acquisition of second language phonology.

In Hurch's (1982) investigation of the acquisition of /h/ by Italian learners of German, a syllable is called for as an explanatory ground of the phenomena observed:

(a) h-epenthesis (precisely, prothesis) e.g. in *Ackermann* ['ha.ker.man], *acht* [haxt]; *beeilen* [bə.'haɪ.lən]; *verursachen* [fər.'hur.sa.xən] etc. (Hurch 1982: 276), is, approximately, hierarchized according to the degree of stress on the syllable concerned. In general, 70 percent of all epentheses in the data take place in a word-initial position, 20 percent - are hiatus-breaking.

In the B&B framework, the above is due to the preference for the **n**→**B** binding, reinforced in a word-initial position¹⁶⁶ by word-initial salience, but also in a hiatus position. /h/ is also inserted according to the degree of stress on the beat following it, according to the rich-get-richer principle, i.e. the stronger a position (*ceteris paribus*, stressed) is, the better it should satisfy the perceptual preferences.

(b) Analogous copying, e.g. in *ich hasse* [hoɪç] *euch*, ['ha.lə] *alle Häuser*, *wir haben* ['hangst] *Angst* etc., is explained as a fortitive improvement of the syllable structure.

In the B&B framework, the explanation is similar to the one above under (a), reinforced articulatorily by a kind of - anticipatory or perseverative - consonantal harmony.

(c) Metathesis, e.g. in *einholen* ['haɪ.no.lən], *abheben* ['ha.be.bən], *inhalieren* [, hi.na.'li.rən], *überholen* [, hy.bə.'ro.lən] etc., has a syllable as a domain of application, while the causality of the process (so-called resyllabification included) lies in the perceptual improvement of the syllable structure.

¹⁶⁵ One type of such variation stems from language-specific constraints acquired in first language acquisition. Menn's (1986) phonotactic constraints model of acquisition predicts for second language that position with respect to word boundary is essential for the production of a cluster (Menn 1986: 245; ref. to Greenberg 1981). In psycholinguistic terms, this means that the production of a particular cluster requires a position-specific program for that cluster. Menn supplies the following examples of phonotactically constrained second language acquisition phenomena with English as L2 (Menn 1986: 246: Table II):

A. Problems with the lack of word-final voicing:

Spanish learners: devoicing

rob [rap] *robber* [rabər]

Mandarin learners: vowel addition

tag [tægə]

B. Cluster problems:

Japanese learners: vowel insertion

street [stərit] *treat* [tərit]

Spanish learners: vowel prothesis

splash [əsplæʃ] *steam* [əstim]

By position-specific programs, Menn means articulatory routines for the execution of canonical word forms, the routines learned in first language acquisition. Learners also apply universal strategies of the improvement of sound sequences in L2 (in accordance with universal preferences), but the choice of a strategy is influenced by the learners' first language phonology.

¹⁶⁶ Secondly, also morpheme-initial position. The quoted h-epenthesis takes place either word-initially (mostly) or across a morpheme boundary.

Firstly, the metathesis takes place between the initial positions of neighbouring morphemes. The morphemes are clearly salient, but still more salient is the word-initial position (words have priority over morphemes, cf. 2.2.5.), which becomes, therefore, reinforced by an **n→B** binding via metathesis. As a result, the structure of both morphemes is changed, so that the boundary is no longer transparent while the phonology of the whole word is improved, both initially (since an **n→B** binding is established) and internally (since an internal consonant cluster is reduced and a new **n→B** binding is established).

(d) "Graphic" interference, e.g. in [hi:r] *ihr*, [hu:r] *Uhr*, [he:rə] *Ehre* etc., is analyzed as an improvement from VC- to CV-syllable. Similar h-prothesis behaviour has been observed for Canadian Francophone learners of English (Hurch 1988b: 146).

The process is again a consequence of the **n→B** preference, while the source of /h/ may indeed be graphic, as suggested by Hurch, or it may appear due to analogy with other epentheses.

James (1987) (cf. also James 1988) observes that syllable-timed rhythm might be considered typical of post-beginning (pre-intermediate) learner systems, obscuring the rhythmic structures of both L1 and L2 (James 1987: 246). James's observation suggests that learners' difficulties with the timing of L2 are resolved in an interlanguage by recourse to a timing pattern which does not differentiate between stronger and weaker beats. One might doubt, however, whether this results in a prototypical beat-timing (cf. 4.2.6.). The latter would impose rigid requirements on the rhythmic structure of interlanguage, for which the provided data is not enough proof.

Hieke (1987) demonstrates how casual speech phenomena ('absorption' in the author's terms) may serve as a measure of fluency in second language acquisition. All the processes he mentions for English have a common motivation, i.e. they result in hiatus-avoidance, ensure a flow of speech from syllable to syllable, and create an impression of tense and lax syllable alternations (Hieke 1987: 55-6). The degree to which a learner demonstrates these phenomena in his/her speech shows his/her approximation to native L2 speech. Clearly, the above shows a universal rhythmic preference for trochaic feet (or foot timing). If this happens to be the case in L2 acquisition, this may well be a proof of high proficiency in the second language (since such regularization of rhythm happens also in L1 casual speech), but, likewise, of the dominance of universal preferences in the process of L2 acquisition.

Tropf (1987) interprets the data from Spanish learners of German in terms of the sonority hierarchy as an independent principle governing syllable structure in the interlanguage. He investigates syllable-initial and syllable-final consonant cluster reduction and syllable-final consonant deletion in the speech of Spanish learners of German and concludes that it is the less sonorous consonants that tend to get deleted, no matter what their position in a cluster, and relatively independently of the syllable structure conditions of L1 and L2. Although the author reports on the deletion of syllable-final consonants by Spanish learners of German and the reduction of syllable-initial double clusters towards CV, there is no evidence in the available data that syllable-initial and -final does not simply mean word-initial and -final or morpheme-initial or final (cf. a remark on Spanish prefix-final clusters Tropf 1987: 185). So, we are dealing with word-initial salience (cf. 2.2.5.) which is an additional motivation for the initial cluster simplification to CV, besides the **n→B** preference. The latter is also a motivating force behind a word-final consonant deletion (although, of course, reinforced by L1-specific preferences).

Tropf's generalization concerning the deletion of less sonorous consonants may be a little premature, since he considered only a very limited choice of clusters. The path of reduction is, however, predictable within the Beats-and-Binding model. In a cluster like /ps-/, a plosive is predicted to drop: /ps-/ does not observe a relevant phonotactic preference, since the sonority distance in /ps/ is smaller than in /sV/. Therefore, the **n→B** preference (reinforced by a big contrast in /sV/) overrides the word-figure status of /p/ and /p/ drops. Another flaw in

Tropf's analysis lies in the fact that he treats affricates on a par with clusters.¹⁶⁷ However, no matter which approach to affricates is adopted (i.e. mono- vs. biphonematic), it is mistaken to say that a reduction within an affricate is unpredictable (cf. Tropf 1987: 179): it is either predictable as above for a cluster (if treated as biphonematic), or as a reduction of an onset and hold phase of an affricate (for which there are both phonetic as well as synchronic and diachronic phonological grounds).

With reference to the claim that an open syllable structure is preferred to a closed one in the process of L2 acquisition independently of the syllable types of L1, evidence for both a preference for CV structure (Tarone 1984) and CVC structure (Broselow 1984, Sato 1984) has been cited by Tropf (1987: 175), James (1988: 43-4) and others. So, beside a tendency for CV structures, which, however, is rarely well isolated from the possibility of L1 transfer (e.g. from a language like Cantonese or Portuguese to English), CVCC structures are reduced to CVC, e.g. in Vietnamese English. A preference for an **n**→**B** binding explains the tendency towards CV's, while the above reduction from CVCC to CVC, in turn, is governed by a more general preference to have sequences consisting only of two bindings to the disadvantage of consonant clusters. Retaining the final C may have the function of marking a word boundary or making a morphological boundary more transparent.

There is no consensus among SLA researchers as to the predominance of a particular strategy in cluster avoidance, i.e. epenthesis over reduction or reverse. L1 seems to influence that choice. Also the distribution of clusters in L1 (e.g. no syllable-initial clusters in Turkish, no syllable-final clusters in Greek, no clusters in both positions in Japanese) influences the acquisition of L2-specific clusters in the respective positions, so that e.g. it is relatively easy for a Turkish learner of English to learn syllable-final /-sp/ while he has difficulties with syllable-initial /sp-/. Benson (1986) discusses the relative difficulty (in terms of the Markedness Differential Hypothesis of Eckman 1977) that Vietnamese speakers are predicted - and found in tests - to have when pronouncing English clusters (Vietnamese does not have clusters). He observes that almost 50 percent of errors concern the elimination of the tautosyllabic cluster structure (Benson 1986: 285), both by means of schwa insertion within or after the cluster and by elimination of one of the consonants. Other errors, in descending frequency, are: devoicing, devoicing combined with the above mentioned strategies, substitution, and metathesis.

In Beats-and-Binding phonology the following predictions can be drawn with respect to the treatment of consonant clusters in L2 acquisition (for detailed predictions see below):

- (a) Whether a cluster is simplified through the reduction of one of its members or epenthesis (e.g. *stra* → *sta* or → *stəra*) may depend on functional criteria (speaker-friendly vs. listener-friendly), rhythmical criteria, or L1 criteria.
- (b) As for epenthesis, anaptyxis is generally preferred over prothesis due to the **n**→**B** preference. Otherwise, the choice is influenced by L1 language-specific phonotactics. For instance, German /ʃtr-/ is rendered by a Spanish speaker as [əstr-] (cf. Sp. /əstraða/ 'street') (Tropf 1987:180) while English *street* is [stəri:t] for a Japanese speaker (see also examples from Menn (1986) above; cf. also the loan-words evidence in Lovins 1973 and Smith 1980). Mandarin learners' anaptyxis in *tag* [tægə] (cf. again Menn's examples) is of a different nature: they cannot use devoicing, like Spanish learners, since they do not have a binding **B**←**n** at their disposal. They can escape the difficulty of pronouncing a final (voiced) consonant only by introducing another **n**→**B** binding.
- (c) With reference to the Turkish/Greek example above, apart from considering a quite plausible influence of L1 phonotactics, one should also consider the universal phonotactic status of /spV/ vs. /Vsp/ clusters. /sp/ is a good medial cluster, and not initial or final. Still,

¹⁶⁷ There is no space to elaborate this issue here; for a comprehensive discussion cf. Luschützky (1993).

word-final position is more tolerant to dispreferred clusters than the initial one, so it is expected to be learned slightly more effectively by L2 learners. This worsens the situation of Turkish learners who do not have initial clusters: the /spV/ is doubly difficult. The situation of Greek learners, on the other hand, is facilitated: they do not have final clusters, but final cluster is universally easier.

To obtain a comprehensive view of the treatment of clusters in second language acquisition, one need no longer be limited by the boundaries of the syllable, but should look rather at intersegmental relationships as they arise in a sequence of sounds, possibly delimited by, more justifiably, boundaries of words and morphemes.

11.3. The empirical study of syllabification in SLA

It has been quite common to collect psycholinguistic/behavioural evidence to match the apparent linguistic evidence for the syllable structure or boundaries (cf. e.g. Treiman 1989, Derwing et al. 1991a,b). Subjects of the tests are usually presented with some blending, substitution, inversion or judgement tasks, which are meant to elicit either intra- or inter-syllabic divisions without explicit recourse to the notion of syllable being made during the tests. Tests of this kind possess certain drawbacks, e.g. they are often based on simple one-syllable words (cf. Treiman 1989), so that whatever claims are made, they refer to the internal structure of a word, and not a syllable. Also, the subjects are trained to perform certain operations, and then simply examined on how well and fast they reproduce them, which does not necessarily provide evidence directly referring to speech capacity. Additionally, the tests are not comprehensive enough, since they are driven by strong presuppositions about syllable structure, and thus leave some variables uncontrolled (cf. Davis 1989 for the pertinent criticism, as well as Fudge's reply in the same volume).

To avoid, at least partially, the drawbacks mentioned, I explicitly used the term syllable with the subjects. The subjects were given a list of lexical items in an L2 they studied and asked to repeat to themselves twice each syllable of each of the words and write down what they have just said. The experiment was conducted on two target languages, German and English, and involved the following groups of subjects:

- (a) 15 learners of German as a second language¹⁶⁸, with the following native languages: Hungarian (2 subjects), Filipino, Spanish, French, Swedish (2 subjects), Persian, Igbo, Slovak, Serbo-Croatian, Italian, Sinhalese, Polish and American English. The control subject was a native Austrian - the course lecturer.
- (b) 39 advanced learners of English as a second language, including: 8 Polish, 8 Austrian, 10 Italian and 13 Spanish learners. The control subject was a native-speaker of English, a university lecturer.

11.3.1. German as L2

11.3.1.1. The test (*Test I*).

The test contained 87 lexical words of German of the following structure:

¹⁶⁸ The subjects of the test were attending a course of level 4 on a six-level scale (Level 5 entitles one to study at an Austrian University, level 6 is a so-called Perfektionskurs 'perfection course') organized by the University of Vienna School for Foreigners (Universität Wien, Wiener Internationale Hochschulkurse: Deutsche Sprachkurse für Ausländer), i.e. they were learners in a natural setting reinforced by intensive (6 hours per week) instruction. The test was conducted in winter semester 1991.

Table 1. Structure of the words in Test 1 (German)

<i>Structure</i>	<i>Number of words</i>
C(C)VCVC(C)	14
C(C)VCVC(C)	12 ¹⁶⁹
C(C)VCCVC(C)	45 ¹⁷⁰
C(C)VCCCVC	13 ¹⁷¹
CVCCCCVC	2 ¹⁷²
CVCCCCVC	1

All test words were two-beat words of varied morphological structure, and contained an array of intervocalic consonantal clusters combining different sonority values.

11.3.1.2. Results of the test.

Table 2. General segmentation results of Test 1

<i>Structure</i>	<i>%(C)CV as the first sequence repeated</i>	<i>% VC(C) as the last sequence repeated</i>	<i>% -VC + CV-repetitions</i>	<i>%-VC + CCV-repetitions</i>	<i>% -VCC + CV-repetitions</i>
C(C)VCVC(C)	70	22	-	-	-
C(C)VCVC(C) cf.note 2	18	19	-	-	-
C(C)VCCVC(C) cf.note 3	6.5	11	74	-	-
C(C)VCCCVC cf.note 4	0.5	6	-	30	49
CVCCCCVC cf.note 5	-	-	-	-	-
CVCCCCVC	-	6.5	-	-	-

Table 2 shows:

- a general preference to preserve CV (or C(C)V) in the segmentations (cf. the percentages in the shaded boxes), as in *Vater* -> *va-va-ter-ter*.
- influence of orthography on segmentation, responsible, e.g., for the low percentage (18%) in C(C)VCVC(C) with an intervocalic double or complex grapheme, as in *Wetter* -> *wet-wet-ter-ter*.

Additionally, an influence of the morphological structure of the words on segmentation was observed, as in *mögen* -> *mög-mög-en-en* (rendered so by 4 subjects), though often indiscernible from phonological and/or orthographic criteria, as in *tragbar* ->

¹⁶⁹ with an intervocalic graphic geminate or more than monographemic representation of a sound.

¹⁷⁰ including 6 with digraphs.

¹⁷¹ 1 with a digraph.

¹⁷² 1 with a digraph.

trag-trag-bar-bar (rendered so by all subjects) or in *flüssig* -> *flü-flü-sig-sig* (3 subjects), *flüss-flüss-ig-ig* (2 subjects), *flüs-flüs-ig-ig* (1 subject), *flüs-flüs-sig-sig* (9 subjects).¹⁷³

As far as the results of the native speaker are concerned, in 22% of the answers she disagrees with the (identifiable) majority answer. The only well documented reason for this discrepancy is the fact that the native speaker was much less influenced by orthography in her syllable repetitions, e.g. in words like: *klopfen, Katzen, sitzen, Wetter, Dampfer*.

In detail, the following segmentation results were obtained with reference to the double and triple intervocalic consonant clusters:

- *V₁C₁C₂V₂* clusters

The test contained 13 types of two-consonant intervocalic combinations (an example of each category is provided, e.g. /ns/ = nasal + fricative), which can be subdivided into clusters which in German are both initial and medial, both final and medial and only medial (cf. Ortman 1991):

initial and medial: /ks/, /kt/, /st/, /sn/, /sm/, /gl/, /ʃl/;

final and medial: /ks/, /kt/, /st/, /rm/, /lt/, /rs/, /ns/;

only medial: /nk/, /nl/, /dn/.

74 % of the VCCV clusters were segmented into VC.CV. All but three types of the clusters contributed to this percentage. The three types are listed in *Table 3*.

Table 3. Segmentations other than VC.CV

Cluster type	% VCC.V	%V.CC V
/lt/-type (good finals): /lt/, /rg/, /lk/, /rt/, /rk/, /ld/	19	0
/gl/-type (good initials): /gl/, /dl/, /bl/, /br/, /pl/, /bl/, /gr/, /tr/	7	26
/ʃl/ (good initial)	0	47

The segmentations, thus, largely proceeded according to universal phonotactics (cf. the cluster space for doubles). Among the other 10 types, 2 qualify as both: medial and initial - /dn/ and medial and final - /nk/, while 8 remaining types qualify as exclusively medial. German does not fully respect these preferences, but they showed up in the segmentations, since the clusters were predominantly treated as medials (i.e. neither initials nor finals), and thus split into *VC.CV*.

- *V₁C₁C₂C₃V₂* clusters

Test 1 contained 13 triple clusters (type=token), subdivided into (cf. Ortman 1991):

initial and medial: /spr/;

final and medial: /rst/, /lft/, /mps/, /nst/, /rks/;

¹⁷³ In fact, only in 12 of the 87 words in the test can morphological influence be completely excluded. In the majority of the test items, morphology may have worked either directly or by analogy.

only medial: /rtl/, /rtr/, /mpn/, /ntsɔ/, /ntn/, /mpl/, /ndl/.

The clusters which largely contributed to the 49% of VCC.CV segmentations (cf. *Table 2*) were /rst/, /mpn/, /lft/, /ntsɔ/, /ntn/, /mps/, /nst/. Of these, /rst/, /lft/, /ntsɔ/, /mps/ (also a good final triple), and /nst/ qualify as good medial clusters (cf. 5.3.8.) and were, therefore, segmented according to the most general preference to preserve CV. /mpn/ and /ntn/ are bad triples altogether and as such were segmented according to the good final doubles they contain, i.e. also into VCC.CV (they also contain good initial doubles, but it's better to bare a cluster finally, and to have a CV initially, unless a good initial concerned were more preferred than a good final concerned when compared on the Cluster Space). The other 6 clusters were segmented as follows:

Table 4. VCC.CV vs. VC.CCV segmentations

<i>Cluster</i>	<i>% VCC.CV</i>	<i>% VC.CCV</i>
/rtl/, /rtr/ (bad medials, contain good final & initial doubles)	67	20
/rks/ (good final, contains good final double)	80	20
/nd#l/ in <i>stündlich</i> (good final double)	80	20
/spr/ (good initial, contains good initial double)	13	87
/mpl/ (good initial, contains good final & initial double)	27	47

The segmentations in *Table 4* provide sufficient evidence for the reanalysis of the clusters by the subjects according to universal phonotactic preferences. The triple clusters are divided according to the preferred double clusters they contain; in one case, a morphological boundary reinforced the division.

11.3.2. English as L2

11.3.2.1. The test (*Test 2*).

The subjects were given a list of 142 English lexical items and asked to repeat to themselves twice each syllable of each of the words and write down what they have just said. The words constituting the list were selected according to a set of comprehensive criteria to give a fully controlled array of patterns (two-beat words, both trochees and iambs, both tense and lax vowels stressed, clusters situated medially, types of clusters of English selected according to Trnka (1968), words with morphological boundaries included, relatively simple items, relatively easy orthoepy). Concrete examples of lexical items were selected by

means of a phonetic access dictionary computer-implemented by Sobkowiak (e.g. 1994a, b).

The following criteria were respected:

- (a) only two-beat long words were selected, e.g. *baby*;
- (b) each phonotactic type was included both as a trochee and an iamb, e.g. *daisy* vs. *defy*¹⁷⁴;
- (c) stressed vowels varied between tense and lax, e.g. *ever* vs. *over*;
- (d) words of the following structures were selected (in approximately equal numbers):

Table 5. Structure of the words in Test 2 (English)

VCV (34 in Trnka 1968)
VCVC (44 in Trnka 1968)
CVCV (408 in Trnka 1968)
CVCVC (668 in Trnka 1968)
VC(C)CV
VC(C)CVC
CVC(C)CV
CVC(C)CVC
CVCCə
CVCCCə

Thus, only medial clusters were included.

(e) the following clusters were represented:

* clusters which can be both initial¹⁷⁵ and medial, e.g. *st*, *fr*, *spl*;

* clusters which can be both final¹⁷⁶ and medial, e.g. *ps*, *nd*, *lst*;

* clusters which are exclusively medial, e.g. *-km-*, *-lg-*, *-kln-*, *-pstr-*

(clusters varied systematically as to their internal structure in terms of sonority distance and order).

(f) words containing a morphological boundary were included;

(g) relatively simple lexical items were chosen in order to eliminate potential pronunciation problems;

(h) near one-to-one orthoepic correspondence was respected as much as English allows and orthographic "geminate" were excluded.

11.3.2.2. Results of the test.

The results are presented separately for double and triple clusters. Segmentations by Italian and Spanish subjects are analyzed in more detail and compared to the results of Polish and Austrian subjects.

11.3.2.2.1. Double clusters: predictions and results.

The following predictions have been made with reference to the segmentation of the doubles (GI=Good Initial, GM=Good Medial, GF=Good Final):

- (a) GI's will tend to remain initial, i.e. to be segmented as V.CCV, unless CV preference wins;

¹⁷⁴ Out of 66 types of monomorphemic one- or two-vowel words, 14 types are one-beat words, 34 types are two-beat trochaic and 18 types two-beat iambic (cf. Trnka 1968: 61).

¹⁷⁵ Nearly all initial clusters (but *spj-* and *smj-*) may become medial (cf. Trnka 1968: 45).

¹⁷⁶ All final clusters may become medial (cf. Trnka 1968: 45).

- (b) GM's and GF's will tend to get split: medials (GM's) get split since they are neither initial nor final, finals (GF's) get split since they are the least salient clusters;
- (c) universally good clusters will be preferred to English-specific ones:
- especially in the case of initials, since they are the most salient clusters;
 - unless there is strong interference from the native language, either reinforcing English or supporting native solutions.

11.3.2.2.1.1. Italian.

Table 1 presents the results for double clusters as treated by the Italian subjects. All exemplars of the 16 cluster types involved in the test are provided. The types are evaluated according to universal phonotactic preferences. The next column provides the status of each cluster in English.

Table 6. Italian: Double clusters (VCCV).

	cluster type	universal phonotactic value	phonotactic value in English	number of answers	% VC.CV	% V.CCV	% VCC.V
1.	nasal + stop ŋk ŋg nd nt	GF& GM	M, F ŋg only M	70	98	1	-
2.	nasal + liquid ŋl	GM	M	10	60	-	-
3.	nasal + glide nj	GI	I, M	30	26	60	-
4.	nasal + affricate nč	GM	M, F	10	100	-	-
5.	fricative + nasal zm	GM	M	20	90	10	-
6.	stop + nasal km	GI	M	10	5	-	-
7.	liquid + nasal lm	GM	M, F	10	100	-	-
8.	stop + liquid dr dl	GI	I, M	40	45	55	-
9.	stop + glide tw	GI	I, M	10	30	70	-
10.	stop + fricative ps kʃ	GM	M, ps F	20	80	20	-
11.	fricative + stop zb st sp ft	GM	all M, ft F, st sp I, F	110	69	30	0.9
12.	affricate + glide čj	GI	M	10	-	80	-
13.	fricative + liquid fr	GI	I, M	20	-	100	-
14.	fricative + glide vj	GI	I, M	10	-	100	-
15.	liquid + fricative lv	GF& GM	M, F	20	85	-	-
16.	liquid + stop lg	GF	M	10	100	-	-

GI: Good Initial
GF: Good Final
GM: Good Medial

I: Initial in English
F: Final in English
M: Medial in English

As can be seen in *Table 6*, out of seven GI clusters, 66% were treated as initials and 27% were split (CV preference). Out of nine GM/GF clusters, 87% were split, and one case only was treated as final. Thus, predictions (a) and (b) are confirmed (see *Table 7* for summary).

Table 7. Italian: Double clusters according to universal preferences.

Italian	% V.CCV	% VC.CV	% VCC.V	V.CCV: VC.CV
GI	66	27	0	2.4
GM/GF	0	87	1	0

As far as prediction (c) is concerned, it is also generally borne out: English finals never changed the universal preference for a medial cluster, i.e. good medials were preferably split (cf. *Table 8*: 1, 2, 3); English medials only slightly influenced the universal preference for good initials (cf. 3); most notably, English initials were also defeated by universal medials to quite an extent (cf. 4).

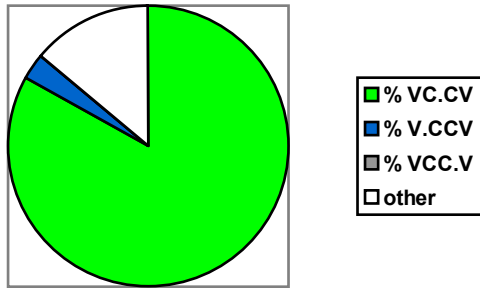
Table 8. Italian: Universal vs. English phonotactic preferences for doubles.

	% VC.CV	% V.CCV	% VCC.V
1. GM vs. M, GM, F vs. M, F	83	3	0
2. GM vs. M, F	93	7	0
3. GI vs. M, GI vs. I, M	15	66	0
4. GM vs. all M, ft F, st sp I, F	69	30	0.9

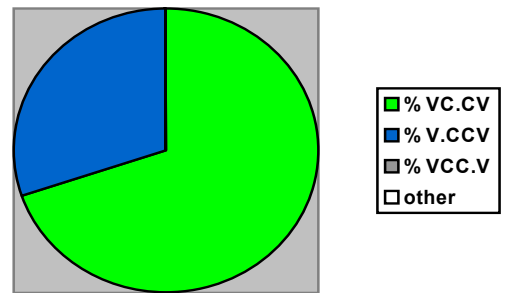
The distribution of the results from *Table 8* is represented in the following graphs.

ITALIAN: UNIVERSAL VS. ENGLISH PHONOTACTIC PREFERENCES FOR DOUBLES

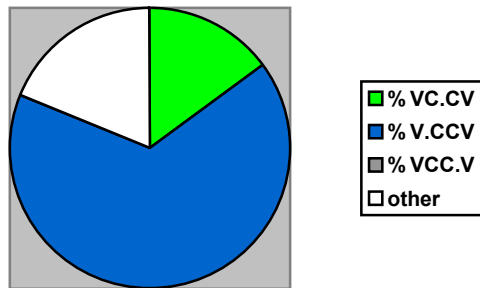
GM vs. M, GM, F vs. M, F



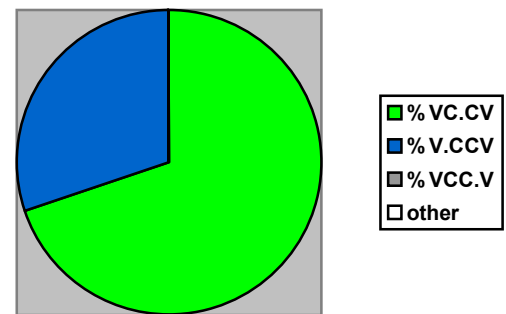
GM vs. M, F



GI vs. M, GI vs. I, M



GM vs. all M, ft F, st sp I, F



11.3.2.2.1.2. Spanish

Table 9 presents the results for double clusters as treated by the Spanish subjects.

Table 9. Spanish: Double clusters (VCCV).

	cluster type	universal phonotactic value	phonotactic value in English	number of answers	% VC.CV	% V.CCV	% VCC.V	% VC(C) .(C)V
1.	nasal + stop ŋk ŋg nd nt	GF& GM	M, F ŋg only M	91	86	-	-	6
2.	nasal + liquid ŋl	GM	M	13	1	orthog. 92	-	-
3.	nasal + glide nj	GI	I, M	39	-	79	-	-
4.	nasal + affricate nč	GM	M, F	13	76	-	-	15
5.	fricative + nasal zm	GM	M	26	92	-	-	-
6.	stop + nasal km	GI	M	13	53	-	-	-
7.	liquid + nasal lm	GM	M, F	13	84	-	-	7
8.	stop + liquid dr dl	GI	I, M	52	54	46	-	-
9.	stop + glide tw	GI	I, M	13	47	53	-	-
10.	stop + fricative ps kʃ	GM	M, ps F	26	84	3	-	7
11.	fricative + stop zb st sp ft	GM	all M, ft F, st sp I, F	143	72	-	4	12
12.	affricate + glide čj	GI	M	13	-	84	7	-
13.	fricative + liquid fr	GI	I, M	26	-	84	-	-
14.	fricative + glide vj	GI	I, M	13	-	92	-	-
15.	liquid + fricative lv	GF& GM	M, F	26	88	-	-	3
16.	liquid + stop lg	GF	M	13	92	-	-	-

As can be seen in Table 9, out of seven GI clusters, 63% were treated as initials and 22% were split (CV preference). Out of nine GM/GF clusters, 75% were split, one case was treated as

initial, 4% were treated as final, 6% as final ambisyllabic. Thus, predictions (a) and (b) are again confirmed (see *Table 10* for summary).

Table 10. Spanish: Double clusters according to universal preferences.

Spanish	% V.CCV	% VC.CV	% VCC.V	V.CCV: VC.CV
GI	63	22	0	2.9
GM/GF	1	75	4	0.01

As far as prediction (c) is concerned, again it is also generally borne out, although with some differences in comparison to the Italian subjects. In particular, English finals did influence the segmentation to some extent (cf. *Table 11*: 1,2,4), but never against the CV preference (due to the ambisyllabic consonant; see the last column). Most significantly, English initials were totally defeated by universal medials (and by English finals to some extent) (cf. 4). This may be at least partially due to the influence of the constrained initial phonotactics of Spanish.

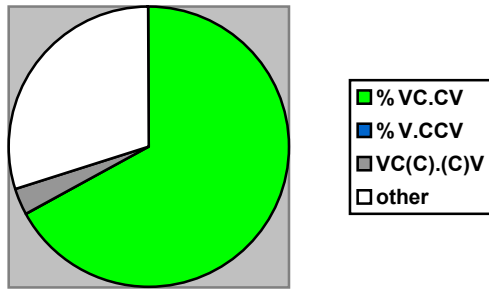
Table 11. Spanish: Universal vs. English phonotactic preferences for doubles.

	% VC.CV	% V.CCV	% VC(C).(C)V
1. GM vs. M, GM, F vs. M, F	67	0	2.3
2. GM vs. M, F	81	1	9.7
3. GI vs. M, GI vs. I, M	22	63	0
4. GM vs. all M, ft F, st sp I, F	72	0	16

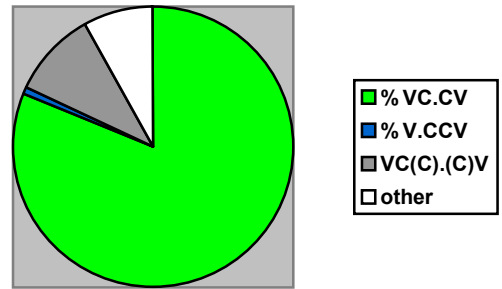
The distribution of the results from *Table 11* is represented in the following graphs.

SPANISH: UNIVERSAL VS. ENGLISH PHONOTACTIC PREFERENCES FOR DOUBLES

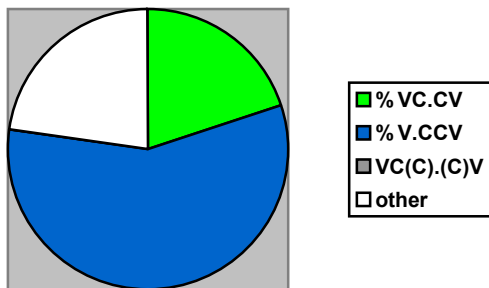
GM vs. M; GM, F vs. M, F



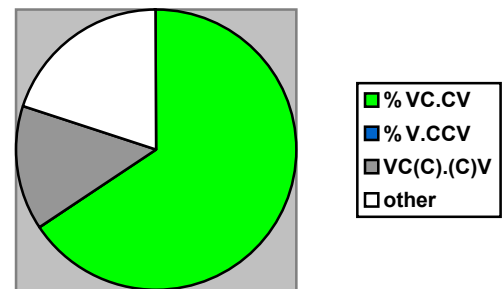
GM vs. M, F



GI vs. M, GI vs. I, M



GM vs. all M, ft F, st sp I, F



11.3.2.2.1.3. Double clusters: comparison.

Italian and Spanish learners of English demonstrated very similar strategies of segmentation of intervocalic double clusters in English. Universally good initials were treated as such in 63-66% of cases; good medials (and finals) were split in 75-87% of cases. When this is compared to the results of the tests involving Austrian and Polish learners of English (for details cf. Dziubalska-Kořaczyk 1997), it turns out that very similar segmentation was also employed by those learners (*Table 12* and *13*). Thus, notwithstanding the phonotactics of a learner's native language, the double intervocalic clusters of English tend to be segmented according to the universal status of such clusters.

Table 12. Double clusters according to universal preferences: comparison.

Italian	% V.CCV	% VC.CV	% VCC.V	V.CCV: VC.CV
GI	66	27	0	2.4
GM/GF	0	87	1	0
Spanish				
GI	63	22	0	2.9
GM/GF	1	75	4	0.01
Austrian & Polish				
GI	66	28	0.2	2.4
GM/GF	18	88	0.9	0.2

Table 13. Relation V.CCV : VC.CV

Cluster value	Italian	Spanish	Austrian & Polish
GI	2.4	2.9	2.4
GM/GF	0	0.01	0.2

11.3.2.2.2. Triple clusters: predictions and results.

The following predictions have been made with reference to the segmentation of the triples:

- (a) triple clusters will tend to be segmented according to the doubles they contain due to the latter's lesser complexity (note that good initial triples include good initial doubles and good final triples include good final doubles);
- (b) the segmentation VCC.CV should be universally preferred over VC.CCV (i.e. $VCC.CV > VC.CCV$) due to the CV preference and more tolerance for clusters in word-final position. However, a number of conditions may override this segmentation:
 - if a triple contains an initial double which is better than the final one in the Cluster Space;
 - if a triple contains an initial double which exists in a specific L2;
 - if a triple contains an initial double which exists in a specific L1;
 - if a specific L1 or L2 phonotactics prefers initial clusters;
- (c) English phonotactics will tend to reinforce the above segmentations when relevant, rather than distort them;

(d) native phonotactics will influence the above segmentations especially in the case of negative evidence (i.e., the lack of some, especially initial, clusters, in L1).

11.3.2.2.1. Italian

Table 14 presents the results for triple clusters as treated by the Italian subjects.

Table 14. Italian: Triple clusters (VCCCV).

	Cluster type	universal phonotactic value	phonotactic value in Engl	Number of answers	% VC.CCV	% VCC.CV	% V.CCCV
1.	fricative+stop+liquid str stl spl	GI d(M+I)	M, str I spl I d(F+I)	60	70	-	30
2.	fricative+stop+nasal stm	GI d(M+I)	M d(F+M)	10	-	100	-
3.	stop+fricative+stop pst kst	GM d(M+M)	M, F d(F+I)	20	50	40	-
4.	liquid+fricative+liquid lfr rsl	GdF+ GdI	M d(F+I)	20	85	15	-
5.	liquid+stop+liquid ltr	GdF+ GdI	M d(F+I)	10	100	-	-
6.	liquid+fricative+stop lst	GM d(F+M)	M, F d(F+I)	10	70	20	-
7.	liquid+fricative+glide rsw	GdF+G dI	M d(F+I)	10	40	10	-
8.	liquid+fricative+nasal rsn	GM&G F d(F+M)	M d(F+I)	10	80	20	-
9.	nasal+stop+liquid mbl	GI d(F+I)	M d(M+I)	10	60	10	-
10.	nasal+fricative+liquid mfl	GI d(M+I)	M d(F+I)	10	100	-	-
11.	nasal+stop+fricative mpʃ	GM&G F d(F+M)	M d(F+M)	10	30	60	10
12.	nasal+stop+affricate ŋkč	GM&G F d(F+M)	M d(F+M)	10	30	70	-
13.	nasal+stop+glide ŋgw	GdF+G dI	M d(M+I)	10	100	-	-
14.	nasal+fricative+stop nʃt	GM d(M+M)	M, F d(F+I)	10	100	-	-

d: refers to **doubles**; other symbols refer to **triples**

The results in *Table 14* confirm prediction (a) about segmentation respecting the doubles included in the triples. 4 types of GI triples, 3 types of GM triples and 4 types of GdF+GdI were much more often segmented as C.CC, while there was a balance between C.CC and CC.C segmentations in the case of GM and GF types, in accordance with prediction (b). This is summarised in *Table 15*.

Additionally, there have been many cases of different syllable counts by the subjects, especially assigning more syllables to a given word than expected by universal or English phonotactics.

Table 15. Italian: Triple clusters according to universal preferences.

Italian	% VC.CCV	% VCC.CV	% V.CCCV	VC.CCV: VCC.CV
GI	58	28	8	2.1
GM	73	20	-	3.7
GM&GF	47	50	3	0.9
GdF+GdI	81	6	-	13.5

There was no significant influence of English phonotactics on the above segmentations, as demonstrated in *Table 16*, while the effect in 1 and 2 (in *Table 16*) is reinforced (cf. prediction (c)).

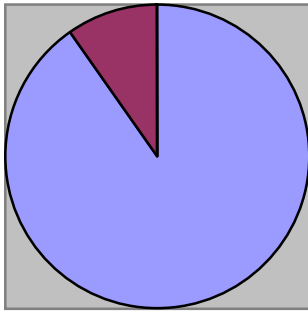
Table 16. Italian: Universal vs. English phonotactic preferences for triples.

	% VC.CCV	% VCC.CV	% V.CCCV
1. GdF+GdI vs. M, d(F+I)	75	8	0
2. GM&GF, d(F+M) vs. M, d(F+M)	30	65	5
3. mixed	69	21	4

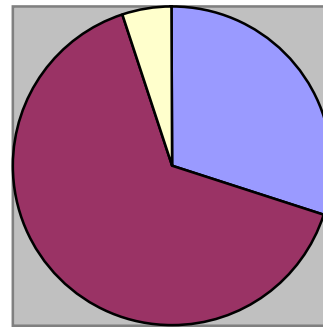
The distribution of the results from *Table 16* is represented in the following graphs.

ITALIAN: UNIVERSAL VS. ENGLISH PHONOTACTIC PREFERENCES FOR TRIPLES

GdF+GdI vs. M, (F+I)



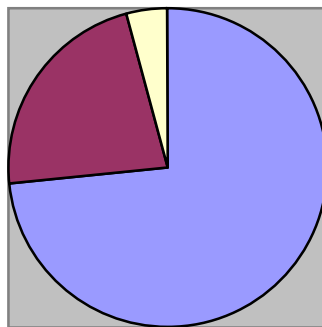
■ % VC.CCV
■ % VCC.CV
■ % V.CCCV



■ % VC.CCV
■ % VCC.CV
■ % V.CCCV

GM&GF, d(F+M) vs. M, d(F+M)

mixed



■ % VC.CCV
■ % VCC.CV
■ % V.CCCV

11.3.2.2.2. Spanish

Table 17 presents the results for triple clusters as treated by the Spanish subjects.

Table 17. Spanish: Triple clusters (VCCCV).

	Cluster type	universal phonotactic value	phonotactic value in Engl	Number of answers	% VC.CCV	% VCC.CV	% V.CCCV
1.	fricative+stop+liquid str stl spl	GI d(M+I)	M, str I spl I d(F+I)	78	80	5	1
2.	fricative+stop+nasal stm	GI d(M+I)	M d(F+M)	13	-	92	-
3.	stop+fricative+stop pst kst	GM d(M+M)	M, F d(F+I)	26	30	42	-
4.	liquid+fricative+liquid lfr rsl	GdF+ GdI	M d(F+I)	26	38	50	-
5.	liquid+stop+liquid ltr	GdF+ GdI	M d(F+I)	13	76	-	-
6.	liquid+fricative+stop lst	GM d(F+M)	M, F d(F+I)	13	-	76	-
7.	liquid+fricative+glide rsw	GdF+G dI	M d(F+I)	13	84	-	-
8.	liquid+fricative+nasal rsn	GM&G F d(F+M)	M d(F+I)	13	53	30	-
9.	nasal+stop+liquid mbl	GI d(F+I)	M d(M+I)	13	84	-	-
10.	nasal+fricative+liquid mfl	GI d(M+I)	M d(F+I)	13	61	7	-
11.	nasal+stop+fricative mpʃ	GM&G F d(F+M)	M d(F+M)	13	-	92	-
12.	nasal+stop+affricate ŋkč	GM&G F d(F+M)	M d(F+M)	13	-	92	7
13.	nasal+stop+glide ŋgw	GdF+G dI	M d(M+I)	13	84	7	-
14.	nasal+fricative+stop nst	GM d(M+M)	M, F d(F+I)	13	-	84	-

The results in Table 17 also confirm prediction (a) about segmentation respecting the doubles included in the triples. Thus, the prediction holds both for the Italian and Spanish subjects. With reference to prediction (b), 4 types of GI triples and 4 types of GdF+GdI were preferably segmented as C.CC; however, in all the other types a *final* double cluster was

preferred (i.e., a CC.C segmentation) (cf. *Table 18*). Specifically, cluster [tm] was never treated as initial ([tm] is a GI), and clusters [st], [fr] and [sl] – almost never (cf. *Table 17*) ([st] is an English I, [fr] and [sl] are both GI's and English I's). This seems to be the case of L1 influence from Spanish (prediction (d)).

Table 18. Spanish: Double clusters according to universal preferences.

Spanish	% VC.CCV	% VCC.CV	% V.CCCV	VC.CCV: VCC.CV
GI	56	26	0.25	2.2
GM	10	67	-	0.15
GM&GF	18	71	2.3	0.25
GdF+GdI	71	14	-	5.1

The above observation about the role of L1 is confirmed by the results of a comparison of universal vs. English phonotactic influence on segmentations by the Spanish subjects. As can be seen in *Table 19*, 1 is a case of relative agreement between universals and English, 2 is a case of almost complete agreement, 7 is a case of reinforcement of one of the universal possibilities by English, 3 is a case of the total influence of an English final cluster, while 4, 5 and 6 are cases in which an (English) final overcomes an (English) initial, which also agrees with prediction (b).

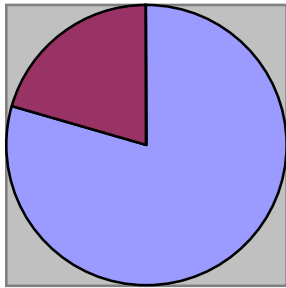
Table 19. Spanish: Universal vs. English phonotactic preferences for triples.

	% VC.CCV	% VCC.CV	% V.CCCV
1. GdF+GdI vs. M, d(F+I)	66	17	0
2. GM&GF, d(F+M) vs. M, d(F+M)	0	92	4
mixed:	42	39	0.1
3. GI, d(M+I) vs. M, d(F+M)	-	92	-
4. GM, d(F+M) vs. M, F, d(F+I)	-	76	-
5. GM, d(M+M) vs. M, F, d(F+I)	-	84	-
6. GM, d(M+M) vs. M, F, d(F+I)	30	42	-
7. cases of reinforcement by English I (4 types)	77	5	0.25

The distribution of the results from *Table 19* is represented in the following graphs.

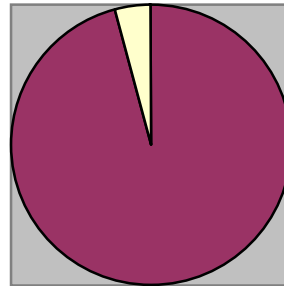
SPANISH: UNIVERSAL VS. ENGLISH PHONOTACTIC PREFERENCES FOR TRIPLES

GdF+GdI vs. M, (F+I)



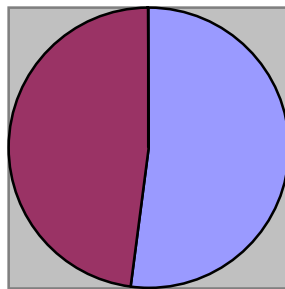
■ % VC.CCV
■ % VCC.CV
■ % V.CCCV

GM&GF, d(F+M) vs. M, d(F+M)



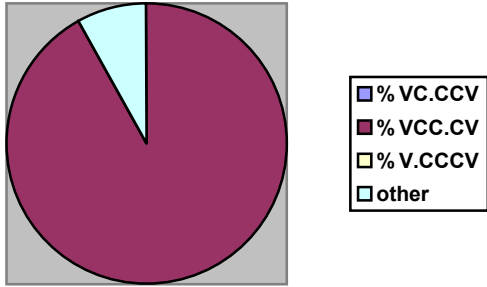
■ % VC.CCV
■ % VCC.CV
■ % V.CCCV

mixed

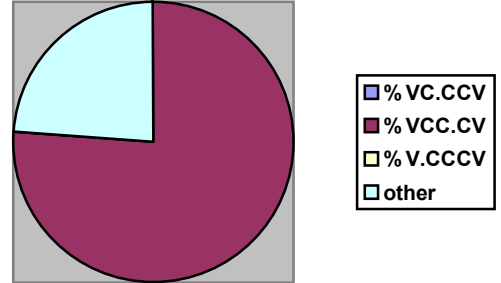


■ % VC.CCV
■ % VCC.CV
■ % V.CCCV

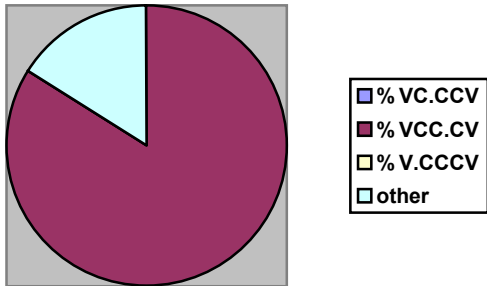
1. GI, d(M+I) vs. M,d(F+M)



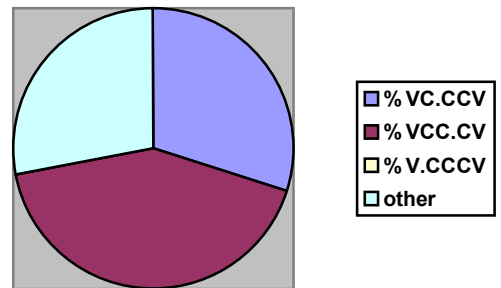
2. GM, d(F+M) vs. M, F,d(F+I)



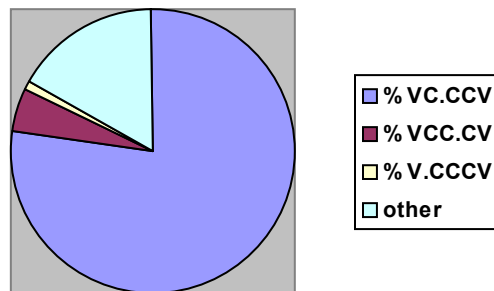
3. GM,d(M+M) vs. M, F,d(F+I)



4. GM,d(M+M) vs. M, F,d(F+I)



5. cases of reinforcement by English I (4 types)



11.3.2.2.2.3. Triple clusters: comparison.

Let us compare the segmentation strategies of triple clusters by Italian, Spanish, Austrian and Polish learners of English. GI's and bad triples consisting of GdF+GdI were segmented similarly by all, i.e. as C.CC (56-81%), opting for the good initial double included in the triple anyway. The same segmentation C.CC (66-73%) was employed to GM's by all but the Spanish subjects, whose L1 influenced their choice. Those triples which are both good medials and finals were preferentially segmented as CC.C (50-88%), i.e. opting for the double final included in the triple. *Tables 20 and 21* summarise the above comparison.

Table 20. Triple clusters: comparison.

Italian	% VC.CCV	% VCC.CV	% V.CCCV	VC.CCV: VCC.CV
GI	58	28	8	2.1
GM	73	20	-	3.7
GM&GF	47	50	3	0.9
GdF+GdI	81	6	-	13.5
Spanish				
GI	56	26	0.25	2.2
GM	10	67	-	0.15
GM&GF	18	71	2.3	0.25
GdF+GdI	71	14	-	5.1
Austrian & Polish				
GI	64	22	13	2.9
GM	66	33	0	2
GM&GF	12	88	0	0.14
GdF+GdI	71	24	1.5	3

Table 21. Relation VC.CCV : VCC.CV

Cluster value	Italian	Spanish	Austrian & Polish
GI	2.1	2.2	2.9
GM	3.7	0.15	2
GM&GF	0.9	0.25	0.14
GdF+GdI	13.5	5.1	3

11.3.3. Final remarks

11.3.3.1. German as L2 vs. English as L2

A comparison of Test 1 (with German as L2) and Test 2 (with English as L2) shows more VCC.CV segmentations in German as L2 than in English as L2. The relation of VCC.CV to VC.CCV segmentations performed by learners in German was 49% to 30%, i.e. 1.63, whereas in English - 37% to 52 %, i.e. 0.71. Since the subjects of both tests form a heterogenous group with respect to their native languages, the above difference must be due to the difference in tolerance towards word-final double clusters in the two languages concerned. German is richer in final complex clusters and also allows for more clusters which can be both medial and final, than English.

11.3.3.2. CV-preference in VCV words

All subjects, no matter their native language, demonstrated a clear preference for a CV in the segmentations of (66) VCV words (see *Table 22*). CV preference was also predominant in the (7) words containing a syllabic consonant, resulting in .CÇ segmentations, analogous to the .CV ones (which prove that a consonant can also serve the function of a beat). Note that segmentations by a native speaker of English showed a percentage of discussed choices lower than all the non-native speakers. This may serve as another piece of evidence that second language learners, no matter how complex the phonotactics of their native language, tend to follow CV preference in their segmentations of English.

Table 22. Preservation of CV in VCV words

	%V.CV	%.CÇ
Italian	85	90
Spanish	82	95
Austrian	78	77
Polish	81	88
<i>English</i>	<i>67</i>	<i>71</i>

Thus, notwithstanding the phonotactics of a learner's native language, intervocalic clusters of English tend to be segmented according to the universal status of the clusters. Some influence of English phonotactics and of the L1 phonotactics has been noted as well. Among the clusters selected in segmentations, initial clusters are the most salient, i.e. the most respected. CV preference has been fully confirmed as a universal strategy in the segmentations of the VCV words. Both CV preference and universal phonotactic preferences govern the transitional behaviour of advanced second language learners between first and second language phonotactics. This means that it is possible to predict potential difficulties learners may have with second language phonotactics and remedy them preventatively.

Importantly, syllabifications performed according to universal phonotactic preferences are *all* explicable in terms of a *single* principle, i.e. the Optimal Sonority Distance Principle (OSDP). Syllabifications in various theories of the syllable necessarily refer to a variety of syllabification principles (maximal onset, sonority sequencing, stress-based syllabification, word-phonotactic principle etc.), each of which is called for in need, while none can alone predict and explain all segmentations.

CHAPTER TWELVE

Aphasia

12.1. Introduction

In Dressler and Dziubalska-Kořaczyk (1995b) we considered the role of the syllable in aphasia. The main claim of the paper was that there is not enough empirical support in aphasiological research for the unit syllable and much more can be explained with the help of B&B Phonology on the one hand, and the unit morpheme, on the other. Buckingham's (1986, 1989, cf. 1990; 1993) production model¹⁷⁷ served as a bridge-theory mediating between aphasiological data on phonological paraphasias and a phonological theory. The mediating role between aphasia and the morpheme was played by Dressler's semiotically based Natural Morphology (cf. 4.2.7.1. on the semiotic precedence of words and morphemes over phonological entities)

12.2. The syllable in aphasia: a short review of common claims

The number of syllables has been claimed to play an important role for many aphasics. Monosyllabic words come easiest to them: total (global) aphasics often limit themselves exclusively to monosyllables, like Broca's famous *tan*. The more syllables in a word, the more difficult it is to repeat the word or to produce it spontaneously. All relevant investigations, however, have counted the number of syllable peaks (cf. Peuser 1978: 125, 311, 389f; Stark & Stark 1990; Kukkonen 1990: 76, 82, 191), rather than the whole unit (having boundaries and structure). In the B&B framework, this is evidence for the saliency of beats.

A special naturalness of CV structures has been observed (de Bleser and Poeck 1984, 1985; Wurzel and Böttcher 1979), which again can be consistent with a B&B explanation.

Buckingham (1989) claimed that the syllabic position remains intact in phonological paraphasias, i.e. that a phoneme transposed from the onset of a syllable through anticipation, perseveration or methathesis always ends up at the onset of another syllable. This is belied by numerous examples from the available data. Here are some examples of such a change of syllabic position: Germ. *Korporal* --> *Lokoral*, with the anticipation of the lateral from coda to onset or reverse in Pol. *wieczna* 'eternal' → *wienczna*¹⁷⁸; likewise, but within the syllable, in Germ. *Soldat* → *Loldat*, *Text* → *Kest*, *Fleisch* → *Schleisch*, or between two words: *die Tafel* → *dief Tafel*. In a corpus of metatheses (cf. Dressler 1988a), one third (!) of the paraphasias did

¹⁷⁷ Based on former models by Garret and Shattuck-Hufnagel (see Dressler and Dziubalska-Kořaczyk 1995b), in this model phonological processing is sensitive to position, i.e. if a segment substitution or transposition occurs (in a slip of the tongue or paraphasia, for instance), it does not distort prosody. Thus, e.g., syllabic positions are preserved.

¹⁷⁸ Polish examples of aphasic disturbances are taken from Zarębina (1973: 56-59).

Since non-beats (n) can also function as quantity beats, the change *konna* → *kuuni* would have exactly the same representation as the one above.

12.3.1.3. Rhythmicization break-down.

Rhythmicization can break down, i.e. the difference between strong and weak beats will level down: every beat will be strong. This is the root of so-called "syllabifying", which is again independent of the unit syllable.

12.3.2. Evidence for CV preference (implied by preference for the $n \rightarrow B$ binding)

12.3.2.1. One of the groups of global fluent aphasics described by de Bleser and Poeck (1984, 1985) produced only CV. Also, one of the patients examined by Karl Gloning in the presence of Dressler produced only the structures [di, ti, t^hi, t^si]. One of her neighbouring patients succeeded, with great effort, in producing [a:]. Thus, the binding $n \rightarrow B$ has precedence over an isolated beat, as predicted by the B&B model.

12.3.2.2. Lindner (1985) collected a lot of examples of "aphasic stuttering", i.e. echo-copying, like *Fest* → fe'fest, *Koks* → ho'hoks: it is a CV- structure that is copied. This often happens during successive approximation attempts, whereby the first or later attempts end up with the production and perseveration of a CV-structure before a CVC-structure is attained, e.g. *Taschentuch* → 'ta 'ta: 'tach, tas 'ga 'gra 'gra:s, 'Ru: 'Ru:f, 'koe 'ko: 'koe 'kostsn, 'ku 'kust ... 'hustet. This clearly points to the precedence of the $n \rightarrow B$ binding over the $B \leftarrow n$ one. Cf. also reduplications in Polish: *talerz* → talelerz; *naczelnik* → naczeczelnik; *daleko* → daleleko etc.

12.3.2.3. Further, Lindner (1985) collected examples illustrating the loss of a non-initial syllable of a word, e.g. *November* → nof'tem. What is deleted is very often simply a CV-structure, e.g. *Beruf* → bef, *Gesellen* → 'gelen. It is a non-initial CV that gets lost due to the preservation of word-onset. Cf. Polish: *pomarańczowy* → pomańczowy, *lokomotywa* → lotywa.

12.3.2.4. Intervocalic hiatus is often avoided (as predicted by the B&B model), either through consonant epenthesis or vowel elision (cf. Calabrese & Romani 1990: 168 n.10) or "vowel gliding" or metathesis.

12.3.2.5. As to paraphasic consonant-substitutions vs. consonant-omissions, generally one can summarise them in the following way: if the production of a consonant is disturbed, one expects its substitution if it participates in an $n \rightarrow B$ binding (to maintain the binding), and its deletion if it participates in no binding (i.e. is part of a cluster). A $B \leftarrow n$ binding is, of course, "half-way" in between, and thus both substitution and deletion may occur, but the scale of probability is maintained. The relevant predictions are still more refined and also take into consideration the position in a word and actual sonority distance (cf. B&B phonotactics).

For example, as demonstrated by Blumstein (1978:193f), 42% of all paraphasic consonant-substitutions in her data take place in word-onset, i.e. affect the consonants of a word-initial CV- or CCV-structure, and only 17% affect word-final or intervocalic consonants, i.e. the consonants in VC# or VCV structures. Here, apart from the precedence of $n \rightarrow B$, the special salience of word-onset is also at work. For instance, it is a well-known fact in aphasia therapy that one can facilitate the word search for the patient by providing him with the word-initial consonant or CV- or CCV- structure. When the patients search for a word themselves, word-onset is decisive for lexical access. Since phonological paraphasias already take place during the lexical search, why the consonant of a CV-structure is much more frequently

substituted in word onset than word-internally (17%) or in word-final VC-structures (also 17%) can readily be accounted for. A consonant with the status of an unbound non-beat (i.e. not in the direct vicinity of a vowel) is much less frequently substituted (23% in all positions in Blumstein's data).

Consonant loss (i.e. deletion of consonants) looks quite different. Confirming the above prediction, in Blumstein's data (1978: 195f) 77% of all consonant-elisions take place in a consonantal environment (in comparison with only 23% of all substitutions).

For German data on consonantal substitutions compare the table below (Lindner 1985: 46):

Table 1. Consonantal substitutions in German aphasics (Lindner 1985: 46).

	Repetition		Spontaneous	
	Broca	Wernicke	Broca	Wernicke
#CV	61,8%	66,6%	76,9%	86,6%
VC#	38,2%	33,3%	10,8%	10,0%

As one can see, significantly more substitutions were observed in an $n \rightarrow B$ binding than in a $B \leftarrow n$ one. An actual sonority distance between members of a cluster may, additionally to the above criteria, influence the choice of a consonant to be deleted.

12.3.2.6. Word-initial vowels are often replaced with CV-structures (cf. salience of word onset), as in *Aschenbecher* \rightarrow 'haschn'pecher, 'boschn'becher, *Uhr* \rightarrow 'bu:a, 'mu:a, also *Anker* \rightarrow *Schalter* (Blanken 1990), *April* \rightarrow *Fabrik*, *August* \rightarrow *hogeust* (Lindner 1985), *Öl* \rightarrow *höl* (Wurzel and Böttcher 1979: 443, note 9).

Similarly, Buckingham (1986: 203ff) presents the following substitutions by fluent aphasics as evidence for the unmarkedness of CV-structures: *apple* \rightarrow *papple*, *after* \rightarrow *fafter*, *elephant* \rightarrow *selezant*; compare Fr. *aviculteur* \rightarrow *caviculteur*, *laviculteur* (quoted in Buckingham 1990: 198). Also, by anticipation in Polish *Agatki* \rightarrow *gagatki*, *okulary* \rightarrow *kokulary*, *armata* \rightarrow *marmata*.

12.3.3. Further aphasic evidence explicable in terms of B&B phonology

Consonant clusters are reduced no matter whether they contain the traditional syllable boundary or not, e.g. in the so-called heterosyllabic groups: *Öffner* \rightarrow 'öfa, *Schöpföffel* \rightarrow *Schöpfel*, *Omnibus* \rightarrow 'ome,bus, *Mädchen* \rightarrow 'me:chen; Pol. *lampka* \rightarrow *lamka*, *serwetka* \rightarrow *sewetka*. Calabrese and Romani (1990: 150f; 166 note 3) maintain that in the case of their patient D.B. the rate of deletion of a consonant was much higher in a tautosyllabic cluster (V.CCV) than in a heterosyllabic cluster (VC.CV). However, their tautosyllabic clusters are systematically different both in the order and quality of the consonants they consist of from the heterosyllabic clusters (only a sonorant, [s], or part of a geminate are allowed in the coda in a heterosyllabic cluster). Therefore, to call these clusters tauto- or heterosyllabic is superfluous in the sense that their belonging to one to two syllables depends on their characteristics (order and quality of the consonants they consist of). For example, in the above study /r/ is deleted more often in a /VprV/ than in a /VrpV/ cluster, since, according to the authors, in the former cluster /r/ is tautosyllabic.

According to B&B phonotactics, in /VprV/ the cluster is a preferred initial, while in /VrpV/ - a preferred final. In both cases, thus, deletion of /r/ is favoured, since it leads to a better vowel-consonant-vowel contrast than in the case of /p/-deletion. However, it is more important to improve a CV than a VC: to do it one needs to delete /r/ in /VprV/ \rightarrow /VpV/ (cf. also the

above *Schöpflöffel* → *Schöpfel*, where additionally dissimilation from the final /l/ plays a role), while no improvement is necessary in /VrpV/, which already includes a /pV/ sequence.

In good word-initial clusters, CV-enhancement results in maintaining the word figure consonant, i.e. the first one (since it guarantees a greater contrast), cf. Polish: *szlafrok* → *szafok*, *Kraków* → *kakuf*, *bląd* → *bond*, while in bad word-initials, the existing CV is maintained, e.g. *grzebyk* → *rzebyk*, *którego* → *turego*.

Also in other examples quoted above, CV-enhancement is at work, e.g.: *Öffner* → 'öfa, *Omnibus* → 'ome,bus (good medials), *serwetka* (good medial/final) → *sewetka*. In *Mädchen* → 'me:chen (a good medial), the morpheme-initial consonant is maintained. In *lampka* → *lamka*, a good triple medial/final is reduced towards a good double medial/final.

Also vowel epenthesis takes place both in traditional tautosyllabic and heterosyllabic clusters. Examples: *Glocke* → *koloke*, *Zebra* → *zebera*, *Milch* → *milech*, *Spruch* → *sebuch*, *Kleingeld* → *keleingeld* (cf. also Polish *flakonik* → *falakonik*) vs. *Öffner* → *ofener* (rare). An epenthetic vowel is preferentially inserted in the neighbourhood of an unbound non-beat (**n**), so that the latter receives a beat (**B**) it can bind to, e.g. {**nnB**} → {**nBnB**}. Less often, a vowel breaks a medial cluster. Anaptyxis is preferred over prothesis due to the **n**→**B** preference.

As far as the relationship between vowel epenthesis and consonant elision in consonant clusters is concerned, one can predict certain syndrome-specific differences in the sense of syndrome-specific disturbances of balance. Broca aphasics have serious difficulties with speech production, therefore they make use of speaker-friendly processes. Simultaneously, they are able to control their production relatively well, so they attempt to sound listener-friendly, too. As a result, one observes in their production of difficult consonant clusters both speaker-friendly consonant deletion (i.e. reduction) as well as vowel insertion which is at the same time speaker- and listener-friendly. Wernicke aphasics, on the other hand, primarily apply speaker-friendly processes, since they suffer from a lack or disturbances of self-control (monitoring).

Masking experiments with aphasics conducted by Clavier-Pinek, Pinck and Nespoulous (1991) demonstrate that disturbances of self-monitoring can double the number of errors. As a result of a serious disorder of self-monitoring by heavy Wernicke aphasia, listener-friendly behaviour is hardly possible. Therefore, we will expect Wernicke aphasics to produce far fewer vowel-epentheses than Broca-aphasics do. This is very well demonstrated by Lindner's (1985:55, compare 39f) data. In her representative sample, collected n.b. for a quite different purpose, in word-initial consonant clusters Broca aphasics produce significantly more epentheses than Wernicke aphasics, and Wernicke aphasics produce significantly more elisions than Broca aphasics, e.g. in *schlich* → *schilich*, *Strudel* → *kurudl* vs. *Sprache* → *brache*.

The greater salience of word-initial consonants and the **n**→**B** preference explain why in phonologically similar lexical paraphasias (Blanken 1990) it is the word-initial consonant and the vowel that are best preserved, e.g. *leben* → *lesen*, *Schwan* → *Strahl*, *Tag* → *Tat*. This is partly indistinguishable from the preservation of CV-structures, e.g. in *Tag* → *Tat*. However, the **n**→**B** preference explains all cases concerned, e.g. also the reduction of CCV-structures to CV-structures, as in the repetition errors of the sort *Drache* → *Dache*, *Rache*¹⁷⁹.

In the reduction of other consonant clusters one can readily distinguish between the putative preference for CV-syllables (cf. Dittmann 1991: 62; Blumstein 1972) and for CV-sequences. Typically, aphasics do not simplify complex syllables of all sorts to CV-syllables. So, in C₁C₂VC-sequences or one-syllable words of this form, the initial C₁C₂V-sequence is reduced to the preferred CV-sequence, i.e. either to C₁V or to C₂V (and not exclusively to a C₂V syllable), e.g. by a heavy Broca aphasic in a repetition test: *Bruch* → *Buch*, *Fraß* → [^hva:s],

¹⁷⁹ N.B., in all the examples above, the sequences produced are existing words.

Schlich → Schich or Schicht, *Schlacht* → Hacht, *Schloß* → ['ho:x], *Trumpf* → Tumpf (cf. also some of the above examples showing the enhancement of CV).

CCCVC-words typically lose one of the onset consonants, e.g. *Strich* → Stich, *Spruch* → Spuch. Generally, a great interindividual and intraindividual variability is demonstrated, so that *Strumpf* may appear as Stumpf, Schrumpf or Schumpf, *strickt* as stickt or schrickt, *Strudel* as Studel, Schrudel, Schudel, Ludel or Schrugen. In the quoted examples, a good initial triple is reduced so that the word figure consonant is maintained (with the exception of the substitution resulting in Ludel). Post-vocally, such reductions are rarer, e.g. in *Milch* → mich, *Korb* → kob, *trinkt* → ticht, *First* → vist.

12.3. Aphasia and morphology

When aphasics have difficulties with long, multibeat words, they often apply the strategy of dividing them into smaller prosodic units. The syllable-based models predict that in such cases resyllabification will occur. On closer investigation, however, the smaller units prove to be morphemes rather than syllables, especially parts of compounds, e.g. *Sicher+heit+s#nadel* → 'sicher##'heit##'nadel, in which the stressed chunks divided by pauses are not syllables, but morphemes, cf. also *Fleisch#preis#steigerung* → 'fleisch##'bleisch##'scheigerung, and *Tasche+n#lampe* → 'tasch##'ssin##'lampe, *Flasche+n#öffner* → 'haschen##'höffer, *Dose+n#öffner* → 'hösel##'höffer] with a middle pseudomorpheme as well as *Thermo#meter* → 'hi:sse, 'hësse, 'hi:me, 'hële##'hëte.

12.3.1. The test

The above examples confirm the assumptions of Natural Morphology and its relationship to phonology. To test these assumptions more specifically, a repetition test was devised¹⁸⁰ and administered to the following patients: two Broca aphasics, one global aphasic, one global transcortical aphasic, one Wernicke and one conduction aphasic (twice). The test was heavily biased towards allowing the patients to syllabify, i.e. it contained many long multimorphemic words (compounds) where morphemes do not coincide with traditional syllables (cf. the Appendix INSERT NUMBER).

81 test items included:

- A) 7 double-beat compounds: each constituent = one syllable = one word;
- B) 7 triple-beat, trimorphemic words: each constituent = one syllable = one morpheme (+/- a word); 1 four-beat word of this type;
- C) 66 multi-beat, multimorphemic compounds, where at least one of the constituents was longer than one syllable (i.e., the items which were a true checking ground for the difference between morphological and syllabic segmentation).

12.3.2. Results of the test

The view that Broca aphasics typically syllabify is not supported by the data. Neither of the two Broca aphasics produced even a single example of syllabification, although they hesitated when repeating words. What they, as well as the other aphasics, performed was morphemic decomposition, i.e. they split multimorphemic words into morphological parts, stressed these morphological parts as independent words (i.e. each with a main stress) and paused at all, or most, of the morpheme boundaries. In other words, segmentation in repetition was clearly morphological and not syllabic.

¹⁸⁰ The test was devised by Wolfgang U. Dressler and myself, and administered in Vienna by Jacqueline and Heinz Stark. I am grateful to all three of them for help. The analysis of the data I performed together with Wolfgang Dressler.

Of the two Broca aphasics, one produced respectively: 6 (of 7) segmentations of the items in A), 2 (of 8) of the items in B), and 60 (of 66) of the items in C) (which all constituted purely morphological segmentations, and not a single syllabic). The other aphasic produced only 8 segmentations: A) 1, B) 1, C) 6 (all morphological). The following are examples of segmentations by the two subjects: A) 'Obst#bàum → 'Obst##báum; B) Blút#er#gùß → Blút##ér##gùß; C) Gärten#ròse → Gärten##ròse, Schlá\$g#obers (with Austrian German syllabification) → Schlá[k]##óbers, Déutsch#unter+richt → Déutsch##únterricht, Schúl#an+fàng → Schúl##ánfang, Schréib#auf#gàbe → Schréibe##áuf##gàbe, Wieder#auf+bàu → Wieder##áufbau, Eì\$#òde (with the traditionally expected resyllabification) → Eì##òde, 'Ort+s#an#gàbe → 'Ort##ángàbe. In all these examples the segmented chunks produced by morphemic decomposition receive main stress as if they were separate words. Thus, the Broca aphasics were shown not to syllabify.

The other aphasics behaved very similarly to the two Broca aphasics, i.e. they segmented words according to the same strategy of morphemic decomposition. The table below presents the distribution of segmentations for the remaining subjects:

Table 2. Segmentations by the non-Broca aphasics.

	A)	B)	C)
global transcortical	0	0	11
global	2	1	23 + 1(3)
Wernicke	13	6	41 + 2(3)
conduction	10	2	66 + 0(2)

In column C), the number to the left presents purely morphological segmentations, whereas the number on the right - syllabic ones (or disputably syllabic). So, there were very few examples of syllabifying by the non-Broca patients; e.g., by a global aphasic: Schlúß#akkòrd → Schlúß##á##kòrd, Nór\$d#africa → Nór##dáfrica; by a Wernicke aphasic: Miß+ách\$st+ung → Miß##ák##túng, Inter+aktión → mí##mí##mí##tér, Rádio#aktiv+it'üt → Rádio##án#gá##schik#ték; by a conduction aphasic: Mikro#organ+ismus --> Mikro##ór##gá##nist##mús. However, examples of syllabific segmentation are few, and they can be explained by binding and phonotactic preferences. Also, articulatory facilitation may be at work. Thus the results of the test provide evidence for the assumption of Natural Morphology concerning semiotic precedence of morphology over phonology.

A more detailed assumption was well supported by the test results, too: in morphological decomposition, segmentation into words was more frequent than that into affixes, because words are more salient than affixes (roots play little role in German morphology and, consequently, in the test). The table below presents word segmentations (WS) and prefix segmentations (PS), and in square brackets the lack of such segmentation when some other morphological segmentation occurred in the same word.

Table 3. Word segmentations (WS) and prefix segmentations (PS).

Broca 1	WS 73 [1]	PS 5 [13]
Broca 2	WS 11 [1]	PS 1 [2]
global transcortical	WS 16 [0]	PS 0 [3]
global	WS 31 [0]	PS 3 [4]
Wernicke	WS 61 [0]	PS 6 [8]
conduction	WS 80 [3]	PS 4 [14]
TOTAL	WS 272 [5]	PS 19 [44]

The numbers show that segmentations into words were extremely systematic - "once a word, always a word" - segmentations, whereas segmentations into morphemes varied, as a result of which only one third of the available prefixes underwent segmentation. The greater autonomy of words, when compared with prefixes, additionally showed up in metatheses: words were metathesized 8 times (1 Broca, 3 global; 3 Wernicke), affixes never. Examples of metatheses are: *'Obst#hecke* → *Hécke###óbst*, *Léhn#sessel* → *Ésel###légen*.

Also the assumption that, among affixes, prefixes are more salient than suffixes, was well supported. In contrast to the above 19 prefix segmentations, only 2 suffix segmentations occurred, both with the conduction aphasic: *Réchen#`üb+ung* → *Ré#ché#`n#`üb#`ùng*, *Dréi#éin+ig+keit* → *Dréi#éinig#keit*. But note that the segmentations were not complete, insofar as no additional primary but only secondary stresses were produced and that pauses were shorter than with prefix segmentation.

As demonstrated above, segmentation in production is preferably morphological or of a morphological nature. Even when speakers (not only aphasics) produce chunks traditionally called syllables, in fact they produce phonological material within word-frames: if they do not manage to access existing morphemes or words, they produce phonologically bound sequences within word-boundaries.

CHAPTER THIRTEEN

*Writing systems*¹⁸¹

The name *syllabic* was given to pre-alphabetic writing systems, e.g. Japanese *katakana* and *hiragana*, Accadian or Hittite cuneiform and other systems (cf. below). On closer inspection, however, it turns out to be doubtful whether these systems in fact involve the concept of the syllable. I intend to demonstrate that so-called syllabic writing systems supply no substantive evidence for a phonological unit syllable, but, on the contrary, tend to supply evidence against it. For a review of stages in the development of writing systems as well as for the presentation of a bridge-theory mediating between graphic and phonological structure, the reader is referred to Dressler and Dziubalska-Kołodziejczyk (1995a). For the purposes of the present work, I will concentrate on graphic correspondences to prosodic units smaller than a phonological word or a foot and larger than a segment.

13.1. Cuneiform writing and syllable boundaries

When one looks at the development of syllabaries from logograms, there is no writing system in which there is any direct correspondence between signs and the units identified by most theories as syllables. Let us begin with the history of cuneiform writing in the ancient Near East, the most famous case of the historical development of writing systems.

The Sumerians assigned to some of their logograms the representation of CVC, CV and VC sequences, but made only restricted use of *syllabograms* (cf. Coulmas 1989: 81), some of them signalling either one or two vocalic nuclei. In fact, many signs can be read with or without a final vowel, as in bala = bal, ana = anu = an, daba = dab = dib, gana = gina = gan = ga, tuku = tuk = tu, ma = pes = pesse, as = asa = assa, etc. While these signs definitely do not support the syllable, they may reflect the development of a **B←n** binding as a follow-up to an **n→B** binding, where a final vowel represented an intermediate stage in the development from {**nBnB**} to {**nBn**}. Morpheme boundaries were often more respected than the putative syllable boundaries, e.g. in ba-an-tuku 'married' from /tuku/ 'to marry' or mu-un-du-an-pes-e = mu-da-pes-e 'expands' from /pes/ 'to expand'. This is explained by the priority of morphology over phonology.

The Accadians (more precisely: Babylonians), when adapting the system to their own language, represented a still wider variety of shapes with their signs, which thus became even more polyvalent (cf. Coulmas 1989: 79ff). For example, one sign represented as = rum = til = ina, another one ri = iri, etc. (cf. Walker 1990: 26), i.e. either a sequence popularly referred to as a syllable or more or less than that. There is nothing peculiar about homography being used here as an economizing device, since it is used in many writing systems. What is of crucial

¹⁸¹ cf. also Dressler and Dziubalska-Kołodziejczyk (1995a).

importance in the above examples is that homography does not respect the number of syllable nuclei or syllable boundaries.

Similarly the Hieroglyphic Luvian syllabary (cf. Marazzi 1990) contains three <CVCV> signs <ara/i, tara, tana> in addition to the majority of <CV> signs (e.g. <hi, hu, ka, ma, nu>, etc.), and some <V> signs and <CVC> signs (e.g. <har, hux, kar, pár>) and only two <VC> signs (<us, ur(a)>).

The clearest candidates for representing a syllable were signs for CVC. But often the probable syllable boundary did not coincide with the graphic representation, e.g. in the following Old Accadian names whose syllabograms reflect their morphological make-up (Gelb 1955: 186, 215, 232, 272, 284) <Dan-i-li, Dur-úl, Es-dar-al-su, Nin-líl-is-gi-in, Tab-i-lí>. In Old Accadian writing, CVC sequences (whether, in traditional terms, tauto- or heterosyllabic) are usually represented by <CVC> signs or <CV-VC> sign sequences. The latter sign suggests itself as a representation of two phonological bindings.

It seems that in Old Babylonian, the <CV>, <VC> and <CVC> signs usually include information about the prevocalic and postvocalic consonant. In syllabic frameworks this amounts to a partial validation of the concept syllable in this subset of signs. In B&B terms, the Babylonian signs always represent both bindings, $n \rightarrow B$ and $B \leftarrow n$, which are obligatory in a CVC sequence, and, therefore, graphically often made redundant. Such signs cannot be expected to coincide with the putative syllable boundaries in a sequence, because it is not the syllable but bindings that are to be represented. For example, <is-pur-am> is a rare variant for <is-pu-ra-am> [ispuram]. Notice that in both sign sequences, obligatory bindings realized by [is], [pu] and [am] are represented, while the other two, realized by [ur] and [ra] are represented alternatively, i.e. non-redundantly, since neither of them need to be represented. Also in Young/Late Babylonian, writings such as <ug-da-at-am-mar, Lis-tar-i-bu> exist.

So the phonological correspondence of Accadian signs always includes a beat (B) – most often just one beat¹⁸² – and one or two bindings in such a way that all nonredundant bindings in a sequence become represented. Cases where two beats are included can be seen as historic remnants of logography and, simultaneously, as remnants of the development of a $B \leftarrow n$ binding from { $nBnB$ } sequences.

Violations of the concept syllable boundary can also be illustrated with Hittite cuneiform writing, adapted from Accadian, cf. the variants <hi-in-ik-zi = hi-in-ga-zi> [hinktsi], <ki-is-sa-an = kis-an> [kisan], <te-it-te-en = te-e-tin = te-it-en> [teten], <wa-al-ah-si = wa-la-ah-si> [walhsi] (but may be with anaptyxis, Eichner, pers.com.). The cited signs clearly illustrate a necessary origin of consonant clusters in former or underlying bindings.

¹⁸² A writing system that would just notate beats would not be distinctive enough in principle, while distinctivity is a main function of writing. Such reduced distinctivity, however, may occur in message transmission through gong and drum-languages, in which the signals beaten out on the instruments represent tonal and rhythmic patterns alone, cf. Carrington (1949: 42ff). In my prosodic typology of languages, such languages would classify as PRE-prototypical beat-timed, since they operate with beats only (are devoid of bindings) and, therefore, need tonal and rhythmic patterns to increase distinctivity and communicate.

Carrington's (1949) study concerns the gong- and drum-languages of the Upper Congo area of Central Africa. Apart from gongs and drums, other instruments are used as well, such as sticks, whistles, bells, horns, stringed instruments as well as the human voice. An interesting feature of the "shouted language" (i.e. one transmitted by the human voice) is that it uses a conventional syllable of the exclusively CV form, e.g. ki corresponds to the high-toned lip of the gong, ke corresponds to the low-toned lip. On the gongs, prominence seems to be reproduced by variation of interval between gong-beats (rather than by differing amplitude of gong-lip vibration).

Most interestingly for the Beats-and-Binding model, a long vowel is represented as TWO consecutive beats on the same lip of the instrument (and NOT e.g. by a number of rapid beats or a single beat followed by a pause).

13.2. Indian writing systems and syllable boundaries

Evidence against the importance of syllable boundaries for writing systems is also provided by Indian writing systems. For example, in the Devanāgarī system of Classical Sanskrit, signs are basically <CV> or <CC(C)V> or <CC(C)(C)V> ones (with an inherent vowel /a/), irrespective of the putative syllable boundaries. I.e., there are sign combinations (ligatures) for consonant clusters irrespective of whether they are tautosyllabic or heterosyllabic, e.g. <tka, tta, tra, ttra, tpa, tpra, tsa, tsna, tsnya, nta, ntya, ntra, ntsa, nra>. In B&B terms, these signs represent a beat (B) and an **n**→**B** binding, which non-redundantly represents the origination of the consonant clusters through **n**→**B** bindings.

13.3. Syllabaries and syllabic constituents

If, as shown above, a so-called *syllabary* does not systematically notate syllables as a whole, it may notate the immediate constituents of the hierarchically organized unit.

If one assumed a division into onset and rhyme¹⁸³, a closed syllable C_1VC_2 should be represented as < C_1 >< VC_2 >. This, however, occurs in no attested writing system. What comes closest is the representation < C_1V_1 >< V_1C_2 > with a so-called dead vowel in the first sign (cf. below). The representation expected by syllable theories is excluded in principle by Beats-and-Binding phonology, since in a {**nB**} sequence BOTH bindings are obligatory and thus need to be represented: a non-beat (n) cannot stay on its own.

Next, a more complex sequence $C_1C_2VC_3C_4$ would be represented as < C_1C_2 >< VC_3C_4 >. Again, this is never the case. What is more, no attested writing system has signs for complex rhymes <VCC>. And as to the position of a dead vowel (signalled as (V)) for representing the onset, one would expect a systematic representation of C_1C_2 by < $C_1(V)C_2$ > (with a dead vowel). In fact, this does not seem to occur. One finds rather < $C_1(V)$ >< C_2V_1 >< V_1C_3 > or < $C_1C_2V_1$ >< V_1C_3 >. In other words, the putative division line between onset and rhyme is not respected at all.

13.4. A preference for {**nB**} signs

Due to the preference for the **n**→**B** binding CV sequences are expected to be the primary targets for the graphic representation of beats with a consonantal environment. This is indeed the preference observed in syllabic writing systems. For example, the Cypriot syllabary has only <CV> and <V> signs. Similar systems are the scripts used in the Caroline Islands (Yap, Truk, cf. Daniels 1992: 87, Justeson and Stephens 1993¹⁸⁴) and many African and Amerindian systems (e.g. Cherokee, cf. Scancarelli 1992). More precisely, the preferred signs are not only <CV> signs, but, more generally, <**nB**> signs. Therefore signs may also represent a consonant followed by a sonorant (functioning as a consonantal beat).

For Hittite cuneiform writing, Eichner (1975) has concluded that signs of the type <kar> actually reflect [kr] with a sonorant beat, provided that in the respective morphological form <kar>¹⁸⁵ never fluctuates with <ka-ar>. Clear examples are <te-(e)-kán> = [tegn] 'earth', <ga-an-ki> = [kanki] 'he hangs' vs. reduced ablaut grade in the plural <kán-kán-zi> = [knkntsi], <tar-

¹⁸³ cf. Kiparsky 1981; Fudge 1987; Kaye et al. 1990; cf. overviews in Vennemann 1988b; Bertinetto in press and references and discussion in Chapter 3, especially 3.4.4.

¹⁸⁴ The Trukese script was developed from English letter names through regularization to the pattern of C_i , interpreted by islanders as syllabic (cf. Justeson and Stephens 1993).

¹⁸⁵ Notice that [kr] with a sonorant beat could not be represented otherwise as <kar>: in this way, the **n**→**B** binding underlying [kr] is expressed.

ah-zi> = [trhtsi] 'he wins'. Comparative evidence both from other archaic Indo-European languages and later, alphabetically written Anatolian languages (particularly Lycian) confirm the assumption of sonorant beats in such examples.

Still, due to the preference for vocalic beats, signs usually represent CV. The consonant preceding the vowel may even only be an allophonic word-initial or word-internal glottal stop, as in Cherokee writing (cf. Schmitt 1980: 125). Less preferred sign types reflect gradually less preferred sound combinations, such as VC, CVC, rarely CCV, whereas the least preferred combination VCC is never represented by a sign. For example, the Linear B syllabary has <CV>, <V>, and rarely <CCV> signs. Modern Amerindian writing systems are based on <CV> signs. Additional consonants are signalled by additional diacritic marks, e.g. in the Cree script, the signs <pwa> and <paw> are modifications of the sign <pa>¹⁸⁶. The reason why the sequence [pwa] is represented as a modification of basic <pa> and not <wa>, seems to be the same as the one underlying the **n**→**B** preference, i.e., to represent a maximum contrast between a beat B and a non-beat n.

Another reflection of the same preference comes from Celtiberic (cf. Untermann 1962; Tovar 1951) written with an Iberic mixture of syllabic and alphabet writing. A sequence [tra] cannot be represented as such, it is represented either by <TA> or <TA-R>, as in <ko-n-po-u-to> = lat. Conplutum, <ko-n-te-pa-ko-m> = lat. Contrebiensium vs. <ko-n-te-r-bi-a> = lat. Contrebia, <ti-r-ta-no-s> = [tritanos]. Thus the sonorant directly preceding the vowel is either not represented, in favour of a stronger consonant (possibly reflecting the **n**→**B** binding enhancement through a bigger sonority contrast), or it is represented by an alphabetic sign, but in the wrong syllabic (i.e. postvocalic) position¹⁸⁷. The latter is also explicable if one asks a negative question: where else could <r> be positioned? Before <ti-> it would have suggested a wrong order of the consonants in a cluster. In between [t] and [i], it would have required a <ri> representation, which would have created the evidently undesired (cf. representations without <r>) effect of [ri] reflecting a more prominent binding than [ti].

13.5. Representing consonant clusters

One way of dealing with consonant clusters is to extend the use of signs that prototypically include reference to a vowel to represent a consonant cluster¹⁸⁸. Thus the graphic representation contains a so-called "dead/blind/mute/empty vowel", also referred to by the term "excess vowel" (cf. Justeson 1977) as it constitutes a graphic over-representation of the respective phonetic content. Clusters of two consonants may be represented by either <CV><CV> or <VC><VC> or <CV><VC> or <VC><CV> or <CVC>. Due to the preference for <CV> signs, the default solution is <CV><CV>, where the first sign contains a dead vowel (the only way in Cypriot, e.g. <po-to-li-ne> = [ptólin])¹⁸⁹. This holds particularly for word-initial position (cf. the

¹⁸⁶ Similar cases: Chipewyan, Slave, Dene, cf. Pinnow 1964: 136ff; Cardona 1986: 261; Haarmann 1990: 261ff; Schmitt 1980: 136ff; Fox, Potawatomi and Winnebago, cf. Justeson and Stephens 1993, who doubt their syllabic character.

¹⁸⁷ a. For a third way, see below on dead vowels, e.g. Celtiberic and Latin.

b. Venetic alphabetic writing has a system of syllable punctuation, whereby any alphabetic sign which does not belong to a CV or CCV sequence is prepunctuated, e.g. <vhrema.i.s.tna>, where only [fre] and [ma] are not prepunctuated (cf. Untermann 1962: 283; Prosdocimi 1967: 26; Justeson and Stephens 1993).

¹⁸⁸ The case in which word-internal VCCV is represented by <VC><CV> is clear. Such representations should not be taken as evidence for syllable boundaries or rhymes because they are simply consequence of how syllabaries reflect the binding preferences **B**←**n** and **n**→**B**.

¹⁸⁹ To be more precise, one needs to add that preconsonantal nasals are usually ignored, e.g. <pa-ta> is [pánta]. Dead vowels in Cypriot writing are said to give evidence for the syllable, since the quality of the dead vowel is identical to the quality of the nucleus of the syllable to which it belongs (called a "nuclear harmony convention" by Justeson and Stephens 1993). But firstly, this is not true for final dead vowels, as in <po-to-li-ne> or <sa-ta-

figure status of a word-initial consonant), but even for word-internal and word-final position, as in Hitt. <pa-ra-a> = [pra], <sa-ra-a> = [sra]; <sa-ra-am-na = sa-ra-am-ma-na>, cf. above <hi-in-ga-zi> = [hinktsi], <wa-la-ah-si> = [walhsi]; <li-in-ik> = [link], <a-da-an-za> = [adants], <lu-uk-ta> = [lukt]. Even word-final simple consonants may be written with a <CV> sign, as in <a-ni-ya-za = a-ni-ya-az>. <CV> signs with dead vowels occur more systematically in Hieroglyphic Luvian, e.g. in the second signs of <mu-ka-sa, ku-ra/i-ku-ma, a-sa-har-mi>, and (as a third strategy) in Celtiberic, e.g. <se-ko-pi-ri-ke-s> = Segobriges, <po-ro-te-n> = lat. Proteni.

A last resort solution is the avoidance solution, i.e. one of the two consonants is not represented. For example, Linear B (cf. the survey in Morpurgo Davies 1987) combines the avoidance solution in, e.g., <a-sa-mi-to> = [asámint^hos/n], <a-ku-ro> = [árguros/n] (notice again the **n→B** preference) with the dead vowel solution as in <ti-ri-po> = [trípos], <to-ko-so> = [tókson], <do-so-mo> = [dósmos], <ke-se-ni-wi-jo> = [ksénwios] (cf. Viredaz 1983 for a phonotactic explanation of the graphic representation of Mycenaean), no matter whether a cluster is hetero- or tautosyllabic in traditional analysis. /s/ is not represented before stop, as in <pe-ma> = [spérma], <ke-re-a₂> = [skéleha], <wa-tu> = [wástu]. This provides evidence for a low survivability of /s/ + stop clusters, in which the ignorable sonority distance between the two consonants succumbs to the overwhelming **n→B** preference (which is enhanced). A dead vowel also appears in stop clusters and nasal clusters, e.g. <ki-ti-me-na> = [ktímena], <pe-te-re-wa> = [pteléwas], <a-mi-ni-so> = [ámnisos], but not in other sonorant clusters, e.g. <ke-ni-qa> = [k^hérnig^wa], <pe-ma> = [spérma] (again, a greater sonority contrast in the resulting clusters enhances the **n→B** preference). Word-final consonants are never reflected, as in the above examples <ti-ri-po> = [trípos], <to-ko-so> = [tókson], <do-so-mo> = [dósmos]. Therefore, also [wánaks] is rendered as <wa-na-ka> with a dead vowel after the stop.

The **n→B** preference also shows up in the origin of alphabetic writing where consonant signs either represented one consonant each or a consonant followed by a vowel¹⁹⁰.

Also the Indian and most South East Asian writing systems (cf. Cardona 1986: 223ff) derive from the Old Indian Brāhmī script whose consonant signs have an inherent subsequent vowel. For example, in the Devanāgarī, the inherent vowel is /a/, and there must be a special mark for any other vowel and for the absence of a subsequent vowel. Thus /CaCa/ is written with two signs, but monosyllabic /CaC/ needs an additional mark of subtraction on the second sign (virāma)¹⁹¹.

13.6. Representing syllable weight

As to syllable weight, there may be evidence for vowel length (as often, but not consistently, in Accadian, e.g. <i-in> for [īn]), but no evidence for checked vowels being equivalent to long vowels. Japanese syllabic Kana writing is claimed to represent morae (e.g. Coulmas 1989: 132). But in fact we find just the representation of vowel length (either by an additional vowel or a length sign) and /n/ in word-final position (where the sign for /n/ is derived from an older sign <mu>). However, in the sequences [njV] written <ni-yV> no extra mora is signalled by the extra sign <ni>. Therefore, no clear evidence for or against moraic theories can be found¹⁹².

si-ku-po-ro-se> = [stasikúpros], and secondly, there are exceptions such as <e-pe-se-ta-se = e-pe-sa-ta-se> = [epéstase]>.

¹⁹⁰ cf. for West Semitic writings Gamkrelidze (1989: 219; 222) on *scriptura defectiva* (no signs for vowel phonemes). The oldest type consists of signs where any vowel may follow the consonant, i.e. the sign is vowel-indifferent. Later, in *scriptura plena*, supplementary signalling of each vowel (*matres lectionis*) was introduced. In "true syllabaries", each sign represents a specific consonant and a specific vowel.

¹⁹¹ A similar system occurs in Fox, cf. Walker 1974: 393ff.

¹⁹² No decisive evidence can come from ideographic writings of mono-beat languages, when the signs acquire phonic characteristics, and from morpheme-syllable writing systems such as Chinese (Cardona 1986: 234ff;

13.7. Conclusion

The graphic evidence discussed above speaks against the psychological reality of a unit that corresponds, in whatever model, to the traditional notion of a syllable. As to the constituents of the syllable, graphic evidence speaks against the onset/rhyme division onset, offset/coda or shell (cf. Vennemann 1988a). Evidence for syllable body (onset including nucleus, rise in terms of Donegan & Stampe 1978) is interpretable as evidence for the **n→B** preference which may coincide with a CV body/rise. The only possible advantage for body over rhyme could be that signs sometimes represent CCV but never VCC. Therefore "demisyllables" as assumed in CV phonology (cf. Clements 1992) are also not supported. At first sight, one might think that the above graphic evidence supports some basic assumptions of Government Phonology (cf. Kaye 1990 and others), for example, the relative unimportance of surface syllables, the basicness of non-branching onsets and rhymes, and empty nuclei. However, <CVC> and <CCV> signs exist, too. Thus the potential evidence writing systems could supply in favour of Government Phonology is not uniform.

In conclusion, the data on the so-called syllabic writing systems presented in this chapter is much more consistently accountable for in terms of the B&B preferences than in terms of the syllable. Half seriously one might add that the only thing "syllabic" about the syllabic writing systems is that their signs may be pronounced by philologists and linguists as what they believe is a syllable¹⁹³.

Coulmas 1989: 105ff). Even less relevant is Korean Han-gul writing, because the Chinese influence refers only to the arrangement of the alphabetic signs (cf. Harweg 1989: 141). As to syllable boundaries, no evidence is provided, unless the writing system has been devised for an open syllable language (as in many African cases), where syllable divisions can be easily predicted by the Beats-and-Binding model.

¹⁹³ For example, Walker 1974 calls any sign or combination of symbols "a syllable", if it can be read as "a syllable".

CHAPTER FOURTEEN

Phonostylistics

In this chapter I will, firstly, examine some cases of phonostylistic, casual speech phenomena which have received a syllable-related interpretation in the literature¹⁹⁴. Secondly, I will inspect some marked clusters which arise due to phonostylistic processes in order to show that syllable structure constraints are less capable of accounting for them than B&B phonotactics. The interdisciplinary bridge theory for casual speech is a socio-psycho-linguistic theory developed by Dressler and Wodak (e.g. 1978, 1982), which takes into account, when investigating the phonology of casual speech, both sociological and psychological variables. In this theory, socio-psychological factors relating to speech partners, such as sex, age, attitude, attention paid to speech, individual factors and the like, are reconstructed in order to better define the speech situation. As a result, the style adequate for the particular situation is predicted. For example, less attention paid to speech implies an informal situation, and thus the use of casual style, in which lenition processes generalize.

14.1. What is phonostylistics?

The term phonostylistics stands for the processes conditioned by style, i.e. style-sensitive or style-dependent ones. A scale of styles may be set up in a variety of ways, still it is generally encompassed within the extremes of *emphatic* vs. *informal*, with *formal* in between. Emphatic style is well-exemplified by motherese and citation forms, informal styles include casual, colloquial, intimate, while a speech, a lecture, or a job interview are examples of a formal style. For the purposes of clarity, I will refer to a simplified binary distinction between *formal* vs. *informal* only.

As far as the informal style is concerned, there exists a whole array of terms in the literature used to refer to approximately the same type of speech: *fast*, *rapid*, *allegro*, *casual*, *connected*, *informal*, *real*, *spontaneous*, or *conversational*. With respect to the primary style-differentiating criteria, the term *casual* seems to be the most adequate or, indeed, the least narrow or vague. The criteria are: tempo of speech and attention paid to speech. The criteria take on different values depending on the situation in which a speech act takes place (topic, aim, relation to the interlocutor, place of a conversation) and on the individual features of the speaker. Most commonly, exactly those situations do arise which trigger casual speech, i.e. in other words, most often we speak casually. The relationship between the two criteria is inversely proportional: the higher the degree of attention the slower the tempo.

The main types of phonostylistic processes are:

¹⁹⁴ The present section is not intended to provide an exhaustive survey of the literature on casual speech phonology. For some representative studies see, e.g., Kaisse 1985, Gósy 1991, Nolan and Kerswill 1990, Zborowska 1997, Shockey 1973, 1997, 1999, Wells 1999.

- assimilations, e.g. of stops and nasals, as in: *that pen, good mother, could get, ten men*; palatalization and coalescence, e.g. in: *did you, hit you, don't you, as yet*;
- reductions, e.g. cluster reductions and degeminations, as in: *a test drive, I asked him*; smoothing, as in: *hour, lawyer*;
- hiatus avoidance, e.g. in: *law and order, situation*;
- assimilation + reduction, e.g. in: *I can't go, don't be silly*;
- reduction and elision of vowels conditioned by rhythm in iso-accentual, stress-timed languages, e.g. *perhaps*;
- consonant epenthesis, e.g. in: *prin[t]ce, min[t]ce*.

I propose a graphic way to represent stylistic variation (Dziubalska-Kořaczyk 1990: 20; see *Figure 1* below). Underlying intention is a term compatible with the mentalistic, psychological theory of the phoneme (cf. such notions as *Lautabsicht, sound image, intention*, in the works of Baudouin de Courtenay, Sapir, Stampe).

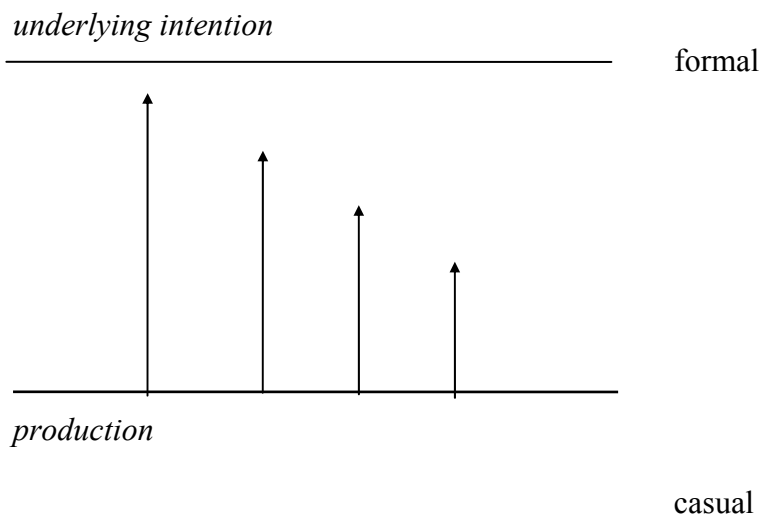


Figure 1.

For instance: underlying intention *happen* /hæpən/, realization in production [hæpɪ]. Further illustrations of phonostylistic processes are quoted below:

- (1)
- | | |
|--------------------|--|
| hisediwungəu | <i>he said he wouldn't go</i> |
| jəʃə:rəbaunəkstaim | <i>you sure about next time?</i> |
| n̩widinsi:iməgen | <i>and we didn't see him again</i> |
| bəpræpʃəkəgimiwʌn | <i>but perhaps you could give me one</i> |

(Sobkowiak 1996: 238)

- (2)
- And also by using a low impedance you can use two conductors shielded.*

Conversational style:

and ænd > æn > ən

also l > ʊ

using ŋ > n

impedance ən > ɲ , s + j > ʃ

you u: > ə > Ø

can kæn > kɲ > kŋ

shielded l > ʊ , z + ʃ > ʒ

TOTAL: 13 PROCESSES

Reading:

and ænd > æn

a eɪ (hypercorrection)

can kæn > kən

conductors z + ʃ > ʒ

shielded l > ʊ

TOTAL: 7 PROCESSES

(Shockey 1973: 83)

14.2. Syllable structure constraints in casual speech

Typically, some reductions as well as a lack of reductions in casual speech are explained by reference to well-formedness constraints on syllable structure. For example, in Welsh the first vowel of a word is dropped in (Dogil 1984: 94¹⁹⁵):

	<i>calon</i> 'heart'	<i>calonau</i> 'hearts'	<i>tymora</i> 'seasons'
slow:	[kálon]	[kalóna]	[təmóra]
fast:	[kálon]	[klóna]	[tmóra]

but not in:

	<i>ceffylau</i> 'horses'	<i>hogenod</i> 'girls'
slow:	[kefila]	[həgénod]
fast:	[fila]	[génod]

First of all, the initial motivation for this kind of deletion is rhythmical. In casual speech, rhythm tends to regularize towards the preferred trochee (cf. 4.2.2.1.). Whether the rhythmicization is introduced via the deletion of an unstressed beat alone or together with the non-beat(s) bound to it is language-specific and depends on how much a given language relaxes the restrictions imposed on its own phonotactics in casual speech. The latter is expected to be ultimately governed predominantly by universal preferences. In the above-quoted case, Welsh tolerates a deletion resulting in the creation of a preferred cluster kl- (cf. 5.3.1.) as well as a less tolerable, but still preferred, cluster tm- (kl- > tm- in Cluster Space for initial doubles, 5.3.1.).

¹⁹⁵ Dogil (1984) quotes these examples from Zwicky (1972). I quote them with the modification of accent placement introduced by Dogil in note 3, p. 94.

However, the whole CV is deleted to prevent the formation of *kf- or *hg- clusters which are both bad initials while they constitute preferred medial clusters (5.3.3.).

In English, deletions of this type¹⁹⁶ are dependent both on universal well-formedness conditions and the sonority of the first consonant of the cluster. Reductions like (cf. Kaisse 1985:33) *b'lieve*, *t'mato* (good initials), *p'tato*, *ftality* (good medials) are tolerated, while **m'ternal* (good final) or **r'member* (good medial) are not. The reduction of a weak vowel takes place: if a resulting cluster is a universally good initial; if a resulting cluster is a marked initial (cf. the section below on the rise of marked clusters in phonostylistics), but the first consonant is not a sonorant. In both cases, the major teleology of the reduction - to obtain or approach a trochaic foot - is satisfied. If the first consonant of a to-be cluster is a sonorant and the cluster would not be a good initial, however, the reduction is blocked since the sonorant would be prone to take up the function of the deleted beat¹⁹⁷. This would contradict the main teleology of the reduction - to reduce the number of beats towards a binary, trochaic foot: the reduction would be dysfunctional.

In Viennese German, the past participle prefix *ge-* (and also other prefixes) loses its schwa before a consonant. The resulting cluster is further reduced (i.e. the /g/ is lost), if the following consonant is a plosive. E.g. (the examples I owe to W.U. Dressler): *gelebt* → gl- (good initial); *gemacht* → gm- (good initial); *genäht* → gn- (good initial); *gefährten* → kf- (good medial); *gestorben* → kʃt- (good medial); *besoffen* → ps- (good medial); BUT: *getan* → tan; *gepackt* → packt; *gekauft* → kauft. In the latter three cases, the to-be clusters would be the best among medial doubles (two stops or stop geminates). The dysfunctionality of such a cluster in an initial position would be greater than the gain of casual speech lenition: in fact, the lenition would not be speaker-friendly, since the cluster would be unpronounceable. Therefore, the whole CV is deleted.

14.3. Rise of marked structures in phonostylistics: Polish casual speech

As has already been said above, casual style is a potential source of marked clusters. The application of casual speech processes, i.e. mainly speaker-friendly lenitions (especially massive vowel reductions), may lead to a temporary rise of “new” clusters which are marked with reference to the universal phonotactics. Some of them may potentially get socioculturally reinforced and become part of language-specific phonotactics.

The Polish data inspected here was a corpus of recorded and transcribed casual speech collected by Madelska (1987). The examined list of 3,106 lexical word types consisted of word types ranked according to the frequency of occurrence: type number 1 had 1,692 tokens, while type number 3,106 had 2 tokens. Out of 3,106 lexical word types, in the production of 27 types marked clusters were found, all word-initial. They arose via vowel reduction. The 27 types contained 12 double clusters, 9 triples, 4 four-consonant clusters and 2 five-consonant ones. Among the doubles, only 4 were real two-consonant clusters, while the other 8 contained a syllabic. All 12 were dispreferred initials when evaluated according to the phonotactic conditions mentioned above. Among the triples, 6 did not contain any syllabic; all but one were dispreferred initial triples (the “good” one contained a syllabic). Multiple clusters are generally too complex to be evaluated other than as disfavoured clusters. The table below lists all 27 types (the triple medials at the bottom of the table were the only “new” clusters observing their respective well-formedness condition, i.e. the one for medial triples).

¹⁹⁶ Cf. a detailed experimental study of weak vowel reduction in English casual speech by Głowacka (Ph.D. in prep).

¹⁹⁷ cf. Chapter 17 on syllabic consonants.

Table 1. “New” clusters resulting from vowel reduction

Double clusters (12)	<i>nč ṇč žč ṃm ṣs ss(2) ṃv zdz zz ẓts ṇd</i>
Triple clusters (9)	<i>tlk ṭlk p̣sk f̣fs ṃvj p̣sn ssn p̣sp ṣtd</i>
Four-consonant clusters (4)	<i>f̣fsk p̣ḳfw p̣f̣fw (2)</i>
Five-consonant clusters (2)	<i>f̣fstk f̣fsṭs</i>
Triple medials (3)	<i>rst(2) ččn</i>

The following table provides examples of words in which "new" clusters arose.

Table 2. Examples of words with “new” clusters

<i>Rank no. (text freq.)</i>	<i>word type in spelling</i>		<i>lexical form transcription</i>	<i>token phonostylistic transcription</i>
30.	znaczy	C	znaçi	nçi nçi
35.	tylko	C	tılko	tlkɔ t kɔ
61.	wszystko	C	fʃistkɔ	fʃskɔ fʃstɔ
84.	przykład	C	pʃikwat	pʃkat pʃkwat
118.	wszysey	C	fʃistsi	fʃsi fʃstsi
188.	rzeczywiscie	C	ʒɛçiviotɛ	ʒçi-
204.	mimo	C	mimɔ	m̩mɔ
271.	mowie	C	muvjɛ	m̩vjɛ
360.	swoim	C, H	sfɔjim	ʃsoim
464.	przynajmniej	C	pʃinajmɛj	pʃna-

Summing up, all “new” initial clusters produced in the corpus were universally marked. Thus, phonostylistic variation of casual speech is indeed a potential source of marked clusters, which may, among others, explain the existence of such clusters across languages.

Another process standing out in the inspected corpus of Polish casual speech is the smoothing of an intervocalic consonant which produces a vowel hiatus with the first vowel stressed. The transition between the two vowels remains rather smooth (slightly gliding), still the weakening or deletion of an intervocalic consonant leads to the distortion of a CVCV structure, and as such produces a marked effect (with respect to the CV preference). In the corpus of 3,106 word types, 177 underwent the process and thus demonstrated the hiatus.

Table 3. Examples of “new” hiatuses (first ten cases)

<i>Rank no. (text freq.)</i>	<i>word type in spelling</i>	
46.	teraz	H
55.	potem	H
69.	miałam	H
77.	duzo	H
79.	domu	H
106.	takiego	H
110.	człowiek	H
142.	trzeba	H
144.	wydaje	H
153.	mama	H

Thus, also the case of hiatus formation is a piece of evidence that casual speech may produce structures marked with respect to universal preferences. In general, phonostylistics is one of the best playgrounds for the activation of universal preferences which otherwise, in formal speech, are constrained by language-specific system adequacy. Still, a wide-spread application of lenitions, apart from bringing about the desired effect of simplification (satisfying the ease of articulation function of phonology) as a side-effect brings also some unintended and partly dysfunctional structures. Such marked structures usually either get further "repaired" (e.g. *trzeba* → *trzea* → *trza*) or simply crop up exclusively as casual speech variants. Sometimes, however, they may stabilize and establish themselves as sanctioned, marked structures in a language. Therefore, phonostylistics helps us explain how markedness should come to exist at all in language; in fact, the *raison d'être* for markedness lies in the preferential rather than absolute nature of universals.

CHAPTER FIFTEEN

Psycholinguistic and metaphonological evidence

Natural Phonology aspires to achieve the psychological reality of its explanations. One of the sources of external evidence is constituted by psycholinguistics which on its own also strives to uncover the psychological reality of linguistic phenomena. Out of the rich area of psycholinguistic evidence, I will discuss some of the studies which are supposed to provide support for the psychological reality of the syllable and/or its components. Such support is drawn from spontaneous errors, errors in short-term memory for speech and from speakers' performance on tasks requiring the analysis and manipulation of sounds (cf. Treiman 1989: 46f), either in oral or written form. Two extra-grammatical phenomena will also be considered: clipping and file extension coining.

15.1. Syllable-counting vs. beat-counting

One of the results of the psycholinguistic research in phonology is the observation that a larger unit like the syllable may be more natural for phonological representations than a smaller unit like the phoneme (cf. e.g. Derwing 1986). In short, syllable counting turns out to be less taxing than subsyllabic or phoneme counting (cf. Dow, M. L. & B. L. Derwing 1987), although with the following reservation: "One of the biggest problems with the counting task (...) was the difficulty of determining what units people were actually counting (...)." (Dow, M. L. & B.L. Derwing 1987: 6). The answer given by the Beats-and-Binding model is straightforward: people count beats. In particular, they count rhythmical beats (**B's**), i.e. the ones that are most intuitively available to users of any language¹⁹⁸.

Also in TOT (tip-of-the-tongue) phenomena, the number of syllables (as well as the position of stress) is claimed to be relevant (cf. Cowan 1992). Again, it is the number of beats that the speaker is able to recover from his memory that matters, i.e. a basic prosodic structure of the not-fully-retrievable word.

What is, at the same time, rejected as a result of psycholinguistic research is the notion of the syllable as a single, indivisible unit as well as of syllables as strings of segments of an equal status (cf. e.g. Dow, M. L. & B.L. Derwing 1987). There is abundant evidence for the primacy of some subsyllabic units of organization over single phonemes. What this proves in terms of the Beats-and-Binding model is the existence of bindings between beats and non-beats. The notion of intersegmental binding is much better suited to account for the regularities observed in psycholinguistic data than the notion of subsyllabic units. I will attempt to justify this statement in the following sections.

¹⁹⁸ Speakers may also count quantity beats (**b's**). This is the case in quantity-sensitive languages. Also for metrical purposes, quantity beats may need to be counted.

15.2. Right-branching vs. left-branching syllable structure

The overwhelming majority of relevant psycholinguistic experiments provides evidence for the internal structure of the syllable. Most often this evidence points to the onset-rhyme (rime) partition of the syllable, much rarer also to the head-coda division. As Treiman (1983) puts it, "there is at least one level of structure intermediate between the syllable and the phoneme" (1983: 2). Both spontaneous (e.g. Pig Latin) and designed word-games and other tasks (e.g. substitution-by-analogy, substitution and identification, deletion, word-blending and other manipulations) (cf. e.g. Dow and Derwing 1987, Treiman 1989) as well as speech errors¹⁹⁹ (cf. e.g. Treiman 1989, Stemberger 1983, Shattuck-Hufnagel 1986, Fromkin 1971, 1973, MacKay 1972, Berg 1989, 1993) and some lexical access and speech recognition studies (cf. Burani & Cafiero 1991 for the role of subsyllabic structure in the access of printed words²⁰⁰) appear to offer evidence for the right-branching structure of the syllable, i.e. for the onset-rhyme division (C)C/VC(C), for example: *shout + yell = shell*.

Less often, a left-branching structure (C)CV/C(C), e.g. *shout + yell = shoull*, or no preference for any structure at all is implied. For instance, in the forced-choice word-blending task (of two CVC words) in Taiwanese, no preference for onset-rime or head-coda blends was found (Derwing, Cho and Wang 1991). However, the experiment concerned, in fact, mono-beat words, since these are the only ones available in the language. In Korean, a head+coda structure was preferred²⁰¹ (Derwing, Cho and Wang 1991).

In all those cases in which the subjects of experiments are asked to manipulate mono-beat words (whether real lexical words or prefabricated phonological words), one can interpret the divisions they introduce only with reference to the unit word or foot. In CVC structures, the most obvious division line will fall at the point of the most salient contrast (strongest perceptual binding: $n \rightarrow B$), i.e. before the beat. For example, in slips of the tongue investigated by Berg, single consonant substitutions syllable-initially occur five times as often as final errors (Berg 1989: 250). This shows, according to Berg, that prevocalic consonants are less dominated by the vowel than postvocalic ones. A VC structure as a whole is also more often affected in slips than a CV one. In CCVC structures, a default strategy will also be to go up to the first beat, since it is the first salient figure of this structure.

The above strategy may undergo modification under the influence of universal phonotactic preferences: particular clusters will be treated as better or worse and manipulated accordingly. For instance, if an initial cluster CC- observes the relevant universal phonotactic preference (for initial doubles), the first consonant is noticeably a figure in a CCVC word (foot). As a consequence, both the first and the second consonant (due to the $n \rightarrow B$ binding) of the cluster are accessible to the language user. The first-choice manipulation would be to leave the first figure-consonant intact and manipulate the second one, as e.g. in *brake fluid* \rightarrow *blake fruid* (Fromkin 1971). The second choice would be to manipulate the first consonant. In the case of clusters violating universal phonotactics, one expects rather the original strategy, i.e. "go up to the first beat" and respect the $n \rightarrow B$ binding, as e.g. in Pol. 'a big candle-wick' *spory knot* \rightarrow *knory spot*.

15.3. The internal structure of onsets and rhymes

¹⁹⁹ Also short-term memory errors (when subjects are presented with material to remember and reconstruct in the course of an experiment).

²⁰⁰ But see Cutler (1989), where she claims that syllabic segmentation is not used in recognition in English (as opposed to French).

²⁰¹ Which is also reflected in Korean orthography.

Blending experiments are designed also to explore the internal structure of the subsyllabic constituents. The existence of this structure is indicated by spontaneous productions like speech errors. So, e.g. Treiman (1989) talks about the nature of the rime and onset as evidenced from speech errors. The rime consists of peak and coda or rather of VC+C, depending on the type of post-vocalic consonant. The quality of this consonant determines the degree of its cohesiveness with the vowel. Liquids cohere more than nasals, nasals more than obstruents (liquids>nasals>obstruents). The nature of the onset is different. Sonority effects are not bidirectional and they do not affect the onset as they do the rime²⁰². A CC/V partition is preferred over C/CV whatever the consonant preceding the vowel.

In the Beats-and-Binding model, both the cohesiveness scale and the asymmetry between pre- and post-vocalic relations receive a principled explanation. In a VCC structure, the final cluster observes universal phonotactics if the sonority distance between the consonants is bigger than (or equal to) the distance between a vowel and a postvocalic C (cf. condition 5.3.2. for final doubles). Therefore, the more sonorous the first C is the better. The parts of phonotactically preferred clusters are more transparent for substitutions in slips of the tongue (therefore, rime was claimed to have constituent parts). Dispreferred clusters tend to get transferred as a whole. In a CCV structure, the n→B binding preference dominates the phonotactic preferences due to the word (foot)-initial position of the CC cluster. As a consequence, the CC/V default partition is preferred in slips (cf. 15.2. above).

Some power of attraction or affinity between vowels and consonants in a string has been alluded to by many researchers in the area of psycholinguistics. For example, Berg (1989 and 1993) talks about intersegmental cohesiveness, basing his claims on slips-of-the-tongue data. The more similar two units are in terms of sonority and a hierarchic syllable structure, the more cohesive they should be (Berg 1989: 245,8). Postvocalic cohesiveness is defined by means of the following scale from the most to the least cohesive combinations: diphthongs (V-glide) > V-liquid (V-r > V-l) > V-C (Berg 1989: 255). Prevoalcalic cohesiveness is illustrated as follows: j allies itself to the V on the right /jV/ rather than to the C on the left /Cj/; in slips with another C1C2V, when C1 and/or C2 are sonorants, j exchanges places with r, l (and n) (Berg 1989: 256). In other words, cohesiveness between segments is assumed to be the greater, the smaller the distance in sonority between them. Firstly, the notion of cohesiveness in the above form is untenable, since one assumes here attraction between sounds of similar sonority. Sonority is a feature that can only be perceptually evaluated. From the perceptual point of view, opposites attract; the greater the CONTRAST (and not the SIMILARITY) between the sounds the higher the power of attraction between them. Secondly, the degree of attraction between two sounds is not independent of context and cannot be measured only by an absolute sonority distance between them. In CV and VC sequences, the bigger the contrast, the more attracted to each other the two sounds tend to be (but also more salient for manipulation). However, in CCV and VCC sequences, the situation changes substantially, since now we are dealing with clusters of consonants, working against the CV preference, and thus subject to phonotactic well-formedness conditions. In general, the bigger the contrast between the consonants, the more preferred the whole sequence is, and all its members become more accessible to the language user.²⁰³

²⁰² At least it has been observed as being so for English (e.g. Treiman 1986, Berg 1993). According to Berg (1993), German is different in this respect and also respects sonority relations word-initially.

²⁰³ According to Berg's approach, CC is far more cohesive than CV or VC, and CV is less cohesive than VC. Within this approach it is difficult to explain the universal tendency for CV to predominate in phonology. As also noticed by Picard (1992), CV and rhyme are difficult to reconcile.

Another concept of a similar nature to cohesiveness was suggested by Derwing and Nearey (1991), namely the "vowel-stickiness" phenomenon. The idea is based on the results of active word-manipulation tasks, substitution-identification tasks and active and passive syllable boundary tasks. Derwing and Nearey found that in a CVCCC structure, the post-vocalic C sticks to the vowel in the order: G>R>L>N>O (glide>r>l>nasal>obstruent) (1991: 211), and in a C'VCVC, the intervocalic C sticks to the preceding V in the order: R>L>N>O (Derwing and Nearey 1991: 212). The advantage of the "stickiness" idea over the "cohesiveness" one is that stickiness describes a relation of a consonant towards a vowel and, thus, makes Cs and Vs functionally distinct (or at least leaves this possibility open). As was demonstrated above, one can predict the "stickiness" behaviour of the discussed clusters on the basis of the universal binding and phonotactic preferences (in the quoted cases, a condition for final triples for CVCCC and an n→B preference for CVCVC).

15.4. Syllabification principles

Psycholinguistic experiments with longer words (most often double-beat ones) are supposed to provide evidence for or against particular linguistic syllabification principles. Generally, speakers tend to break (a) before a single intervocalic consonant and (b) between intervocalic CC. Geminates and long consonants are treated as di-segments by literate, better educated speakers. Illiterates or semiliterates treat them as single and, accordingly, break before them (after a vowel) (cf. e.g. Derwing 1992²⁰⁴). For instance, Korean speakers demonstrated a preference to divide V-/C/V and VC-/C/V at the positions marked by hyphens even though their orthography permits the breaks at the slashes (cf. Derwing, Cho and Wang 1991).

Treiman (1992) investigated the role of sonority in phonological parsing in written and oral tasks. In particular, her intention was to verify the validity of the Maximum Onset Principle and the Sonority Contour Principle as syllabification principles. She examined the fate of single intervocalic consonants in two-beat, monomorphemic words e.g. *melon* (*me/lon* or *mel/on*; e.g. *on-mel* or *lon-me* or *lon-mel*). Obstruents proved to be better syllable-initial consonants than sonorants. Such a result is predictable on the basis of the n→B preference.

Secondly, Treiman examined two-beat monomorphemic words with medial -st- type clusters and -dr- type clusters. They were predominantly parsed according to the pattern: *ma-drid* vs. *es-tate*. The author concluded that there was a tendency to maximize onsets, but it was qualified by sonority effects, i.e. both of the investigated principles were at work. Within the Beats-and-Binding model, the *ma-drid* vs. *es-tate* parsings are predictable without recourse to any extra principle (such as the Maximum Onset Principle). A /dr/ cluster is a good word-initial double (cf. 5.3.1.), while /st/ is a good medial cluster (cf. 5.3.3.) and they are parsed according to phonotactic preferences.

Another generalization encountered in the psycholinguistic parsing studies is that phonotactic constraints for words are valid for syllables (e.g. Fallows, D. 1981). In the Beats-and-Binding model phonotactic preferences refer to positions of clusters within a word, i.e. word-initial, medial and final. No additional constraints are necessary.

Finally, the influence of literacy on speakers' ability to manipulate phonological material has been emphasized in numerous studies (e.g. Morais, José et al. 1989, Derwing 1992, Dow and Derwing 1987, Cowan 1992, Cutler 1989). This is not to be denied. For example, a preliterate or illiterate speaker would not parse a German affricate into a stop and a fricative, as is prescribed e.g. by Siebs or Duden (*trop-fen*, *emp-fangen*) according to the rule that the last C of a cluster at the end of a written line is transferred with the following vowel to the next line.

²⁰⁴ An intervocalic oral "pause-break" task administered to English, Arabic, Blackfoot, Korean and Swiss German speakers.

An Austrian student of mine (Karin Waska 1993) conducted an orthographic segmentation (graphic word division) experiment with 9 adult (literate) speakers of German. The results show that the speakers tend to parse firstly in a spoken fashion, and only secondarily according to spelling division rules.

15.5. "Short words"

Another way to uncover the psychological reality of universal phonology is to investigate the creation by the language users of new lexemes which are phonologically highly functional. Those creations satisfy the needs for shortness, ease of pronunciation and distinctivity. They have been labelled "short words" since they have been created by means of various shortening techniques applied to longer words or phrases. I will base my few remarks concerning "short words" on the comprehensive survey and analysis of those creations in German and French completed by Ronneberger-Sibold (1992, 1996, 1997a,b, 1998) as well as on a study of French clippings (i.e. one of the shortening techniques) by Kilani-Schoch (1996).

Typical examples of "short words" are clippings, e.g. Grm. *Limo* < *Limonade*, Fr. *manif* < *manifestation*, and acronyms, e.g. Grm. *LKW* /elka:ve:/ < *Lastkraftwagen*, Fr. *S.I.D.A.* /sida/ < *syndrome immunodéficitaire acquis* (Ronneberger-Sibold 1996: 261). The following phonotactic and prosodic properties have been found to characterize "short words" (cf. Ronneberger-Sibold 1996: 271) in German and French:

1. in both languages, the preference for a closed syllable in the monosyllables, the preference for open syllables in the polysyllables, and the overall preference for disyllables;
2. in German, a closed syllable is preferably placed at the beginning of a "short word", in French - at the end;
3. there are more monosyllables (as compared to the disyllables) in French than in German.

The above properties receive the following explanation in Beats-and-Binding phonology. "Short words" preferably have the form of a binary foot with no consonant and thus no $B \leftarrow n$ binding at the end, i.e. $CVCV \{nBnB\}$. One-beat words are of the shape $CVC \{nBn\}$, involving both bindings. The retention of the final non-beat makes the structure nearer to the binary foot in terms of the amount of prosodic material (cf. also Kilani-Schoch 1996), as well as in terms of informational load: the final consonant differentiates this particular $\{nB\}$ from all other $\{nB\}$'s of the same segmental content.

Language-specific modifications of the above universal preferences are the following: in German, a preferred structure is either $CVCV$ or $CVCCV$, both involving the medial $B \leftarrow n$ binding. In French, a preferred structure is $CVCVC$ (with $B \leftarrow n$ binding at the end). The difference has to do with the different timing of the two languages: German tends to have $B \leftarrow n$ bindings wherever the input is created due to its stress-timing. French tends to avoid $B \leftarrow n$ bindings and to allow for them most of all at the end of words due to its beat-timing. The final consonant in French may also serve a demarcative function on the lexical level. The differing number of mono-beat "short words" in both languages reflects typological preferences (French is more of an isolating type than other modern Indo-European languages).

Already this very short overview of the characteristics of "short words" demonstrates that the latter constitute an interesting playground for both universal and language-specific phonological preferences, where recourse to the syllable is superfluous.

15.6. File extension coining

A computer file name extension "is an optional addition to the file name in a suffix of the form ".xxx" where "xxx" represents a limited number of alphanumeric characters [...] The file name extension allows a file's format to be described as part of its name so that users can

quickly understand the type of file it is without having to "open" or try to use it" (Tucker 1999). In Dziubalska-Kolaczyk and Sobkowiak (2000) we attempted an experimental analysis of one type of file extension, namely .CCC, with a view to assessing the effect of the English and /or universal C-cluster phonotactics on the extension preferences. The hypothesis was that universal phonotactic conditions would affect the choices which extension makers take. In this way one could show that a metalinguistic activity such as file extension coining observes some non-metalinguistic regularities and constraints.

While performing this limiting metalinguistic task, extension makers obey certain principles mostly aimed at maximizing mnemonicity and minimizing redundancy: (1) word onsets are retained, (2) also of the second term of a compound, if any, (3) vowels are dropped, unless word-initial. Phonotactically speaking, the most interesting case obtains for bisyllables of the C(C)VC(C)CVC(C) structure where there are four or more consonants and the encoder must decide which of these will go to make up the extension. In accordance with the above observations, in the case of consonantal-only extensions, the first three consonants could be used. Thus, $C_0VC_1C_2C_3V$ becomes $C_0C_1C_2$, i.e., in fact, clipping occurs. This method finds support in psycholinguistic research on language processing which has shown (at least) the preference for left-to-right processing, as well as in the salience of word-initial position.

Predictably, simple clipping could be disturbed by some non-phonological features of the word concerned, mostly true or pseudo-morphological boundaries or orthography. Within phonology, the potential competitor to clipping in creating an extension is phonotactics, specifically the principles constraining the co-occurrence of consonants in clusters (as far as consonantal extensions are concerned). The following hypotheses have been formulated within the B&B phonotactics with reference to three-consonant extensions coined from word-medial -CCC- words of the shape CVCCCV(C).

Hypothesis I refers to the input of the operation of extension coining, i.e. $C_0VC_1C_2C_3V$. Since the encoder is forced to choose only two of the three medial consonants, s/he is expected to choose the phonotactically "legal" (universally or in English) pair, i.e. either a good word-final cluster (-VC₁C₂) or a good word-initial one (C₂C₃V-). If both are correct, the choice may be influenced by the above described clipping principle.

Hypothesis II refers to the output of the operation, i.e. CCC. The encoder is expected to aim at some legal cluster as an output sequence, i.e. some legal triple (again, either universally or in English), since otherwise s/he would arrive at a non-grammatical output (from the point of view of universal or language-specific phonology).

To test these hypotheses empirically, we asked subjects to choose from the two or (in one case) three provided extensions coding the same word. Out of 114 items carefully selected from the *Oxford Advanced Learner's Dictionary* according to a number of criteria²⁰⁵ we selected a dozen to include in the actual questionnaire (see Appendices). The subjects were

²⁰⁵ To obtain word-medial -CCC- words we scanned the computer-readable version of the *Oxford Advanced Learner's Dictionary*, filtering in only the following entries:

- bisyllables — to keep syllable number and structure reasonably constant
- paroxytones — to avoid the syllable-delimiting effect of ultimate stress
- nouns and adjectives — to give more credence to the alleged aim of the questionnaire: to build 'good' extensions from full words (attested extensions are almost always based on nouns and adjectives)
- monomorphemic words — to avoid the confounding effect of morphology (for example, *control*, *penthouse*, *wistful* were excluded)
- words of 'easy' orthography — to avoid confounding effects of grapho-phonemic mismatches and irregularities (for example, *chandler*, *penguin*, *rescue*, *restaurant*, *sheldrake*, *sixty*, *tungsten*, were excluded).

sixty-nine first-year students of English philology at the School of English, Adam Mickiewicz University, Poznań, all of them highly proficient learners of English as a second language. The results of the experiment are presented in *Table 1* below.

Table 1. Cluster preferences in extension coining

word	C ₀ C ₁ C ₂	C ₀ C ₂ C ₃	sum N
<i>wolfram</i>	wlf 48	wfr 21	69
<i>vintner</i>	vnt 61	vtn 8	69
<i>tincture</i>	tnc 55	tct 13	68
<i>symptom</i>	smp 42	spt 27	69
<i>semblance</i>	smb 49	sbl 19	68
<i>muskrat</i>	msk 55	mkr ²⁰⁶ 14	69
<i>minster</i>	mns 43	mst 26	69
<i>doctrine</i>	dct 55	dtr 14	69
<i>culprit</i>	clp 59	cpr 10	69
<i>prostrate</i>	pst 57	ptr 11	68
<i>plankton</i>	pnk 34	pkt 33	67

word	C ₀ C ₀ C ₁	C ₀ C ₀ C ₂	C ₀ C ₀ C ₃	sum N
<i>sculptor</i>	scl 23	scp 40	sct 6	69

As far as *Hypothesis I* is concerned, final doubles of English were consistently selected, regardless of the phonotactic legality of the initial doubles or the universal status of the respective clusters, thus apparently corroborating the strength of the clipping principle. Detailed results are collected in *Table 2* below.

Table 2. Phonotactic preferences in extension coining

	N	C ₀ C ₁ C ₂	C ₀ C ₂ C ₃
all eleven words	11	51.6	17.8
E.-legal -C ₁ C ₂ & C ₂ C ₃ -	7	53.7	16.4
E.-legal -C ₁ C ₂ & illegal C ₂ C ₃ -	4	48.0	20.3
universally good finals	7	49.7	18.7
universally bad finals	4	52.5	16.2
universally good initials	7	54.2	13.8
universally bad initials	4	43.5	24.7

As far as *Hypothesis II* is concerned, the inspection of the outputs of extension coining shows that all the CCC outputs preferentially selected by our subjects (the left-hand column in *Table 2* above, i.e. C₀C₁C₂) are universally preferred medial triples (cf. 5.3.7.). The table below presents these results:

²⁰⁶ In this questionnaire the onset cluster <kr-> is counted among legal ones, even though it is graphotactically offending.

Table 3. Preference for universally good medial triples

	N	C ₀ C ₁ C ₂	C ₀ C ₂ C ₃	ratio
good C ₀ C ₁ C ₂ & C ₀ C ₂ C ₃	7	43.5	24.7	1.7
good C ₀ C ₁ C ₂ & bad C ₀ C ₂ C ₃	4	54.8	13.8	3.9

A scan of attested English medial triples over the entire lexicon shows that (with very few disputable exceptions²⁰⁷) no output -CCC- cluster in our experiment occurs intramorphemically as a medial triple in English, thus invalidating observations of any putative English-specific phonotactic preferences. The choice of universally preferred medial triples is a rather robust effect, with the good triple being selected against the bad one almost four times more often, as seen in Table 3. The χ^2 test applied to the data in Table 4 yields 3.789, at 1 degree of freedom, which is significant at close to p=0.05. This means that, while the overriding principle in extension coining may be the metaphonological/ metagraphemic clipping, there is non-random and statistically significant teleological effect of the universal phonotactic preference for good medial triples as extensions.

Why should the preference for good medial triples play such a role in extension coining? Here are some of the potential reasons:

- The resulting (output) C-triples are bad initials or finals in English. Thus, the only potential position for the triples would be medial.
- Within the theory of Natural Phonology, universal preferences, and in this case, universal phonotactic preferences, are expected to affect the speakers' choices in speech acquisition, perception and production, as well as in such metaphonemic tasks as extension coining.
- As the subjects were Polish learners of English, one can expect that specifically English constraints would be superseded by universal preferences.²⁰⁸

To summarize, it appears that apart from the strategy of clipping and the influence of English-specific phonotactics, file extension coining is also subject to B&B universal phonotactic conditions. Research on file extension coining opens up another subfield in the study of English metaphonology as well as provides yet another source of external evidence for the B&B model of phonotactics.²⁰⁹

²⁰⁷ *Capstan, tapster.*

²⁰⁸ The effect of their Polish phonotactics might of course also be considered (which we did not do).

²⁰⁹ Notice that the syllable played no role in the analysis of the data.

CHAPTER SIXTEEN

Evidence from phonetics

16.1. Introduction

Due to the role phonetics plays in natural phonological explanations, the present chapter is yet another in this monograph excursus to phonetics in search of support for Beats-and-Binding phonology. In Chapter 4, all postulated units, relations and preferences received their respective phonetically grounded motivations. This chapter will be a brief extension of the discussion of a number of relevant phenomena, primarily connected with temporal patterning in speech, with the aim of providing further phonetic evidence for the B&B model. The phenomena include: isochrony, transitional characteristics of CV vs. VC sequences, and vowel-length variations like the so-called compensatory lengthening, closed syllable vowel shortening and length adjustments in the context of voiced vs. voiceless consonants.

16.2. Isochrony revisited

It is generally agreed, both by speakers/listeners and linguists, that speech, like other manifestations of human behaviour, is rhythmical (cf. Chapter 4). There is no agreement, however, as to the basis for this intuition, or, in other words, how rhythm is realized phonetically. It is known that the basis is not acoustic isochrony (cf. Fowler 1983: 387), and it is not likely that "any units of naturally produced speech are realized isochronously" (387). In Fowler's view (cf. Fowler 1981, 1983), it is the vowels that are rhythmically timed in sequences of monosyllables, and the latter are believed by speakers and listeners to be isochronous. More specifically, it is neither the timing of vowel onsets, nor the timing of syllable-initial consonants, but the timed sequencing of the vowels as produced that corresponds to perceived syllable timing (cf. Fowler 1983). For instance, it has been shown (cf. Fowler and Tassinari 1981; Fowler 1983: 388; a discussion in Browman and Goldstein 1988: 150f) that the sequences of digits with acoustically isochronous intervals between onsets do not sound isochronous to listeners. The lineup in isochronous perception appears to be the P-center (perception-center), which is situated within the initial consonant sequence, always in the same relation to the vowel (cf. below the discussion of the C-center). Thus, the P-center, i.e. the psychological onset of an acoustic event, does not correspond to its acoustic onset.

Fowler argues, on the basis of experimental evidence for bidirectional coarticulation and shortening effects in CVC and VCV sequences, that, possibly "vowels do not change their produced durations in consonantal contexts; rather, the consonants overlap them more or less" (Fowler 1983: 392). In other words, she claims that vowels are produced as a separate cyclic stream, while consonants are overlaid on their leading and trailing edges. Since in this way vowel and consonant lengths are compensatory, durational variations of both are accounted for (e.g., one would talk of compensatory lengthening when a consonant loss uncovers part of a

vowel's produced extent, so that its measured duration is longer; cf. Fowler 1983: 405). In this model, talkers produce evenly timed vowels when they intend a rhythmic sequence of stressed monosyllable, while they relax that cyclicity to give an impression of either stress- or syllable-timed language (cf. Fowler 1983: 407). Listeners, on the other hand, hear what talkers intend them to, so they have to be able to hear through the coarticulatory overlap of segments (409). There have been attempts to address the question of why speech is produced in the above manner (summarized by Fowler 1983: 408-9). Firstly, coarticulation potentially facilitates the perceptibility of serially ordered speech sequences (a sequence of discrete units would indeed be difficult to recover)²¹⁰. Secondly, vowels constitute a natural articulatory class, yielding approximately the same global vocal tract shape. So, for instance, they can be produced even with a perturbation (e.g. with a jaw fixed by clenching a bite block). In a later paper, Fowler et al. (1986) observe that some changes of vowel and consonant coordination do not appear to require the previously described vowel cycle on which consonants are superimposed, but they do require "the interaction or blending of consonants and vowels within a single articulator and between articulators" (Fowler et al 1986: 6).

The above studies give support to: (1) the idea of the sequence of vocalic beats with consonantal non-beats bound to them; (2) the idea of the intentional phonemic representation adhered to by Natural Phonology (cf. the talkers and listeners above); (3) the idea of binding between beats and non-beats (cf. blending above); (4) the idea that durational and timing effects can be expressed without recourse to the syllable. Simultaneously, they do not provide any direct evidence for the syllable.

16.3. Transitional characteristics of CV vs. VC sequences

Support for the preferably stronger binding of a non-beat to the following ($n \rightarrow B$) rather than to the preceding beat ($B \leftarrow n$) can be seen already, for instance, from the X-ray microbeam studies of temporal relationships in VCV sequences in Japanese (cf. e.g. Kiritani et al. 1977). The studies demonstrated that the left-to-right effect of the consonant on the following vowel is greater than that of the right-to-left effect of the consonant on the preceding vowel.

Binding preferences also find support in the gestural model of Articulatory Phonology, developed by Browman and Goldstein (1986, 1988, 1989). The notion of the syllable is used in the model and syllable structure is specifically discussed (cf. Browman & Goldstein 1988). However, whenever the terms syllable-initial or syllable-final occur, they seem to refer, in fact, to word-initial or prevocalic and word-final or postvocalic positions respectively²¹¹. On the basis of articulatory evidence from American English, Browman and Goldstein observe that postvocalic consonants behave differently to prevocalic ones: "while initial consonants are related to their words in terms of a single global metric for the entire cluster, the C-center (consonant center)²¹², final consonants appear to be related to their words in terms of the local metric of achievement of target" (1988: 149). Thus, they conclude that "postvocalic consonants are organized on the basis of their sequential relation to the vowel rather than on the basis of their syllabic affiliation" (148), i.e. they are organized "with respect to their left edges (achievement of target)" (148). The C-center coordinates the initial consonant cluster with the vowel. The consonants are dispersed around the C-center and overlap the vowel. In final

²¹⁰ But see Byrd (1991).

²¹¹ "In order to explore the effect of syllable affiliation, we compared gestural patterns of utterances with different presumed WORD AFFILIATIONS (emphasis mine) for consonantal gestures, for example, 'pea splots' versus 'piece plots'." (Browman & Goldstein 1988: 141)

²¹² C-center is calculated with reference to the so-called "anchor point", e.g. in [pi `splats], the C-center for the cluster [spl] is determined with reference to the point of the attainment of the target (also the acoustic closure) for the [t] of [ats] (cf. Browman and Goldstein 1988: 143).

clusters, only the achievement of target of the consonant directly following the vowel is coordinated with the vowel. Browman and Goldstein conclude that this difference may account for some of the different phonological properties of initial and final consonant sequences.

For the purposes of Beats-and-Binding phonology, the above observations confirm the nature of the bindings $n \rightarrow B$ and $B \leftarrow n$. In particular, the fixed relation between the C-center and the vowel confirm the preference for the perceptual $n \rightarrow B$ binding, whatever the number of prevocalic consonants. In other words, although articulatorily a vowel may be preceded by a cluster of consonants, perceptually the effect obtained is that of a consonantal gesture followed by a vocalic one, as in a CV. That prevocalic clusters are perceived in terms of one global perceptual center followed by a vowel is evidenced by the existence of the P-center (cf. above). The P-center is a perceptual correlate of the articulatory C-center. Simultaneously, the existence of both centers supports the idea of the lack of any interconsonantal bindings²¹³, since the consonants in a cluster are related as a whole to the vowel. As to the postvocalic position, the consonants are sequenced so that the target of the postvocalic consonant is attained as the vocalic gesture is turned off (as opposed to the target portions of initial consonants, which overlap the time frame for the vowel; cf. Browman and Goldstein 1988: 152). Apart from speaking against the syllable-rhyme, this correlates with the phenomenon of phonological weight as affected by syllable-final but not syllable-initial consonants and could account as well for the coarticulatory differences between word-initial (more coarticulation) and word-final position (though not for compensatory lengthening - cf. Fowler's model above).

Evidence for the preference of the $n \rightarrow B$ binding over the $B \leftarrow n$ one is provided by the study of assimilation conducted in the gestural model by Byrd (1991). Assimilation is analyzed as the result of an articulatory process of gestural overlap. In a VC1C2V sequence, assimilation favouring C2 is not only a consequence of the information about place contained in the release burst of C2, but also, and predominantly, a consequence of the information contained in the formant transitions of C2V. Assimilation was investigated firstly in a VC1C2V sequence and, then, in a truncated condition, i.e. in a VC1 (left after the truncation of C2V). In the truncated condition, a greater degree of gestural overlap was required to make assimilation of C1 at all perceivable to the listeners. This was due to the loss of necessary information contained in the CV transition following C1. Byrd (1991: 114) also quotes another study (by Repp 1978) which supports his own results. Repp (1978: 477) stated the following: "While removal of VC transitions from a VCV utterance has a negligible effect, so that their absence can hardly be detected..., removal of the CV transitions dramatically reduced the identifiability of the medial consonant."

16.4. Adjustments of vowel quantity

As to other durational properties, experimental data shows that voicing-related variations in vowel length occur whether there is an intervening syllable boundary or not (cf. Maddieson 1985: 216). However, so-called closed syllable vowel shortening is considered to be evidence for the rhyme of a syllable (cf. Maddieson 1985). Still, firstly, the shortening is most common in languages having geminate consonants (in quantity-sensitive beat-timed languages), and then it affects a vowel which, as a beat B, necessarily binds a first constituent of a geminate - a non-beat n - to itself. A geminate is the best medial cluster, and as such guarantees that its members participate in, respectively, $B \leftarrow n$ and $n \rightarrow B$ bindings. Secondly, in other languages in which the shortening is observed, it is demonstrated by comparing CV and CVC sequences constituting words. In the word-final position a non-beat (consonant) is inevitably bound to a beat (vowel)

²¹³ Relations of sonority distances between consonants, specified by OSDP, serve the purpose of preserving a cluster of consonants against the overwhelming perceptual tendency towards a single interpretation of a prevocalic cluster.

by the B←n binding. Thus, in both cases quoted, the shortening affects a vowel participating in a B←n binding. A phonetic explanation of the shortening of a vowel in the context of a consonant bound to it (whether the process phonologizes in a language or not) may be sought in Fowler's model (cf. 1981, 1983, 1986). Namely, separateness of vowel and consonant production allows for an overlap between the two, and thus for a complementarity of length. This relation needs to be dynamic, and would probably depend on the degree of blending between a vowel and a consonant (cf. Fowler et al 1986:6). This explanation, however, is not compatible with the supportive account of binding relations based on the gestural model (cf. above). This incompatibility points to the conclusion that compensatory phenomena belong to a higher level of prosodic structure rather than the putative syllable. Only higher in the prosody can they be accounted for. Precisely this step is followed in Beats-and-Binding phonology: quantity is resolved at the foot level (cf. Chapter 4, Chapter 9). A foot-like candidate unit of prosody for modelling segmental durations which appears to be capable of replacing the syllable is the V-to-V unit (cf. Fant & Kruckenberg 1988; Fant, Kruckenberg & Nord 1991): from the onset up to but not including the following onset (cf. also Barbosa and Bailly 1992, Hirst 1993).

Hirst (1993²¹⁴: 34) observes that existing arguments for the syllable as a unit tend to be arguments for syllabicity rather than constituency. "Syllables...are identified by their peak characteristics rather than by their boundaries or their internal coherence" (Hirst 1993: 34). He concludes that "the syllable is not perhaps so strongly entrenched as a phonological unit as has often been believed" (Hirst 1993: 34).

One can draw endlessly from experimental phonetic studies to find support for the organization of the speech stream based on beats and bindings rather than on the syllable. The above has only meant to illustrate where to search.

²¹⁴ See also the whole volume of Lund Working Papers 1993 which constitutes a collection of contributions to the ESCA Workshop on Prosody 1993. The most recent of this series of workshops, Prosody 2000, centered on intonation research, and as such did not contribute any new evidence with reference to the syllable.

CHAPTER SEVENTEEN

Consonantal beats (N's)

17.1. Some generalizations about consonantal beats

All languages have vocalic beats (notated with B in the Beats-and-Binding model). Many languages (e.g. 85 surveyed by Bell 1978) also have consonantal beats (notated with N in the B&B model). Due to the universal preference for a vocalic realization of beats, there is an implicational relationship between the occurrence of vowel-beats and consonant-beats: $B \gg N$. Among consonants, sonorants are preferred to obstruents as consonantal beats, although there are languages possessing only obstruent-beats (Bell 1978: 158). In disagreement with the sonority hierarchy, nasals are preferred to liquids as consonantal beats.

A consonant is classified as a beat "when it functions phonetically as a syllable peak [a beat in our terms] from the point of view of the native speaker" (Bell 1978: 156). This identification strategy points to the relative nature of a consonantal beat, reflecting language-specific perception.

Consonant-beats tend to occur in unstressed positions. However, they are themselves often stressed, as in English, Czech or Koryak (Bell 1978: 161). Consonant-beats rarely contrast in length. Examples of languages demonstrating a contrast are: Sanskrit (short vs. long syllabic /ṛ/), Slovak (the contrast is demonstrated by /l/ and /r/), Slovenian, Serbian and Croatian (the contrast is demonstrated by /r/).

There is a strong preference for N's to occur without any n's (non-beats) bound to them; they may also participate in an $n \rightarrow N$ (e.g. /t_l/) or $N \leftarrow n$ (e.g. /ṛt/) binding²¹⁵. The source of the function of a beat is typically a vowel (cf. Bell 1978: 165). Most commonly, a consonantal beat originates from a syncope of a vowel²¹⁶ whose function is shifted to one of the non-beats in its direct neighbourhood. Therefore, there will be one consonant less in the neighbourhood of a new consonantal beat. Naturally, syncope is neither a necessary nor a sufficient condition for an N to come into being: it may also result in the creation of a cluster.

Among other possible or conceivable sources of N's, apart from a possible assimilation of consonantality by a vowel (e.g. Jap. /m̄masa/ < /umasa/, Bell 1978: 166), there is a spontaneous acquisition of a B-function by one of the consonants in a cluster (cf. Bell 1978: 167), e.g. /rt/ \rightarrow /ṛt/. Bell (1978) quotes Czech syllabic ṛ, ḷ, m̄ as having possibly derived in some cases from plain r, l, m e.g. /krve/ > /kṛve/, /vedl/ > /vedḷ/, /bratr/ > /bratr̄/, /sedm/ >

²¹⁵ But there are also words like Czech /sm̄ṛt/ 'death' (cf. Polish *śmierć*), in which a consonantal beat is accompanied by a cluster of consonants.

²¹⁶ And not from a syncope of any beat, since an N cannot reduce to give rise to yet another N; thus, */sm̄ṛt/ \rightarrow /sm̄t/ is impossible).

/sed̩/ (reductions as in /modl/ > /mod/, or Polish *brat* support this analysis²¹⁷). However, as Bell (1978: 167) states, this source of N's is "highly disfavoured".

17.2. Pre- and post-lexical consonantal beats

A universal preference is not to have consonantal beats in a language. This preference may already be overridden in a language-specific fashion on a pre-lexical level, or only post-lexically. So, e.g. in Czech or Serbian and Croatian, consonants already function as beats pre-lexically (e.g. /r/ in Cz. /p̩rst/ 'finger', /k̩rst/ 'baptism'; S-C. /k̩rk/ 'name of an island', /vr̩t/ 'garden'). In English, consonantal beats might get lexicalized as a result of a generalization of a post-lexical process e.g. /l/ in /lit̩/ < [lit̩]. Post-lexically, a function of a beat may get shifted to a neighbouring consonant if a vowel is lost, in order to preserve the rhythmic structure as well as the phonotactics of a sequence, e.g. English *happen* → ha[p̩m], Polish *wszystko* → [f̩sko] 'everything', and the like.

17.3. Predictions of the B&B model concerning consonantal beats

A consonant is likely to become a beat when: (a) it appears in a dispreferred cluster (e.g. after syncope) (b) it will, as a beat, contribute to the creation of an n→N or N←n binding²¹⁸ (i.e. a consonantal beat N with a less sonorous consonant²¹⁹). E.g., syllabic /r̩/ in /atr/ will contribute to the creation of a n→N, and in /rta/ - to the creation of an N←n, while it will NOT tend to become a consonantal beat in /art/, which would result in an impossible *{BN} sequence or in /tra/, which would result in an equally impossible *{nNB}²²⁰. The conditions (a) and (b), however, are not sufficient for any consonant which fulfills them to necessarily become a beat: so, e.g. in Polish, 100% of word-final /-dw/ clusters in Dunaj's data (Dunaj 1985: 33) reduce to /d/ (which in turn undergoes word-final devoicing to [t]), e.g. *schudł* /sxudw/ → [sxut] 'he lost weight'.

Since n→B > B←n (i.e. n→B binding is preferred to B←n binding) and B > N (i.e. a vocalic beat is preferred to a consonantal one), {nB} > {Bn} > {nN} > {Nn}. The preference {nN} > {Nn} finds support in many languages.

- (1) In Sanskrit, the preferred roots were of the {nN}-shape, i.e. /apr̩/, and not /r̩pa/.
- (2) After the loss of yers, Old Church Slavonic still retained a preference for {nB} and {nN}.
- (3) Comparing: Czech /v̩k/, dim. /v̩ček/ > Grm. *Wiltsek* vs. Serb.Croat. /vuk/; or Serb.Croat. /sr̩b/ > Grm. *Serb/e*, Hung. *Szerb*, Pol. *Serb*; or Serb.Croat. /hr̩vat/ > Hung. /horvat/, Grm. *Kroat/e*, Pol. *Chorwat*, one can observe the change from the original n→B binding to the n→N binding in the process of N-formation. The n→N binding thus created is often, in turn, rendered as {nB}, e.g. in the adaptation of foreign names.

²¹⁷ Although in their Indoeuropean predecessors the vowels were present.

²¹⁸ Once a consonantal beat N is created, it can feed further processes, e.g. in phonostylistics: in Germ. [ha:bm̩] (N-creation) → [ham̩] (inter-beat consonant reduction) → [ham] (N-loss).

²¹⁹ And, in the case of clusters of consonants neighbouring the N, if the relevant phonotactic preferences are observed.

²²⁰ Those sequences are impossible due to the qualitative difference between vocalic and consonantal beats. Whereas vocalic beats B's (which are preferred exactly due to their vocalic realization) may neighbour each other in a sequence (cf. Polish *aorta*), consonantal beats N's cannot, and also cannot be adjacent to vocalic B's.

- (4) In Serbian and Croatian²²¹, the only consonantal beat /r̥/ is distributed similarly to vowels, e.g. /j̥r̥vo/ like /jivo/, /s̥r̥/, /sḁs̥r̥/, like /so/, /sḁsu/, i.e. exactly parallel to n→B bindings (CV's). /r̥zḁsi/ like /uzak/, however, is also possible, i.e. an N←n binding (parallel to a B←n one).
- (5) Also in Czech, consonants tend to vocalize according to the {nN} > {Nn} preference. The two consonantal beats /r̥/ and /l̥/ do not appear at the beginning of a word, thus for example in /r̥čeni/ there are only two beats, in /rtut̥/ there is only one beat, so an N←n binding is avoided. In /tr̥n/, /pr̥st/, /p̥ln/, /v̥l̥č/, /m̥l̥č/, both n→N and N←n bindings are present. However, in /vitr̥/, /bratr̥/, /bobr̥/, /vichr̥/, /mysl̥/, /vezl̥/ (also /sedm̥/, /osm̥/ - poss. pronun. /sedum/, /osum/) only an n→N binding is present. Interestingly, /j/ blocks N-formation e.g. in /pejr̥/ (vs. /humr̥/, /vsiml̥/). Notice that /-jr̥/ observes the phonotactic preference for word-final clusters (cf. 5.3.2.). Therefore, no need for N-formation arises.
- (6) Vowel reductions in Polish phonostylistics appear to be controversial. On the one hand, according to the above discussed preference for n→N, *melodia* becomes [m̥l̥odia] after the loss of the first vowel, *federalnej* becomes [fed̥ralnej] etc. (cf. Rubach 1977: 73). Note, however, that in this way a new beat N is adjacent to a vocalic beat B, and thus a highly dysfunctional²²² sequence is created (cf. footnote 6 above). On the other hand, the data from Dressler & Madelska (1989: 85) point rather to the reductions towards [m̥l̥odia], [fed̥ralnej] or [f̥deralnej], /v̥ ogule/ → [vogle] (→ [vogle]) etc. In [m̥l̥odia] and [f̥deralnej], the non-adjacency condition is respected; also, the initial consonantal clusters would be bad initial doubles (cf. 5.3.1.). In [fed̥ralnej] and [vogle], however, N's and B's are adjacent. Those variants may constitute an intermediate stage before a complete loss of an N-beat, when the "new" medial clusters -dr- and -gl- start to be treated according to their status, i.e. as initial doubles (they are both good initials, cf. 5.3.1.).

We stated above that {Bn} > {nN}. The reversal of this preference is possible in languages in which consonantal beats have an equal status to vocalic ones. In Serbian and Croatian, /r̥/ has vowel features, e.g. length and distinctive intonation; it is also, as already mentioned above, distributed in the same positions as vowels. It is evident that in /sḁs̥r̥/, an n→N binding /s̥r̥/ is stronger than a B←n one /ḁs̥/, since otherwise /r̥/ would be weakened or lost altogether (cf. Pol. *wiatr*). The same holds for an already mentioned subset of words containing N's in Czech, i.e. /vitr̥/, /bratr̥/, /bobr̥/, /vichr̥/, /mysl̥/, /vezl̥/ etc.

Further, one would expect long (=double) beats to be preferably vocalic, i.e. BB > NN. This is confirmed by the observation that long consonantal beats (NN) are allowed when N's have the same status as vowels in a language, as e.g. in Serbian and Croatian²²³, but not in Czech. Although length is the only relevant feature of Czech vowels, /r̥/ and /l̥/ cannot be long, which is seen best when the length is expected morphologically e.g. in dim. formation: hrad - hr̥adek, les -(l̥esek-) l̥isek, dub -(d̥ubek-) d̥ubek, BUT: k̥r̥/k- k̥r̥/ček, s̥r̥/p- s̥r̥/pek, v̥lk- v̥l̥ček. It is also predicted that N+N hiatus will be avoided, just as B+B hiatus (or even more so, since B>N). Thus also the hiatus of N and B will be avoided (as already mentioned above). In Serbian/Croatian, consonantal beats do occur before and after a vowel (vocalic beat), but only

²²¹ The data on Serbian, Croatian and Czech are taken from Mares (1988).

²²² as well as counterintuitive

²²³ cf. also Macedonian and Slovenian /r̥/, Slovak /r̥/ and /l̥/.

across a morphological boundary, e.g. /umr̄+o/ (like /uma+o/), /ʃr̄+ax/, /na+r̄nem/. In connected speech it comes to "contraction" and the beat-status of the consonants disappears e.g. /umr̄+o/ → [umro] (like /zna+o/ → [zno]). A hiatus is thus liquidated giving priority to an n→B binding.

Summing up, the distribution of consonantal beats N's observes and is predictable from the basic preferences of B&B phonology, i.e. the preference for the vocalic beat and the preference for the n→B binding over the B←n one (n→B > B←n), as well as from the qualitative difference between N's and B's.

CONCLUDING REMARKS

The present monograph sought to introduce and develop a model of Beats-and-Binding phonology, embedded in the epistemological framework of Natural Linguistics. The intention was to show that:

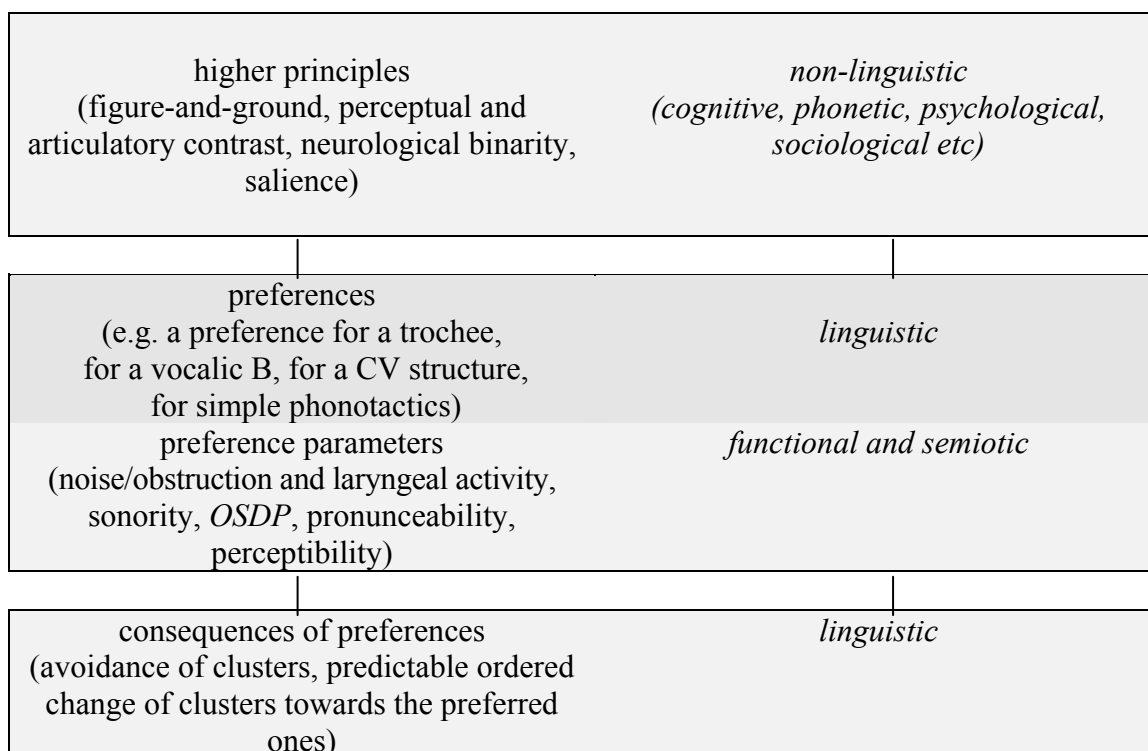
- (a) phonology can provide a syllable-less account of representations and processes, and that this account is more comprehensive and better principled than an account in which the syllable is taken as a basic rather than epiphenomenal unit of structure,
- (b) measures and formalisms can be derived from the principles of Natural Linguistics without harm to the theory,
- (c) it is possible to derive universal phonotactics within the model presented and that all the phonotactic well-formedness conditions go back to one single principle (in contrast to syllable-based phonotactics, which refers to multiple and partly contradictory principles), and
- (d) external evidence provide support on a par with internal evidence for the present model while they are both simultaneously its explanandum.

As far as (a) above is concerned, Beats-and-Binding phonology operates with the units called beats (B's) and the relations called bindings. Universal phonotactic preferences follow directly from the binding preferences. With the fundamental concepts of beats (B's), bindings and phonotactic preferences, B&B phonology displays high predictive and explanatory potential when confronted with both language internal and external evidence. The syllable has been shown to be epiphenomenal in the B&B approach to phonology and thus at most to be a consequence of the operation of the B&B preferences, but never their domain or trigger.

Discussion has concentrated on those areas which used to constitute a favourite playground for syllable-based explanations in phonology. Needless to say, sources of internal and external evidence have been treated selectively and not exhaustively. Language-specific phonotactics has been treated preliminarily and requires further and more typologically diversified data. Still, Beats-and-Binding phonology has been demonstrated to offer a promising new line of phonological research, devoid of the traditional bias towards the syllable. Indeed, neither internal nor external linguistic evidence convincingly supports the notion of the syllable or the proposed syllabic constituents. Recent developments in phonetics have signaled a shift away from traditional units like the phoneme and the syllable towards other operationalizing notions like gestures or units such as the V-to-V one. Numerous trends in modern phonology have in some way or other dispensed with the syllable or let the functions previously assigned to it be executed by a different unit, e.g. by the mora. Many have kept the syllable in their theoretical frameworks or descriptions as if "in reserve", from force of habit. Beats-and-Binding phonology introduces an alternative, syllable-less account of the organization of sound structure.

In order to realize postulate (b) above, the B&B model has first of all been grounded in the functional principles of Natural Linguistics. The way in which the explanatory framework

of Natural Linguistics can be envisaged has been shown in Chapter Four. Below, the same explanatory system is shown as applied in Beats-and-Binding phonology.



The explanatory system of Natural Linguistics for B&B Phonology

The above graph reminds us that:

- B&B phonotactics is quantified (by means of *OSDP*, i.e. Optimal Sonority Distance Principle) and formalized (via well-formedness conditions, representations of sequences, Cluster Spaces)
- phonotactic well-formedness conditions (which define the preferred distributions of clusters) are derived from B&B preferences
- B&B preferences are derived from principles and preferences of Natural Linguistic theory

This implicational sequence means that quantification and formalism of B&B phonotactics are derived from Natural Linguistic theory, and thus do not contradict it.

With reference to postulate (c) concerning universal phonotactics, phonotactic well-formedness conditions formulated in the B&B model have been based on the *Optimal Sonority Distance Principle*, and *not* on the Sonority Sequencing Principle. In Chapter 5 I summarized the weaknesses of the Sonority Sequencing Principle in order to prove that *OSDP* makes substantially more refined predictions about the relative goodness of clusters than does the SSP. Furthermore, the status and behaviour of a cluster is predictable *solely* on the basis of the *Optimal Sonority Distance Principle*, i.e. the *same* principle applies in all cases. This is a substantial advantage in comparison to phonotactic constraints based on the syllable, since in the latter case many different (and contradictory) syllabification principles need to be called for in order to explain varying behaviours of clusters.

Universal Cluster Space constitutes a matrix against which language-specific phonotactics can be described. More importantly, it also allows for the evaluation of the phonotactics of a given language. In particular, the so-called more stable clusters as well as the less stable ones

can be distinguished, and thus predictions can be made as to their behaviour in language use, acquisition and change.

These predictions, as well as other more general predictions of Beats-and-Binding Phonology, have been subject to testing and verification against internal and external evidence. This is a link to postulate (d) above, the last of the four major postulates of this monograph. By surveying a large number of diversified internal, historical and external sources of data, an attempt has been made to demonstrate the B&B model's potential to explain phonological phenomena. This in turn provides support for the model itself. On the one hand, Beats-and-Binding Phonology allows for a substantially more holistic picture of universal and language-specific phonology than a model constrained by syllable-driven explanations. On the other, both in terms of content and form, B&B Phonology is a purposeful extension of Natural Phonology, and as such, hopefully, increases the explanatory potential of Natural Linguistic theory.

ENGLISH AS L2: APPENDIX WITH TEST ITEMS.

1. Edo	2. odour	3. obey
4. ever	5. over	6. aha
7. itchy	8. atchoo	9. ajar
10. any	11. emu	12. ole
13. away	14. edit	15. epoch
16. again	17. acid	18. easing
19. ahead	20. itching	21. agent
22. adjoin	23. image	24. Amis
25. enough	26. Arab	27. oral
28. arise	29. earwig	30. awake
31. figure	32. baby	33. decay
34. busy	35. daisy	36. defy
37. Fuji	38. feature	39. mature
40. demo	41. coma	42. canoe
43. gala	44. holy	45. rely
46. kiwi	47. nowhere	48. beware
49. cabin	50. modus	51. debug
52. Kevin	53. Mavis	54. deceit
55. gadget	56. cogent	57. digest
58. comic	59. female	60. demean
61. merit	62. folic	63. delayed
64. wayward	65. reward	66. cable
67. fatal	68. weapon	69. devil
70. basin	71. pidgin	72. final
73. persuade	74. parsnip	75. parsley
76. forefront	77. refrain	78. hydrant
79. redress	80. between	81. review
82. module	83. deduce	84. manure
85. dilute	86. display	87. costume
88. tipsy	89. fifty	90. poncho
91. textile	92. solstice	93. husband
94. cosmic	95. pockmarked	96. vulgar
97. helmet	98. ghastly	99. pamphlet
100. belfry	101. bumptious	102. semblance
103. juncture	104. gangling	105. penguin
106. poultry	107. chopsticks	108. monster
109. postman	110. minstrel	111. cistern
112. diction	113. lantern	114. bungle
115. dismal	116. gospel	117. sample
118. medley	119. wedlock	120. bingo
121. hunger	122. salvage	123. velvet

124. concord	125. monkey	126. panda
127. candid	128. value	129. volume
130. canyon	131. union	132. distract
133. restrain	134. gastric	135. pastry
136. custom	137. pasta	138. pastime
139. postage	140. restive	141. restore
142. sustain		

GERMAN AS L2: APPENDIX WITH TEST ITEMS.

kaputt	Wetter	warten
Redner	wechseln	Fenster
Dampfer	furchtbar	Vater
Wasser	linken	täglich
Anlaß	borstig	Karpfen
pünktlich	reden	kommen
finden	Liebling	Muster
dünsten	Klempner	Landstrich
Tropen	Morgen	möglich
Aspekt	Hälften	knusprig
mögen	flüssig	Renten
Diplom	tragbar	Kränzchen
komplett	gabeln	futtern
Gurken	Fabrik	basteln
zärtlich	Laken	Balsam
weiblich	Botschaft	stündlich
lachen	Stempel	flagrant
Dichtung	Rentner	laufen
Bandit	friedlich	duften
Porträt	waschen	bilden
Geschlecht	Faktum	plumpsen
füßen	dulden	getrost
rutschen	murksen	Gehalt
Falken	Kitzler	klopfen
Katzen	Falter	Wagnis
schwärmen	sitzen	Fremden
Prisma	Prospekt	galant
Kerzen	Priester	Poren
Bericht	kamen	bringen

APPENDIX. Facsimile of the questionnaire form

Computer file extension questionnaire

Dear Respondent!

File extensions are three-letter strings following the name of the computer file. Their function is to code the type of the file and to serve as a mnemonic. For example, one of the best known such extensions is **.doc**, which is used with MS Word **documents**, e.g. syllabus.doc.

Another is **.exe**, used to code **executable files**, e.g. msword.exe.

Sometimes there are many options to compress a word to a three-letter extension. For example, **configuration** files have different extensions: .cfg or .cnf. In this questionnaire you are asked to choose one of the provided extensions for a given word. Just circle the extension of your choice. If you make an error, simply cross the circle and put a new one.

Your choice will help computer scientists to create good, user-friendly extensions. Thank you for your cooperation!

<i>wolfram</i>	.wfr	.wlf	
<i>vintner</i>	.vnt	.vtn	
<i>tincture</i>	.tct	.tnc	
<i>symptom</i>	.spt	.smp	
<i>semblance</i>	.smb	.sbl	
<i>sculptor</i>	.scp	.set	.scl
<i>prostrate</i>	.pst	.ptr	
<i>plankton</i>	.pkt	.pnk	
<i>muskrat</i>	.msk	.mkr	
<i>minster</i>	.mns	.mst	
<i>doctrine</i>	.dtr	.dct	
<i>culprit</i>	.clp	.cpr	

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