Cross-linguistic Challenges for the Prosodic Hierarchy: Evidence from Word Domains

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Abstract

In Prosodic Phonology, domains for the application of phonological patterns are modeled as a Prosodic Hierarchy whose architecture is characterized by adherence to the Strict Layer Hypothesis. The theory predicts, among other things, that i) prosodic domains cluster on a single universal set of domains ('Clustering'), and ii) no level of prosodic structure is skipped in the building of prosodic structure ('Strict Succession'). In this paper, we report some of the results from a large-scale typological survey on the empirical evidence of word domains which challenge this theory. First, in languages where a prosodic word domain cannot be motivated, Clustering and Strict Succession are violated. We substantiate this claim by an in-depth study of word structure in Vietnamese. Second, languages in which multiple domains between the foot and the phonological phrase can be motivated constitute another deviation from Clustering. This point is illustrated by a detailed examination of the multiple word domains in Limbu. We conclude that the theory does not correspond well to the cross-linguistic evidence and advocate an alternative approach in which prosodic domains are conceived of as intrinsic and highly specific properties of individual rules or constraints.

1. Introduction

A crucial aspect of phonological patterns is the domain in which they apply. The massive body of research in Prosodic Phonology, the branch of phonological theory which is devoted to the study of such domains, culminates in a prosodic hierarchy summarized in the figure in (1).

(1) The Prosodic Hierarchy (Selkirk 1980, 1984; Nespor and Vogel 1986; Hayes 1989)

Prosodic Domain	Phonological Patterns	Mapping
U	e.g. Final Lengthening	syntactic information
|		
I	intonation contours	
|		
P	postlexical processes	
|		
C	clitic-specific processes	morphosyntactic information
|		
ω	minimality, phonotactics, etc.	morphological information
|		
φ	stress, rhythm	phonological information
|		
σ	phonotactics	
|		
μ		

In the most elaborate version of the prosodic hierarchy, eight levels provide the theoretical framework for the analysis of prosodic domains: the mora (μ), the syllable (σ), the foot (φ), the prosodic word (ω), the clitic group (C), the phonological phrase (P), the intonational phrase (I) and finally the utterance (U). The respective domains are referenced by

phonological patterns of which the most common are given the second column of Figure 1.[1] Whereas the lower constituents in this hierarchy are defined purely phonologically, all constituents from the prosodic word upwards are mapped onto morphological, morphosyntactic or syntactic structure structure. Whereas the mora and the syllable define the domains of stress and are the loci of internal phonotactic generalizations like the Sonority Sequencing Principle (Blevins 1995), the foot forms the domain for rhythm generalizations (Hayes 1995). The prosodic word is mapped onto morphological structure, e.g. a stem and its affixes, and is characterized by minimality constraints, phonotactic generalizations and the application of phonological processes (Peperkamp 1997, Hall and Kleinhenz 1999). The clitic group has been proposed to account for phonological patterns which are restricted to combinations of a host word and a clitic, for example the Latin clitic stress rule (Nespor and Vogel 1986: 160ff.). The phonological phrase and the intonational phrase reference syntactic phrases or clauses and provide constituents for postlexical processes and intonation contours, respectively. Finally, the utterance, as the largest domain in the hierarchy, accounts for phonological processes such as utterance-final lengthening, which applies across constituents and spans sentences. Although the prosodic hierarchy interacts with morphosyntactic structure, the theory does not assume that prosodic and syntactic structure are always isomorphic. Quite to the contrary, mismatches between these modules of grammar justify the formulation of Prosodic Phonology as a component in its own right (Nespor and Vogel 1986).

With respect to the universal status of the prosodic hierarchy, several opinions have been articulated. Whereas Selkirk (1980: 109) considers it a "universal repertory of domain types from which languages may draw", Nespor and Vogel (1986: 11) assume that the phonology of a given language must include all of the levels. They motivate this assumption by two theory-internal arguments. First, a theory that requires all languages to have all

[1] In standard terminology, a prosodic domain is said to be "motivated" by phonological rules or phonotactic generalizations. However, as we will show in this paper, it is problematic to consider prosodic domains as existing independently of given rules or constraints, a view which is implicit in the 'motivation' metaphor.

domains is stronger than a theory which allows for the omission of a domain within the phonology of a given language. Secondly, since Prosodic Phonology relies on the interaction of different components of grammar, the absence of a prosodic domain would imply the absence of interaction between the components of grammar. This would be undesirable for the overall architecture of a grammatical theory. On the other hand, many of the proposed levels of prosodic structure have been disputed on the basis of both theoretical considerations and language-particular evidence. Nespor and Vogel (1986: 72ff.) discarded the necessity of a sub-syllabic level like the mora. Hyman (1982) and Auer (1994) have defended analyses of the prosodic structure in Gokana and !Xóõ, respectively, in which the syllable plays no role, casting doubt on its status as a universal prosodic category. With respect to the prosodic word level, Hayes (1980: 95f.) notes that some languages can be described as lacking word stress, for example West Greenlandic, suggesting that the construction of a word tree in metrical structure is optional in universal grammar. In her reanalysis of the dichotomy between syllable- and stress-timed languages, Kleinhenz (1996) even claims that the absence of the phonological phrase is characteristic for the latter language type. Finally, in Selkirk's (1980: 124) analysis of the phonological domains in Sanskrit the intonational phrase cannot be motivated and is skipped in prosodic tress.

These occasional discussions notwithstanding, the only prosodic domain whose universal status has been seriously challenged is the Clitic Group. This domain has been proposed by Nespor and Vogel (1986) and survives in some more recent analyses, for instance Kabak and Vogel's (2001) analysis of Turkish word stress. But a number of researchers reject the concept and argue for other mechanisms in the prosodization of host-clitic combinations, for instance prosodic integration, prosodic incorporation, or recursivity (Zec 1988; Inkelas 1989; Zec and Inkelas 1991; Zec 1993; Selkirk 1995; Booij 1996; Peperkamp 1997; Inkelas and Orgun 2003; Zec 2005).

Apart from offering the domains listed in (1) as analytical tools, the standard theory of Prosodic Phonology also makes predictions with respect to the architecture of phonology. Essentially, these can be summarized under the cover terms Clustering, Strict Succession, and Proper Bracketing, which together constitute the Strict Layer Hypothesis (Selkirk 1984). The Clustering Hypothesis states that phonological domains cluster on the single universal set of domains enshrined in the prosodic hierarchy. In other words, it predicts that, within and across languages, phonological patterns from different phonological tiers, such as phonotactics, segmental and suprasegmental phonology, will be sensitive to these eight domains and not more (Inkelas and Zec 1995: 547f.). The Strict Succession Hypothesis predicts that in the building of prosodic structure none of the levels of the hierarchy can be skipped, i.e. that each level *L* is followed by a level *L*-1 until the terminal level *L*=0, i.e. the mora. Accordingly, any unit of the prosodic tree will be composed of one or more units of the immediately lower unit, for example, a prosodic word can only be composed of one or several feet, but not of one or several syllables (Nespor and Vogel 1986: 7). Finally, since it is assumed that a unit of a given level of the hierarchy is exhaustively contained in the superordinate unit of which it is part, the theory predicts that all phonological domains will show Proper Bracketing and that no language will exhibit non-stacking domains (Nespor and Vogel 1986: 7).

Whereas most work in Prosodic Phonology accepts these three hypotheses as established and uncontroversial assumptions, some contributions question the universal validity of and the empirical basis for such generalizations. As Inkelas and Zec (1995: 548) put it, "[w]hile the predictions are clear, in practice the evidence is less so." In agreement with a growing body of literature that challenges many traditionally accepted phonological universals (e.g. Pierrehumbert 2003, Blevins 2004, Mielke 2004), we propose to submit the

predictions of the Prosodic Hierarchy to rigorous empirical testing. In this paper, we report some of the results from a large-scale typological survey that allows such testing.[2]

What we find in this survey challenges the theory in crucial ways: deviations from the predictions of the Prosodic Hierarchy hypothesis turn out to be the norm rather than the exception. First, as we will show in this paper, a prosodic word domain cannot be motivated in languages like Vietnamese and one would to have to assume that this level of prosodic structure is systematically skipped, in flagrant violation of the Strict Succession Hypothesis. Second, as we will also demonstrate, there are languages like Limbu, where multiple nonisomorphic word domains can be motivated on the basis of the encountered phonological processes. In the phonology of these languages, Prosodic Phonology has to assume several overlapping domains intermediate between the foot and the phonological phrase. Such non-stacking domains run counter the predictions of the Clustering Hypotheses.

To be sure, deviations from the predictions of the Prosodic Hierarchy have been noted before, and in Section 2 we discuss how such deviations have been analyzed in the past. We conclude that the proposed solutions capture only very specific kinds of deviations and may work well only if deviations were marginal phenomena. What our survey suggests, however, is that deviations are highly varied and that they are the cross-linguistic norm, not exceptions. To substantiate this claim, we report findings from our database, and in Section 3 and 4 we take Vietnamese and Limbu as representative examples of the survey and embark on in-depth analyses of their prosodic domains, thereby showing how we arrived at our quantitative cross-linguistic finding. In Section 5, we discuss the implications of these findings for the theory of the Prosodic Hierarchy and offer suggestions on how prosodic domains could be

[2] We gratefully acknowledge funding for this by the Deutsche Forschungsgemeinschaft (Grant No. BI 799/2-3). For a project description and ancillary material, including analyses of individual languages, see www.uni-leipzig.de/~autotyp > projects and > language reports. The database itself will be made public by the time of publication of this and related papers, presumably sometime in 2008.

typologized in closer correspondence to the cross-linguistic evidence. Section 6 concludes the paper.

2. Word Domains in the Prosodic Hierarchy

When deviations from the prosodic hierarchy are discussed in the literature, they are accounted for by listing exceptions in a finite list, by positing recursive domains, and by factoring out prosodic domains to different phonological tiers. We review these proposals in turn.

2.1 Finite Lists of Deviations

Early on, Nespor and Vogel (1986: 109-144) noted a number of complications which may arise in the prosodization of morphological structure and which may provide sources for deviations from the Clustering Hypothesis. The simplest type of phonology-morphology mapping is found in languages like Greek where a number of phonological patterns, such as Nasal Assimilation and Stop Voicing, cluster on a prosodic word which is coextensive with the grammatical word, i.e. the stem and all its affixes. However, in a substantial number of languages the prosodic word is mapped to morphological domains smaller than the grammatical word. In Hungarian, for instance, the prefix constitutes its own prosodic word with respect to vowel harmony, whereas stem and suffix are prosodized together as a separate prosodic word. A further complication arises when the prosodic integration of an affix depends on its membership to a specific lexical class, like in Dutch. With respect to syllabification, prefixes constitute their own prosodic word, e.g. (*ont.erven*) ‘to disinherit’,

whereas the prosodization of stems and suffixes varies. On the one hand, a number of stem-suffix combinations are prosodized as one prosodic word, e.g. (*roo.d-ig*) 'reddish'. Other such combinations, however, are parsed as two prosodic words, one which references the stem and one which references the suffix, e.g. (*rood*)-(*ach.tig*) 'red-like'. For the latter class of morphemes, Nespor and Vogel (1986: 140) have to stipulate a diacritic [+W] which marks the elements in questions as prosodic words in the lexicon. Under such an approach, deviations from the Clustering Hypothesis are thus handled by a finite list of diacritically marked morphemes (cf. Kabak and Vogel 2001 for a recent analysis of Turkish word stress which relies on lexical pre-specification). The various types of phonology-morphology mapping at the word level discussed above are summarized in (2).

(2) A typology of prosodic word domains (Nespor and Vogel 1986: 109-144)

Phonology-Morphology Mapping	Language
a. $(\text{prefix-stem-suffix})_{\omega}$	Greek
b. $(\text{prefixes})_{\omega}$, $(\text{stem-suffix})_{\omega}$	Hungarian
c. $(\text{prefixes})_{\omega}$, $(\text{stem-suffix})_{\omega}$, or $(\text{stem})_{\omega}$-$(\text{suffix[+W]})_{\omega}$,	Dutch

Although this list already opens up a number of options for cross-linguistic variation, Nespor and Vogel (1986: 110) deliberately discard a third option in the prosodization of the word, namely the possibility that the prosodic word is larger than the grammatical word. However, as other studies have convincingly demonstrated, this assumption has no empirical basis (see e.g. Dixon and Aikhenvald 2002). For instance, Booij (1995, 1996) demonstrates that enclitics in Dutch, which can be said to constitute grammatical words on their own, are integrated into the prosodic word domain of their host with respect to syllabification, Prevocalic Schwa deletion and Homorganic Glide Insertion.

2.2 Recursive Word Domains

Data from cliticization has also proved instructive with respect to other types of deviation from the prosodic hierarchy. Peperkamp (1996, 1997) presents a convincing analysis of stress assignment in host-clitic combinations in Neapolitan Italian by positing recursive word domains. This relaxes the notion of strict succession to a condition that level *L* dominates a level *L*-1 or *L*, instead of just *L*-1. The data in (3) illustrate the crucial data in Peperkamp's analysis.[3]

(3) Recursive word domains in Neapolitan Italian (Peperkamp 1996: 113)

a. $(((\text{cónta})_{\varphi})_{\omega}\ (\text{ténnə})_{\varphi})_{\omega}$

b. $(((\text{cónta})_{\varphi})_{\omega}\ (\text{tə})_{\sigma})_{\omega}$

c. $((\text{tənə})_{\varphi}\ ((\text{cóntə})_{\varphi})_{\omega})_{\omega}$

d. $((\text{tə})_{\sigma}\ ((\text{cóntə})_{\varphi})_{\omega})_{\omega}$

The stress assignment in these host-clitic combinations can be accounted for by formulating a single rule of stress placement, which puts stress on the rightmost trochaic foot in a word, and the recursive application of this rule on all word domains. In (3a) both the host *conta* and the clitic cluster *tenne* constitute trochaic feet. The phonology-morphology mapping will grant the host prosodic word status, and since this word consists of one foot only, it will take trochaic stress. The two enclitics constitute a foot on their own which is adjoined to the preceding prosodic word. The stress placement rule now applies again to the word domain which consists of the prosodic word and the clitic cluster with foot status. According to the

[3] Glosses for the elements in these examples are: *conta* 'tell (imp.)', *te* 'you' and *ne* 'partitive clitic'.

stress rule, which applies recursively on this second word domain, the rightmost foot of the prosodic word receives stress and the clitic cluster surfaces with a primary stress on its first syllable. This mechanism also accounts for the behavior of the unstressed singleton enclitic in (3b), which does not have foot status, and the unstressed proclitics exemplified in (3c) and (3d), which can never be the rightmost foot in a word. The crucial part of this analysis lies in the fact that the recursive domain is defined by one and the same rule, which applies at each level of recursion.

2.3 The Relevance of Phonological Tiers

Evidence from cliticization also draws attention to problems for the prosodic hierarchy which are caused by overlapping domains. Hyman et al. (1987) describe two phonological domains in Luganda which have formerly been treated as word domains in the literature. The first is characterized by the presence of only one high to low pitch drop and is referred to as the tone domain (TD). The second domain is defined by a rule of Final Vowel Shortening and is referred to as the quantity domain (QD). Under closer scrutiny, both domains turn out to be postlexical in including clitics, and the authors therefore analyze these domains as Clitic Groups. The examples in (4) illustrate the various constellations which are possible with respect to these prosodic domains.

(4) Tone and quantity domains in Luganda (Hyman et al. 1987: 100, 106)

a. QD $((\text{tú-ly-áá})_{\omega}\ (\text{kô})_{\omega})_{C}$ ‘we eat a little’

TD $((\text{tú-ly-áá})_{\omega}\ (\text{kô})_{\omega})_{C}$

b. QD $((\text{te-tú-ly-à})_{\omega})_{C}\ ((\text{mu-púùnga})_{\omega})_{C}$ ‘we don’t eat rice’

TD $((\text{te-tú-ly-à})_{\omega})_{C}\ ((\text{mu-púùnga})_{\omega})_{C}$

c. QD $((\text{tú-ly-á})_{\omega})_{C}$ $((\text{mú-púùnga})_{\omega})_{C}$ ‘we eat rice’

TD $((\text{tú-ly-á})_{\omega}$ $(\text{mú-púùnga})_{\omega})_{C}$

d. QD $((\text{te-tú-ly-àà})_{\omega}$ $(\text{kô})_{\omega})_{C}$ ‘we don’t eat rice’

TD $((\text{te-tú-ly-àà})_{\omega})_{C}$ $((\text{kô})_{\omega})_{C}$

The data in (4a) and (4b) are unproblematic since the tone domain and the quantity domain are isomorphic. In (4a), the host-final vowel is not affected by Final Vowel Shortening and the combination of host and enclitic can be said to constitute one quantity domain. With respect to tonal phonology, the structure which is referenced by Final Vowel Shortening is also characterized by a single pitch drop, i.e. it also constitutes one tone domain. In (4b), the construction is split into two quantity domains and two tone domains, respectively. Note that each of the domains exhibits a pitch drop and lacks a final long vowel. The interesting cases are those given in (4c) and (4d). In the former, the syntactic string is prosodized as two quantity domains but at the same time as one tone domain. In the latter, on the other hand, the words form one quantity domain but at the same time two tone domains. As Hyman et al. (1987) demonstrate, this data can only be handled within Prosodic Phonology if one assumes that different tiers of phonology, here the tonal and the skeleton tier, can constitute different domains.[4]

2.4 The cross-linguistic observation

Apart from the few cases just reviewed, the discussion of deviations from the Prosodic Hierarchy and the Strict Layer Hypothesis is mostly restricted to language specialists’ literature and the theoretical consequences are hardly ever addressed. In order to evaluate

[4] The actual formal representation of the dissociated tiers remains unclear in the summarized proposal.

whether the proposed solutions can be generalized cross-linguistically, we need to survey deviations systematically. Clearly, positing finite lists of exceptions (Section 2.1) is a non-starter for theory formulation if deviations are not caused by individual lexical items in individual languages but a general pattern. Positing recursive domains, and thereby relaxing the Strict Succession Hypothesis, will resolve deviations only if the evidence for multiple domains is based on a single process that can be analyzed as applying recursively (Section 2.2). If the evidence comes from different processes, e.g. tonal and segmental processes, mismatching domains cannot be analyzed as recursive structures. Finally, generalizing tier-specific domains (as in Section 2.3) as a universal principle makes the prediction that, if word-level processes do not cluster on a single domain, they cluster relative to tiers.

To further explore deviations, we surveyed 60 languages by collecting as much information as possible on their categorical, non-gradient phonological processes,[5] in many cases consulting primary data and/or experts. We further focused on maximal domains in contrast to minimal domains and excluded domains which are referenced by lexically specified processes. We then determined, for each process, what kind of morphological structure it references (stems, stems plus prefixes, stems plus clitics etc.). Of the 60 languages coded this way, we find only 14 languages where phonological processes cluster on a single domain between the foot and the phonological phrase (excluding all gradient, phrasal processes and all processes tied to specific lexical items). For 43 languages, we find phonological evidence for more domains than what is predicted by the Clustering Hypothesis. Of these 43 languages, most allow the motivation of two or three word domains (17 and 13, respectively) but 13 languages even evidence more than three domains. Finally, 3 languages

[5] By excluding gradient processes, we merely follow traditional assumptions in the literature on the Prosodic Hierarchy, making it harder for us to demonstrate multiple domains between foot and phrase. That said, we are not convinced that gradient processes should be treated differently from categorical ones: both need a specification of the domains in which they apply.

(Lahu, Car and Vietnamese) resist the motivation of a domain between syllable and phrase, if only purely phonological, lexically general rules are considered.

This survey suggests that languages with deviations from the Prosodic Hierarchy are more common than not, casting strong doubts on the validity of the theory. Obviously, this claim stands or fails with how well and how robustly we analyzed the languages in the survey. Instead of describing the generic coding methodology that we followed in our survey, we aim at demonstrating the robustness of our analyses by presenting two case studies in detail.[6] We concentrate on one language that deviates from the theoretical predictions by having less prosodic structure (Vietnamese) and one language that deviates by having more, and to some extent improperly bracketed prosodic structure (Limbu).

3. Challenge 1: Vietnamese, or the lack of prosodic word domains

In a number of languages, motivating a prosodic word domain on purely phonological grounds turns out to be non-trivial. For example, in a recent study on the word in Dalabon, a polysynthetic Australian language of Arnhem Land, Evans et al. (in press) apply a number of phonological tests for the definition of the prosodic word. Neither morphophonemic processes, such as vowel harmony, assimilation or dissimilation, nor phonotactic constraints nor suprasegmental processes, such as stress assignment, provide conclusive evidence for word boundaries. In their discussion of the relation between the grammatical and the prosodic word, the authors thus have to rely on pause placement and intonation contours. Note that within Prosodic Phonology pauses and intonation are usually taken to operate on the level of

[6] Further methodological discussion and more extensive quantitative analysis of our dataset is part of a companion paper currently in preparation.

the intonational phrase and not the word.[7] Although structurally very different, Vietnamese, a Viet-Muong language of Vietnam, poses a comparable problem to the universality of the prosodic word since on purely descriptive grounds "there is no significant unit in Vietnamese intermediate between the syllable and the phonological phrase" (Thomas 1962: 521). In order to investigate the status of the grammatical word and the prosodic word in this language, we will first summarize the morphological structure of Vietnamese. Secondly, we will analyze the prosodic structure of Vietnamese before we combine the evidence in a descriptively adequate prosodic hierarchy for the language.

3.1 Morphology and the structure of grammatical words in Vietnamese

Although the definition of the word in Vietnamese has stirred up some discussion (Thomas 1962; Thompson 1963; Noyer 1998), linguists working on the language usually agree on the point that on morphological grounds, one can isolate forms which show different degrees of morphological complexity and phonological length (Emeneau 1951; Thompson 1965; Dinh-Hoa 1997). The examples in (5) summarize the main options for the phonological shape of monomorphemic and polymorphemic words.[8]

(5) Possible word forms in Vietnamese (Thompson 1963: 50f., Nhàn 1984: 181)

	Monomorphemic	Polymorphemic
Monosyllabic	*sớm* 'early', *đi* 'go'	*đ-ây* 'here', *v-ầy* 'this way'
	có 'exist', *ghế* 'chair'	*n-ào* 'any', *s-ao* 'however'
Disyllabic	*Sài-gòn* 'town name'	*Mỹ-quốc* 'America', *bối-rối* 'perplexed'

[7] For a similar case where prosodic word boundaries seem to be equated with intonational phrase boundaries see Henderson (2002). See also Blevins (2001) for pause placement and the prosodic word in Yurok.
[8] While we use the rhetoric of morphemic analysis in this paper, none of our claims depends on whether one analyses morphological structure in terms of morphemes or by some other mechanism of feature realization.

	va-li ‘suitcase’	*bàn-ghế* ‘furniture’, *người ở* ‘servant’
Trisyllabic	*Thủ-dầu-một*, ‘town name’	*Liên-hiệp guốc* ‘United Nations’
	com-mi-nít ‘communist’	*ngôn-ngữ học* ‘linguistics’
Tetrasyllabic	*a-me-ri-ca* ‘America’	*vô-tuyến điện-thoại* ‘radio telephone’
Hexasyllabic	---	*bổi-rổi bổi-rổi bổi-rổi* ‘be very perplexed’

Monomorphemic words are most commonly monosyllabic. The few polysyllabic monomorphemic words are place names, e.g. *Sài-gòn* and *Thủ-dầu-một*, or loans, such as the French borrowings *va-li* ‘suitcase’ and *com-mi-nít* ‘communist’ and the English borrowing *a-me-ri-ca* ‘America’. Polymorphemic words, on the other hand, are most often polysyllabic. As we will see below, however, the morpheme analysis of the monosyllabic forms in (5) is not secure. Other morphologically complex forms are the result of the two productive morphological processes found in the language, viz. reduplication and compounding. For instance, *bối-rối* ‘perplexed’ is derived by the reduplication of the base *rối* ‘confused’ and *bàn-ghế* ‘furniture’ is formed by compounding the two stems *bàn* ‘chair’ and *ghế* ‘table’. The successive and recursive application of these processes yields forms which are even longer than two syllables. For instance, *Bổi-rổi bổi-rổi bổi-rổi* is the output of recursive application of reduplication on the base *bối-rối*, followed by successive repetition of this. *Vô-tuyến điện-thoại* is a compound which is composed of the two complex stems *vô-tuyến* ‘wireless’ and *điện-thoại* ‘telephone’.

The main rationale for considering the forms in (3) grammatical words is the fact that they can occur as basic free forms and that they have a conventionalized coherence and meaning. However, as we will discuss below, they are problematic with respect to other criteria which have been proposed in the literature, namely that of cohesiveness and of fixed

ordering (Dixon and Aikhenvald 2002: 19).[9] After having laid out the essentials of Vietnamese word structure, we proceed to the detailed characterization of the morphological processes in Vietnamese.

3.1.1 Affixation

In principle, affixation may contribute to the definition of both morphological and prosodic word domains. In many Mon-Khmer languages, for instance in Mon, the presence of a consonantal prefix conditions the phonation type register of the prefix-stem combination (cf. Bauer 1982). In Vietnamese, the only candidate for subsyllabic bound morphemes in the language is found in the deictic elements in the paradigm given in (6).

(6) Deictic elements in Vietnamese (Thompson 1963: 43; Thompson 1965: 142)

***đ**âu* 'anywhere, wherever'	***đ**ây* 'here'	***đ**ấy* 'there'
***n**ào* 'any, whichever'	***n**ày* 'this'	***n**ọ* 'another, that'
***b**ao* 'to whatever extent'	***b**ây* 'to this extent'	***b**ấy* 'to that extent'
***s**ao* 'however, in whatever way'	***v**ầy* 'this way, thus'	***v**ậy* 'that way, so'

On the basis of the resemblance between the deictic elements in each row, Thompson (1963, 1965) analyzes the recurring initial consonants as bound morphemes with a fixed meaning. In this analysis the prefix *đ-* attributes the meaning 'place, relative position' to the deictic elements in the first row. Accordingly, *n-* signifies 'particular referent' in second row, *b-* expresses 'to a certain extent' in the third row and *s-* ~ *v-* means 'in a particular way' in the fourth row. However, this analysis has been refuted by a number of authors, e.g. Nhàn (1984:

[9] The criteria for grammatical wordhood that we use here and in the following are the traditional ones, as discussed, e.g. by Bresnan & Mchombo (1995), Mohanan (1995), Harris (2002), Dixon & Aikhenvald (2002), Bickel & Nichols (2007), Bickel et al. (2007), among many others.

28f.), because the meanings associated with these initial consonants cannot be traced in other forms. It might be more appropriate to treat this phenomenon as a pattern of sub-morphemic resonance which structures the paradigm and may have diachronic relevance, but which does not entail a compositional semantic structure (a phenomenon dubbed 'eidemic', as opposed to 'morphemic' resonance by Bickel 1995 and Bickel and Nichols 2007; also cf. Janda and Joseph 1992 on 'meta-redundancy-rules'). If the doubts concerning the morphological segmentation of the monosyllables in (6) are justified we have to conclude that there are no monosyllabic polymorphemic forms in Vietnamese. Accordingly, unlike in other Mon-Khmer languages, the question whether prefix-stem combination constitute a special prosodic domain at the monosyllabic level does not arise.

3.1.2 Reduplication

Reduplication is a productive morphological process in Vietnamese and it expresses a number of categories, such as distributive, iterative, attenuative, intensive and emphatic (see Thompson 1965: 139ff. and Noyer 1998: 80f. for a summary). The various reduplicative patterns with prefixed and suffixed reduplicants are given in (7). In what follows, we underline the bases of the reduplicated forms.

(7) Patterns of reduplication in Vietnamese (Thompson 1965: 139f.)

	Prefixed	Suffixed
Alliterative	*la-<u>lết</u>* 'do with much pain'	*<u>rõ</u>-rệt* 'be very clear'
Riming	*bối-<u>rối</u>* 'be uneasy, troubled'	*<u>khóc</u>-lóc* 'cry, whimper'
		<u>sạch</u>-nhách 'be absolutely clean'
Vocalic	*lếu-<u>láo</u>* 'be ill-mannered'	*<u>mập</u>-mạp* 'be fat, chubby'
Tonal	*bứ-<u>bự</u>* 'be very big'	*<u>đen</u> đẻn* 'be rather black'

Complete	*noi noi* ‘keep talking and talking’ (*noi* ‘talk’)
	sạch sạch ‘be rather clean’ (*sạch* ‘be clean’)

In alliterative reduplication, only the onset of the base is copied to the prefixed or suffixed reduplicant. Riming reduplication is characterized by the fact that the rime of both base and reduplicant are identical. In some cases the tone of the reduplicant changes in the process. Comparing the two constituents in vocalic reduplications, we see that everything except for the vowel is repeated in the reduplicant. In tonal reduplication everything except for the tone is retained in the reduplicant. Finally, since both members of complete reduplications are entirely identical, we cannot decide whether the reduplicant is prefixed or suffixed in disyllabic forms. Apart from the segmental resemblances these forms show they are also characterized by tone harmony, i.e. base and reduplicant agree with respect to the register of their tone. We will discuss this issue in some detail below.

As noted above, the various processes of reduplication may apply successively and/or recursively on a base, yielding output forms of considerable length. Consider the examples in (8).

(8) Multiple reduplication in Vietnamese (Nhàn 1984: 247-249)

a. *lục*	→	*lục-lọi*	→	*lục-lục-lọi-lọi*
‘search’		‘search inside out’		‘search over and over’
b. *ngầm*	→	*tầm-ngầm*	→	*tẩm-ngẩm-tầm-ngầm*
‘underground’		‘very secret’		‘extremely secretive’

In (8a), alliterative suffixing reduplication applies on the base *lục* in the first step of the derivation. The output is again input to a rule of total reduplication applying to both members

of the base *lục-lọi*, yielding the form *lục-lục-lọi-lọi*. In (8b), riming prefixing reduplication operates on the base *ngầm* in the first step of the derivation. The output of this process *tầm-ngầm* is then input to tonal prefixing reduplication which results in the form *tẩm-ngẩm-tầm-ngầm*. With respect to the degree of complexity which reduplications can exhibit, this morphological process behaves like the other productive morphological process in the language, namely compounding.

3.1.3 Compounding

Stems can be combined in a number of ways to derive compound words. Thompson (1965) distinguishes two major types of compound structures in Vietnamese, syntactic compounds, which parallel phrases, and non-syntactic compounds, whose structure is not paralleled by syntactic phrases. The examples in (9) represent the various types of compounds found in the language.

(9) Types of Compounds in Vietnamese (Thompson 1965: 126ff.)

Syntactic	Non-syntactic
a. *bàn-ghế* 'furniture'	b. *sợ-hoảng* 'be terrified'
(*bàn* 'table' + *ghế* 'chair')	(*sợ* 'be afraid' + *hoảng* 'be panic stricken')
~ *bàn ghế* 'tables and chairs'	
c. *người ở* 'servant'	d. *học trò* 'schoolchild, pupil'
(*người* 'person' + *ở* 'be located')	(*học* 'to study' + *trò* 'school-age child')
~ *người ở* 'person residing'	

Cross-cutting the distinction between syntactic and non-syntactic compounds, a distinction can be made between coordinative (i.e. dvandva) formations, in which both elements are

weighted equally, and adjunctive formation, which show internal complement-head structure (Nhàn 1984: 270ff.). The generalizing compound in (9a) and the reinforcing compound in (9b) can be said to consist of two coordinated heads. The specializing compound in (9c) and the attributive compound in (9d) consist of a head and a modifier. In the former, the first element is the head and the second element is the modifier, in the latter the second element is the head and the first element is the modifier. Some compound-like structures, such as *quốc-gia* 'nation, country' (*quốc* 'nation' *gia* 'household, establishment'), are exceptional in sofar as their components only appear in compound structures. Thompson (1965: 120) calls them 'pseudo-compounds'.

Compounds can recursively undergo further compounding, such that the combination of various elements leads to word forms of considerable morphological complexity and length. The examples in (10) show structures in which three and four elements are combined to form a morphologically complex word.

(10) Multiple compounding in Vietnamese (Thompson 1965: 136f.)

a. *ngôn-ngữ học* 'linguistics'

(*ngôn* 'speech, word' + *ngữ* 'language' + *học* 'to study')

b. *vô-tuyến điện-thoại* 'radio telephone'

(*vô* 'without' + *tuyến* 'wire' + *điện* 'electricity' + *thoại* 'speech, conversation')

In the derivation of the word in (10a), the two bound forms *ngôn* 'speech, word' and *ngữ* 'language' are combined to yield the compound *ngôn-ngữ* 'language', before this latter form is compounded with the stem *học* 'to study'. The second derivation in (10b.) involves the combination of *vô* 'without' and *tuyến* 'wire' yielding the compound *vô-tuyến* 'wireless' and the combination of *điện* 'electricity' and *thoại* 'speech, conversation' yielding the compound

điện-thoại ‘telephone’. These forms are again input to a rule of compounding which results in the complex form *vô-tuyến điện-thoại* ‘radio telephone’.

3.1.4 Grammatical wordhood

The outputs of reduplication and compounding often have conventionalized meanings that are no longer compositionally derived. From this point of view, the forms would seem to qualify as unitary grammatical words. But the forms fail on other conventional criteria of grammatical wordhood as terminal nodes in the syntax, such as non-interruptability and ordering constraints. In Vietnamese, polysyllabic strings with a conventional meaning can regularly be interrupted by phrasal elements, regardless of whether the strings consist of one or more morphemes. The data in (11) illustrate this by examples with monomorphemic, reduplicate and compound strings.

(11) Interruptability of Vietnamese words (Nhàn 1984: 6; Noyer 1998: 82)

a. *cà-phê* ‘coffee’ vs. *cà với phê* ‘coffee and the like’

b. *đo đỏ* ‘reddish’ vs. *đo không đỏ* ‘not reddish’

c. *nhà cửa* ‘house, home’ vs. *Tôi xay nhà xay cửa* ‘I build a house’

In (11a), the monomorphemic French loan *cà-phê* ‘coffee’ is split by the conjunction *với* ‘with, and’, which is inserted between the two syllables of the string. The constituents of the reduplication *đo đỏ* ‘reddish’ in (11b) may also be separated by another phrasal element, in this case, the element *không* ‘not’. The insertion of *với* and *không* could *prima facie* also be analyzed as endoclisis (Harris 2002; Bickel et al. 2007). But such an analysis would not carry over to (11c). Here, the two constituents of the compound *nhà cửa* ‘house, home’ appear in interlocking order with the adjacent verb *xay* ‘build’. In such sentential constructions, a

reduplicated twin of the adjacent word (*xay*) in the clause breaks the unity of the compound word. These data clearly cast doubt on the grammatical integrity of the forms.

In many languages, the constituents of grammatical words are subject to strict ordering constraints not found among phrasal elements. Vietnamese confronts us with variable orders like those illustrated in (12).

(12) Variable order in Vietnamese words (Nhàn 1984: 6; Thompson 1965: 130)

a. *quần-áo* vs. *áo-quần* 'clothes' (*quần* 'trousers' + *áo* 'tunic')

b. *chọn lựa* vs. *lựa chọn* 'to select' (*chọn* 'choose' + *lựa* 'choose')

c. *bổi-rổi bối-rối* vs. *bối-rối bổi-rổi* 'be troubled' (base: *bối-rối*)

d. *com-rom còm-ròm* vs. *còm-ròm com-rom* 'be emaciated' (base: *còm-ròm*)

The first two examples show two conjunctive compounds consisting of two nouns in (12a) and two verbs in (12b), in which the order of the constituents can be varied without a difference in meaning. In (12c) and (12d), we see reduplications with disyllabic reduplicative bases, *bối-rối* and *còm-ròm*, respectively. In the output form, the reduplicant of theses bases can appear either before the base or after it, without any semantic differentiation. Although it is not clear how common such variable orderings are in Vietnamese, the fact that such forms are possible speaks against strict ordering constraints for grammatical words in the language.

There are languages in which elements inside a grammatical word can freely permute (e.g. Chintang, Bickel et al. 2007). However, in Vietnamese, it is not even clear whether the domain of free permutation is a grammatical word: the only evidence that they are words is non-compositional semantics, but non-compositional semantics can obviously also be a property of phrases, as witnessed by idioms. Since, as we observed before, the syllables of polysyllabic strings can mix with phrasal elements even if they have a conventional and non-

compositional semantics, it is indeed likely that they are themselves terminal nodes in the syntax, and not subconstituents of terminal nodes. In line with this, Nhàn (1984) postulates the syllable as the minimal unit of grammatical analysis in Vietnamese. In the more recent analysis of Noyer (1998) the distribution of such *syllabemes*, the cumulation of the syllable and the morpheme, is governed by general rules of syntax, which operate across various levels of grammatical structure.

To conclude, there is no evidence that there are terminal nodes in the syntax longer than one syllable. Yet the question remains whether polysyllabic strings perhaps form prosodic word units.

3.2 Phonological Domains in Vietnamese

In order to find out whether polysyllabic strings of the kind discussed above form prosodic words, we review all known phonological properties of the language and discuss their relation to morphosyntactic structure.

3.2.1 The syllable

Traditionally, the study of Vietnamese phonology is primarily concerned with the syllable, which is the domain for phonotactic generalizations and the distribution of tone. The figure in (13) presents a schematized representation of the syllable structure in Vietnamese.

(13) The syllable in Vietnamese

Tone	
Initial	Rhyme
C	(w)V(V)(C)

Each syllable obligatorily starts with an onset consonant, traditionally referred to as the initial. The initial can be any consonant except for the bilabial, voiceless stop /p/. The rhyme consists of a vocalic (potentially diphthongal) nucleus that is optionally preceded by a glide /w/ and followed by a coda chosen from among a set of 8 segments (*p, t, k, m, n, ŋ, y, w*).

The syllable is also the tone-bearing unit in the language. Vietnamese distinguishes six tones: *ngang* (high level), *sắc* (high rising) and *hỏi* (low rising) can be grouped in class A, whereas *huyền* (low level), *nặng* (creaky falling) and *ngã* (creaky rising) can be grouped in class B.[10] Every syllable is realized with one of these six tones. With respect to the *sắc* and *nặng*, these tones have short allophones (called *sắc2* and *nặng2*, respectively) whose distribution is restricted to syllables which are closed by a stop consonant. This phonotactic constraint on the distribution of allotones underlines the interdependence of phonotactics and the distribution of tones at the level of the syllable.[11]

3.2.2 Tone Harmony

The realization of tones is remarkably stable in running speech, i.e. there are no tonal Sandhi rules which operate on phrasal or sentential levels (Pham 2003 for a recent analysis of Vietnamese tone). However, there are several patterns of reduplication in Vietnamese which result in polysyllabic forms which seem to exhibit tone harmony. Recall that the different reduplication patterns illustrated in (7) exhibit different correspondences between the base and the reduplicant, ranging from complete identity to partial segmental identity with respect to initial or rhyme or partial identity in tone register. Which reduplication process applies to which base cannot be predicted by general rules but the choice is determined by the lexical

[10] In Vietnamese linguistics, the two series of tones are traditionally referred to as the first or high register and the second or low register, respectively.

[11] Diachronically, the syllable served as the domain for the evolution of the Vietnamese tone system. Whereas the voicing contrast in the onset lay ground for the distinction between high and low register, the deletion of final /h/ and /ʔ/, respectively, resulted in additional tone distinctions in both registers (Haudricourt 1954).

class of the base. The data in (14) illustrate alliterative suffixing reduplications which result in disyllabic forms. These forms adhere to tone harmony.

(14) Tone harmony in Vietnamese reduplication (Pham 2000: 228)

a. *mau* 'fast' → *mau mắn* 'very fast'

b. *láu* 'clever' → *láu lỉnh* 'very clever'

c. *đỏ* 'red' → *đỏ đan* 'very red'

d. *vất* 'laborious' → *vất vả* 'very hard'

e. *tàn* 'worn out' → *tàn tạ* 'very worn out'

f. *lạnh* 'cold' → *lạnh lẽo* 'very cold'

g. *mỡ* 'greasy' → *mỡ màng* 'very greasy'

h. *ngặt* 'severe' → *ngặt nghèo* 'very hard'

The examples in (14a) to (14d) show reduplications of bases with class A tones, namely *ngang*, *sắc*, *hỏi* and *sắc2*, respectively. The tone of the second syllable in the reduplications is never identical to the one of the base, but in each case the tone of the reduplicant belongs to class A as well. Accordingly, we find the combination *ngang - sắc*, *sắc - hỏi*, *hỏi - ngang* and *sắc2 - hỏi*, respectively. The bases in the reduplications in (14e) to (14h) carry class B tones, namely *huyền*, *nặng*, *ngã* and *nặng2*. The tone of the reduplicant belongs to class B as well. Following the possibilities allowed for by tone harmony, we therefore get the tone combinations *huyền - nặng*, *nặng - ngã*, *ngã - huyền* and *nặng2 - huyền*, in order of appearance. Note that the examples in (14c) and (14d), in which the base of the reduplication is bisyllabic, tone harmony is also respected in the output form.

Since the rules of tone register harmony operate on forms which are the output of the morphological process of reduplication, the domain of their application is potential evidence

for the prosodic word domain (cf. for instance DiCanio 2005 who considers register harmony a characteristic of the prosodic word in Mon and Khmer). However, the postulation of such a domain on the basis of tone register harmony is problematic. Under the classical conception (e.g. Nespor and Vogel 1986; Peperkamp 1996), prosodic domains can only be motivated by phonological rules that are general across the lexicon. Tone register harmony in Vietnamese, however, is not general across the lexicon since a number of reduplications violate register harmony. For instance, although the reduplicated form in (14b) *láu lỉnh* 'very clever' obeys tone register harmony, there other reduplications, like *cứng-cựng* 'very hard', which combine a class A tone, namely *sắc* with the class B tone *nặng*. The crucial point here is that reduplications only show tone register harmony when they are derived by a reduplication process which relies on partial tonal correspondence of reduplicant and base. Whether a base will participate in such a process is a matter of lexical specification and not of rules that are general across the lexicon.

Another problem for analyzing forms as those listed in (14) as prosodic words comes from the fact that such strings are interruptible. Some relevant forms are given in (15).

(15) Interrupted reduplicative words in Vietnamese (Noyer 1998: 82)

a. *đo không đỏ* 'not very red'

b. *tin có xa tít* 'indeed very very far'

c. *gầy không gò* 'not very thin'

In (15a), prefixing reduplication of the *hỏi*-toned base *đỏ* 'red' gives the complex form which obeys register harmony in that the reduplicant carries the class A tone *ngang*. When the *ngang*-toned *không* is inserted into this reduplication, all syllables agree with respect to tone register. The same holds true when prefixal reduplication and the insertion of *có xa* 'indeed

far' yield a sequence of the class A tones *ngang-sắc-ngang-sắc* in (15b). If we assume that the bisyllabic reduplicative forms (such as *đo đỏ* 'very red') constitute a prosodic word in which register harmony applies, however, the data in (15c) are unaccounted for: here, the *ngang*-toned *không* breaks a combination of two class B tones, namely *huyền-huyền*. The harmony patterns would suggest that (15c) contains two prosodic words, (*gầy gò*)$_{\omega}$ with class B tones, and (*không*)$_{\omega}$ with a class A tone. If so, then (*không*)$_{\omega}$ would have to be analyzed as center-embedded into (*gầy gò*)$_{\omega}$, yielding the structure (*gầy* (*không*)$_{\omega}$ *gò*)$_{\omega}$. But this bracketing makes false predictions on tone harmony because the outer brackets would delimitate a word domain in which tone harmony should be respected. This is not case: as noted, *không* retains its non-harmonizing tone and thus blocks tone harmony within the higher domain. No recursive domain structure allows harmony rules to skip *không*.

The data in (15) are much easier to account for if reduplication is not seen as a word-bound process but is analyzed as a copy process in which segments and tone specifications are copied in a lexically specified way to create a new syllable.[12] In such an analysis, the first step in the derivation would copy the segments and the tone class properties of *đỏ* 'red' to provide the reduplicated syllable. Note that the tone in the reduplicant is neutralized to the unmarked member of class A, namely *ngang*, yielding *đo đỏ* 'very red'. Since the two syllables do not constitute a domain, elements such as *không* can be inserted between the two syllables in the second step of the derivation. This derivation results in the output form *đo không đỏ*. In such an approach, tone harmony would only be a side effect of the copying of tone features in the course of reduplication and would not define a prosodic domain in the strict sense (see also Raimy 2000; Inkelas and Zoll 2005).

3.2.3 The Phonological Phrase

[12] This has been suggested to us by Jochen Trommer.

Although the analysis of stress in Vietnamese still offers rich research opportunities, the consensus at this point is that stress is assigned at the level of the phrase. There are three degrees of stress: weak, strong, and heavy. The default stress rules inside a phonological phrase are i) that sequences up to three syllables alternate between weak and strong stresses and ii) that heavy stress is usually placed on the last syllable (Thomas 1962: 521). In other words, the basic pattern is one of iambic phrasing. The phonological phrases in turn are defined as pause groups, cf. (16).

(16) Phonological phrasing in Vietnamese (Thompson 1965: 107)

(ˈ*Nói*) (*phải* ˈ*có* *người*) (*nói* ˈ*đi*) (*nói* ˈ*lại*) (*chớ* ˈ*bắt*)

speak ought exist person speak go speak come prohibit constrain

(*người ta* ˈ*nói*) (*một mình* ˈ*hoài*)*!*

someone speak alone continually

‘For a conversation, [you] ought to have people talking back and forth, not make somebody talk alone all the time!’

The utterance in (16) consists of seven phrases which vary in phonological length from monosyllabic to trisyllabic. The first phrase consists of a word only, whereas the second one is made up of three syllables. Although phrase-final stress is the default, the placement of heavy stress within a phrase is ultimately governed by the semantic saliency of the elements within the structure. This principle accounts for the non-final stress in the second phrase of the utterance, in which the head *có* ‘exist’ receives heavy stress in penultimate position of the phrase. As we will see below, such cases of non-final stress placement are also evidenced in polysyllabic words.

Polysyllabic strings with monomorphemic, reduplicative, or compounding structure are all subject to exactly the same principles of stress assignment as *bona fide* phrases. (17) lists a number of such strings, with varying degrees of complexity.

(17) Stress in polysyllabic words in Vietnamese (Thompson 1965: 126ff.; Nhàn 1984: 101)

a. *va-ˈli* 'suitcase'

b. *nói ˈnói* 'keep talking and talking'

c. *mơ ˈmơ màng ˈmàng* 'deep in the state of dreaming'

d. *người ˈta* 'somebody'

e. *một ˈmình* 'alone'

f. *Liên-ˈhiệp quốc* 'United nations'

g. *hoa ˈhồng* 'rose'

h. *hoa ˈhồng* 'pink flower'

i. *Tôi không ˈbiết*. 'I don't know'

Stress assignment in monomorphemic words (17a) does not differ from that in reduplication (17b) and (17c) or in compounding (17d) to (17g). Since this stress assignment is also identical to that in the phrases (17h) and (17i), we can conclude that the phonological phrase is construed on a number of adjacent syllables irrespective of their internal composition. Note that the tetrasyllabic reduplication in (17c) is treated as two constituents for the sake of iambic phrasing.[13] (17f) illustrates another deviation from the default final stress. Here, the pseudo-compound has its origin in structural borrowing from Chinese. In such Sino-

[13] Iambic phrasing of tetrasyllabic expressions has also been described as the preferred rhythm of Vietnamese poetry, e.g. *Lạy ˈTrời mưa ˈxuống* 'I pray for the rain to fall' (see Liêm 1970).

Vietnamese compounds, stress is assigned to the left branch of the construction, in which stress is realized on the final syllable.

The examples in (17) all involve strings uttered in isolation. Comparing the two isolated realizations of the morphologically complex forms *người ta* 'somebody' and *một mình* 'alone' in (17d) and (17e) with their counterparts in actual phrasing in (16), we notice that within larger phrases, the last element is regularly stressed, whereas the compounds do not take heavy stress: *người ta* ˈ*nói* and *một mình* ˈ*hoài*, respectively. This observation provides additional evidence for the analysis of stress assignment as a phrase-level phenomenon in Vietnamese.[14]

3.2.4 The Intonational Phrase and the Utterance

So far we have encountered evidence for syllables and for phonological phrases in Vietnamese. The distribution of non-terminal and terminal intonation provides evidence for intonational phrases and utterances, respectively. The utterance given in (18) illustrates the relevant facts for this analysis.

(18) Intonation in Vietnamese (Thompson 1965: 108)

(*Tôi* ˈ*đến nha*), (*má* ˈ*tôi*) (*mở cửa* ˈ'*ra*), (*tôi* ˈ*vô*).

I arrive house, mother I open door exit, I enter.

'I arrived at the house, my mother opened the door, and I went in.'

[14] Thompson (1965) reports that the initial syllable takes weak stress in some compounds. For *một mình* 'alone' in (17) this analysis would entail that the word is characterized by a iambic pattern of a weak stress immediately followed by a medium stress. However, it is unclear if this stress assignment differs from other phrases in which the semantically less salient element receives weak stress. Another question concerns the status of weak stress assignment. Thompson (1965) describes it more as a tendency than as an obligatory rule.

The utterance in (18) comprises of three intonational phrases and four phonological phrases. The first intonational phrase is coextensive with the first phonological phrase. The comma indicates the realization of falling intonation on the final part of the phrase, which primarily signals the speaker's intention to continue. The second intonation phrase, which is again delimited by falling intonation, encompasses two phonological phrases with regular final heavy stress. The final syllable of the third intonational phrase is at the same time the final syllable of the utterance. The period represents the realization of fading intonation at the end of this utterance, which signals that the speaker assumes a certain result of his speech and allows the hearer to take his turn. In terms of prosodic domains, decreasing intonation can be viewed as a property of the intonational phrase, which maps onto syntactic units potentially containing more than one phrase, i.e. clauses. Terminal intonation, of which fading intonation is only one type, closes the phonological utterance which relates to the sentence.

3.3 Summary

As we observed in the preceding, Vietnamese has evidence only for a fraction of the prosodic domains predicted by the Prosodic Hierarchy. The syllable can uncontroversially be motivated on the basis of phonotactic constraints concerning the onset and the rhyme, the distribution of tone and the realization of stress. It proved particularly difficult to motivate a prosodic word domain on the basis of the available data. This is due to basically two problems which stem from the problems in defining the word in morphology and phonology.

The grammatical word as terminal node in the syntax has a dubious status since the individual syllables of monomorphemic, reduplicative or compounding strings allow variable ordering and can mix with phrasal elements. This suggests that Vietnamese syllables are

direct targets of syntactic operations, not shielded off from the syntax by a more complex grammatical word node (cf. already Emeneau 1951: 2-4, 44-45).

In phonology, no lexically general phonological rule is known to exclusively references polysyllabic strings, again regardless of whether these strings consist of a single morpheme, a reduplication or a compound. Tone harmony turns out to be a lexical stratum rule which only applies to specific kinds of reduplication. Stress assignment operates on the level of the phrase and does not respect any constituency between the phrase and the syllable. The conclusion which has been reached in the literature is that in phonology, the syllable boundary has to be equated with the word boundary (Nhàn 1984: 56).

Less problematic is the motivation of prosodic domains above the word level. Morphemes which are combined in morphologically complex words or syntactic phrases are characterized by a default iambic stress pattern which delimits the phonological phrase. Syntactic phrases and clauses map into non-terminal intonation contours, which demarcate the end of intonational phrases. Sentences, finally, map into phonological utterances which are closed off by terminal intonation contours realized on the final syllables of the construction.

The Vietnamese data can be summarized in a Prosodic Hierarchy which maps prosodic, morphological and syntactic domains, as in (19).

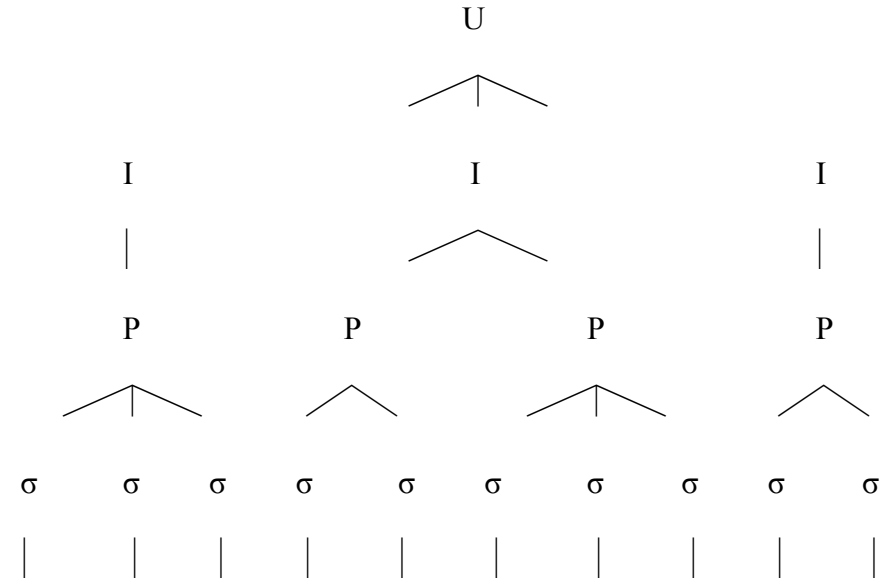
(19) A Prosodic Hierarchy for Vietnamese

Prosodic Domain	Phonological Patterns	Mapping
U	terminal intonation	sentences
|		
I	non-terminal intonation	clauses

|		syntactic phrases, polysyllabic
P	stress rules	monomorphemic strings,
|		compounds, reduplications
σ	phonotactics, tone-bearing unit, stress-bearing unit	

The prosodic tree in (20) summarizes our analysis of prosodic domains in Vietnamese.

(20) A prosodic tree for Vietnamese



Tôi ˈ*đến* *nha*, *má* ˈ*tôi* *mở* *cửa* ˈ'*ra*, *tôi* ˈ*vô*.

I arrive house, mother I open door exit, I enter.

'I arrived at the house, my mother opened the door, and I went in.'

The hierarchy deviates in crucial ways from the proposed universal Prosodic Hierarchy. Since the syllable and the word are non-distinct in phonology, the building of higher levels of prosodic structure obligatorily has to skip the level of the word. The crucial point about the prosodic structure of Vietnamese is that the phonological patterns which characterize polysyllabic words, i.e. the stress rules, are identical to those which characterize

polysyllabic phrases. Accordingly, the building of prosodic trees relies on the grouping of syllables, irrespective of their morphosyntactic status as bound morphemes or words. Note also that Vietnamese offers no evidence for other prosodic domains, such the foot or the Clitic Group. In our cross-linguistic survey, we observed a very similar hierarchy, again without a word level, in Lahu (Lolo-Burmese, Sino-Tibetan; Matisoff 1973) and in Car (Nicobarese, Austroasiatic; Braine 1970).

4. Challenge 2: Limbu, or multiple prosodic word domains

Vietnamese and similar languages challenge the theory of the Prosodic Hierarchy by evidencing fewer domains than expected. We now turn to languages that evidence more domains than expected. Specifically, we discuss cases where there is evidence from general phonological rules for a multitude of non-isomorphic domains between the foot and the phrase, arranged in such a way that the multitude cannot be reduced by positing additional domains or recursive structures. We focus on Limbu, an Eastern Kiranti (Sino-Tibetan) language of Nepal (Weidert and Subba 1985; Michailovsky 1986, 2002; van Driem 1987, 1997; Ebert 1994; Bickel 1998, 1999, 2003; Hildebrandt, forthcoming). We first delimit the grammatical word, and then turn to prosodic domains.

4.1 Morphological domains in Limbu

The grammatical word in Limbu is characterized by the morphological properties of different morphemes, such as stems, affixes and enclitics as well as the morphological processes which govern their combination. Affixes, which are attached to the stem by prefixation, suffixation and circumfixation, are realized in various template positions within the nominal and verbal

word. Stems themselves can be combined to form complex compound verbs. Limbu also has a class of enclitics which syntactically have phrasal distribution and scope, but nevertheless are integrated into a phonological domain at the word level.

4.1.1 Affixation

In both nominal and verbal morphology, the grammatical word can be defined as consisting of grammatical elements which always occur together following a strictly ordered template.

Nouns inflect for possessor agreement (in person and number), number (singular, dual, plural), definiteness (definite vs. indefinite) and case (absolutive, ergative/ instrumental, genitive, comitative, locative, mediative, allative, intrative, comparative, and a number of combinations thereof). Definiteness is marked only in the singular (by *-ʔin*, which in turn assimilates to *-ʔil* before the ergative/instrumental in *–le*) and only in the absolutive, genitive, and ergative/instrumental case.[15] Since singular number is zero-marked, the two categories appear in a single position:

(21) POSS-stem-DEF/NUMBER-CASE

Nominal inflection is obligatory, except for non-relational nouns where possessor agreement is optional. In turn, all affixes realizing these categories strictly subcategorize for nominal stems, which indicates that we are dealing with morphological elements and not independent phrasal elements. The only exception is the ergative/instrumental case, which is also found on finite, nominalized verb forms. However, when the ergative/instrumental appears on such forms (as well when following derivational suffixes in *-a*), definiteness can no longer be

[15] Note that, although he discusses the category and its marking, van Driem (1987) does not gloss definiteness systematically in his reference grammar; also note that Limbu has in addition a phrase-level enclitic article (*=n*), which appears on either attributes or heads in NPs (see Bickel 1999 for discussion on the syntax of the article).

marked, and the sequence definite-ergative (*-ʔin-le* > *-ʔille)* is reanalyzed as the post-consonantal allomorph of the plain ergative *-lle* which appears only and always after vowels.

Derivational morphology of nominal stems also shows circumfixation. One such case the formation of free from bound color roots such as *mak* 'black'. In this derivation, the discontinuous affix *ku*-root-*la* is circumfixed to the color morph, e.g. *ku-mak-la* 'black'. (The bound color roots are relational nouns in Limbu).

Verb morphology makes use of the same affixation types, but it involves many more affixes and categories. The Limbu verb agrees with the intransitive subject, and among transitives, with both the subject and the primary object (i.e. the sole object of monotransitives and the most goal-like argument of ditransitives). Agreement categories are person (first inclusive, first exclusive, second, third) and number (singular, dual, plural). Verbs inflect also for tense, aspect and mood. The marking of all these categories is distributed across 4 prefix and 13 suffix positions. Evidence that that entire string of prefixes, a stem (or several) and suffixes form a single grammatical word comes from the following: i) all inflectional categories are obligatory in finite verbs; ii) all affixes involved are strictly subcategorized for verb stems and do not appear on other stems or word forms; iii) some categories are simultaneously expressed by a prefix and one or more suffixes, e.g. negation; iv) no phrasal element can ever intrude, not even clitics. That all inflectional elements are inside the same grammatical words, and that none of them behaves like clitics is furthermore shown by the fact that agreement affixes (prefixes and suffixes in verbs, prefixes in nouns) regularly co-occur with agreement-triggering NPs in argument position, and that agreement affixes cannot be gapped under identity.

4.1.2 Complex Stems

Both verbal and nominal stems can form compounds, but they differ in their morphological structure (and as we will see, in their phonological structure as well). The following are nominal compounds:

(22) Nominal compounds in Limbu (van Driem 1987: 27, 54)[16]

a. *laŋ+yo:p*	vs.	*ku-laŋ+yo:p*
leg+imprint		3POSS-leg+imprint
'footprint'		'his footprint'
b. *te:ʔl+phuŋ*	vs.	*ku-de:ʔl+ku-bhuŋ*
clothes+flower		3POSS-clothes+3POSS-flower
'garments, clothing'		'his clothing'
c. *cum+de:ŋ*	vs.	*a-njum+a-nde:ŋ-haʔ*
friend+comrade		1POSS-friend+1POSS-comrade-p
'buddy'		'my buddies'

All words in (22) are comprised of two nominal stems, for instance *laŋ+yo:p* (leg+imprint) 'footprint', and are presented in their bare forms in the first column. The second column illustrates these compounds in affixation. In (22a), one possessive prefix is attached at the left edge of the compound, i.e. in this case, the compound behaves like a simple stem. In (22b), on the other hand, prefixation of the possessive marker applies twice, both to the first and the second member of the compound. For the sake of prefixation, the compound in (22b) constitutes two morphological stem domains. With respect to suffixation, example (22c)

[16] The following abbreviations are used in the word-for-word glosses for Limbu: 1 = first person, 2 = second person, 3 = third person, A = transitive subject, ASS = assertive, COND = conditional, CTR = contrastive, DEPR = deprehensative, GEN = genitive, INF = infinitive, IPFV = imperfective, LOC = locative, NEG = negation, negative, NOM = nominalizer, ns = nonsingular, p = plural, P = primary object. POSS = possessive, PST = past, Q = question marker, REFL = reflexive, s = singular, S = sole argument of intransitives, SUB = subordinator, VOC = vocative, x>y = x is transitive subject, y is primary object.

shows that even such compounds which form two stem domains in prefixation behave like single stems when it comes to plural marking. The word in the second column consists of two stems, *cum* 'friend' and *de:ŋ* 'comrade', which are compounded to *cum+de:ŋ* 'buddy'. The possessive prefix for the first person *a-* appears twice, once on the first and once on the second member, respectively. The plural marker *-haʔ*, however, is only suffixed once, at the end of the whole complex.

Verbal compounds differ from nominal compounds with regard to prefixation possibilities. Consider the data in (23).

(23) Verbal compounds in Limbu (van Driem 1987)

a. *cuŋ+ji:k-maʔ*	vs.	*cuŋ+gɛ-ji:kt-ɛ=i:*?
cold+cool.off-INF		cold+2-cool.off-PST=Q
'be cold'		'Are you cold?'
b. *caha+jo:k-maʔ*	vs.	*caha+kɛ-jo:g-w=i:*?
want+do-INF		want+2-do-3P=Q
'want, desire, require'		'Do you want it?'
c. *nam+phɛp-maʔ*	vs.	*nam+kɛ-bhɛtt-u=aŋ*
sun+fetch/bring-INF		sun+2-fetch-3P=and
'place out in the sun to dry'		'Having put it out in the sun…'

The first column presents complex stems in infinitival (citation) form. The second column shows affixation to these stems. While in nominal compounds, agreement prefixes are found on one or both stems, in verbal compounds prefixes only ever occur on the rightmost stem.[17]

[17] The reason for this difference is that verbal compounds historically derive from complement-verb structures, where the complement is either another verb, as in (23a), a verbal loanword, as in (23b), or a nominal, as in (23c). It is likely that in none of these cases, the complement was ever treated as an inflectable verb stem.

4.2 Phonological domains in Limbu

Sino-Tibetan linguistics has traditionally focused on the syllable as the key domain of both phonological and morphological regularities in the languages of the family (e.g. Matisoff 1991a, b), with occasional extensions to the foot (e.g. Bickel 2003). However, a number of studies have revealed the relevance of additional prosodic domains in the application of phonological processes. For instance, the tone domain in many Bodish languages includes roots and various bound morphemes and can, accordingly, best be analyzed with appeal to the prosodic word (Mazaudon 1973; Denwood 1999; Noonan 2003; Hildebrandt 2003). In what follows, we present a fine-grained analysis of the phonological domains in Limbu. Starting from the syllable, we discuss how multiple prosodic word domains are referenced by phonological generalizations and processes. As a byproduct it turns out that trochaic footing has a salient status in the prosodization of words. In order to distinguish the various prosodic words from higher levels of prosodic structure, we also discuss processes which apply at the level of the phonological phrase. Although our understanding of Limbu intonation is too premature to evaluate the status of the intonational phrase and the utterance, the data discussed in the following makes our second challenge to the Prosodic Hierarchy obvious enough: there is no reason to assume that phonological processes should universally cluster on one prosodic word domain or that prosodic domains can never violate Proper Bracketing.

4.2.1 The syllable

The syllable in Limbu is the domain for most (though not all) phonotactic generalizations. The canonical syllable structure of the languages is schematically summarized as in (24).

(24) The syllable in Limbu (van Driem 1987: 16)

Onset	Nucleus	Coda
(C_1 (G))	V	(C_2)

The nucleus slot in the syllable template given in (24) can be filled by one of the thirteen vowel phonemes of the language or by a syllabic nasal. The nucleus is the only obligatory component of a syllable in Limbu. When a syllabic nasal constitutes the nucleus of a syllable, neither the onset nor the coda position is filled. With a vocalic nucleus, fourteen of the eighteen consonant phonemes can function as the onset of a syllable. Consonant clusters are only possible in onset position, where the second member of a cluster must be one of the phonemes /y/, /w/ or /l/. The coda slot can optionally be filled by ten of the eighteen native consonant phonemes.

Additional evidence for the syllable comes from the allophonic rules. For instance, voiceless plosives /p, t, k/ are released in syllable-initial position but they are unreleased with accompanying glottalization in coda position, i.e. as [$p^{ʔ}$, $t^{ʔ}$, $k^{ʔ}$]. In addition, the vowels /i/ and /o/ have more centralized variants when a syllable ends in a velar nasal consonant, but not when they are immediately followed by a velar nasal consonant which provides the onset for the next syllable (van Driem 1987: 2ff.). The phonotactic restrictions summarized above, as well as the interdependencies in the distribution of different consonantal and vocalic allophones within the canonical syllable template, therefore allow a straightforward postulation of the prosodic domain of the syllable.

4.2.2 The Prosodic Word

Although the syllable domain allows for the expression of a number of phonotactic generalizations, some phonotactic patterns in Limbu can only be captured with reference to a domain higher than the syllable.

One regularity referencing words is the alternation between the two allophones [l] and [r] of the phoneme /l/.[18] The distribution of these can be stated with exclusive reference to syllable structure only for two contexts. First, in loans, /l/ is realized as [l] in syllable-final position, e.g. *beɬ* 'plant name'. Second, in native words, the phoneme surfaces as [r] when it is the second member in initial clusters, for instance in the second syllable of *cɔk.krɔk.ma* 'uvula'. Apart from this, the distribution of the allophones is governed by word structure. Syllable-initial /l/ always surfaces as [l] in word-initial position, while in word-medial position it is realized as either [r] or [l], depending on the structure of the preceding syllable. The realization is [r] if the preceding syllable is open or ends in a glottal stop (which, accordingly, could be analyzed as a vocalic feature: Michailovsky 1986). The realization remains [l] after closed syllables, i.e. after consonants, cf. (25).

(25) Distribution of syllable-initial, word-medial /l/ in Limbu (van Driem 1987: 4ff.)

/l/ → [r] / {V, ʔ} __

The domain to which this distributional rule applies is smaller than the grammatical word, as it excludes prefixes. Consider the following data, which illustrate the application of the rule in morphologically simple and complex words. The forms on the left show /l/ onsets after open syllables, the forms on the right after closed syllables.

[18] Although this synchronic pattern resembles rhoticization, such a characterization would be inadequate from a diachronic point of view. The allophonic variation shown above is the result of an older merger of */r/ and */y/, leaving */l/ and */r/ in complementary distribution, see van Driem (1990).

(26) The [l] ~ [r] alternation in Limbu (van Driem 1987: 4ff.)

a. *nɛ**r**ɛt*	vs.	*lup**l**i*	
‘heart’		‘earthquake’	
b. *pha-**r**e siŋ*	vs.	*mik-**l**e raŋ*	
bamboo-GEN wood		eye-GEN color	
‘the wood of bamboo’		‘the color of the eyes’	
c. *kɛ-**l**ɔʔ*	vs.	*mɛ-l-**l**ɛ-baŋ*	(< *mɛ-n-**l**ɛ-baŋ*)
2-say		NEG-NEG-know-1s>3.PST	
‘you say’		‘I didn’t know [it]’	

In line with (25), /l/ onsets are realized as [r] in postvocalic position and as [l] in post-consonantal position (26a-b). However, as shown by the data in (26c), when /l/ is located at a prefix-stem boundary, it does not exhibit the predicted alternation and surfaces as [l] both after open and after closed syllables. This suggests that prefixes are outside the domain in which the /l/-alternation applies.[19] This can be accounted for by positing a prosodic word structure like *kɛ-*(***l***ɔʔ)$_{\omega}$. In this structure, stem-initial /l/ now appears at the left edge of the prosodic word. This is a position where /l/ always surfaces as [l].

While at the beginning, the domain of the /l/-alternation is delimited by the stem boundary, at the end, it includes everything that is part of the same grammatical word (suffixes, other stems in compounding) and even clitics. The following data show the predicted alternations with enclitics and complex stems.

(27) The [l] ~ [r] alternation with enclitics and complex stems

a. *pe:g-i=**r**o:*	vs.	*pe:g-aŋ=**l**o:*

[19] Limbu does not have prefixes which start in /l/. There is thus no way of telling whether a prefix or prefix clusters form their own prosodic domain with respect to the [l] ~ [r] alternation.

	go-p=ASS		go-1sPST=ASS
	‘Come on, let’s go!’		‘I’m on my way!’
b.	*kɔŋ lɛ:s-u=**r**əcə*	vs.	*ma:ŋgha kɛ-n-nis-u-n=**l**əcə*
	this know-3P=DEPR		far 2-NEG-see-3P-NEG=DEPR
	‘He appears to know.’		‘You seem to be myopic.’
c.	*yaʔ+**r**a:k-maʔ*	vs.	***l**a:k-maʔ*
	paddy+trample-INF		trample-INF
	‘to perform the rice dance’		‘to trample, stamp, walk underfoot, kick’

In all cases, /l/-onsets surfaces as [l] after consonants and as /r/ after vowels and the glottal stop.

If, as we claim, the prosodic word domain includes everything to the right of the initial stem, this predicts that prefix-stem boundaries inside this domain would show the /l/-alternation, unlike boundaries between prefixes and the initial stem. Domain-internal prefix-stem boundaries are regularly found as a result of verb compounding because, as noted in Section 4.1.2 above, only the rightmost stem can ever hosts prefixal morphology in such compounds. The prediction is borne out by the following data.

(28) *yaʔ+gɛ-ra:kt-u*

paddy+2-trample-3P

‘You performed the rice dance.’

In sharp contrast to the non-cohering status of the prefix with simple stems (see 26c), the prefix which is attached to the rightmost syllable of a complex stem is prosodically integrated

into the prosodic word domain. The initial segment of *la:k-maʔ*, accordingly appears in word-medial position in such a construction, i.e. (*yaʔ*+*gɛ-**r**a:kt-u*)$_{\omega}$, and therefore surfaces as [r].[20]

The same domain as the one referenced by the /l/-alternation is also relevant for the distribution of non-contrastive glottal stops in Limbu.[21] One variant involves glottal stop insertion.[22] This is found before vowel-initial syllables at the left edge of initial stems.

(29) Glottal stop insertion in Limbu (van Driem 1987: 15)

a. /iŋghɔŋ/ [ʔiŋghɔŋ]

'message'

b. /ku-iŋghɔŋ/ [kuʔiŋghɔŋ]

3POSS-message

'his news'

c. /a-i:r-ɛ/ [ʔaʔi:rɛ]

1-wander-PST

'We (plural, inclusive) wandered.'

(29a) shows a monomorphemic word *iŋghɔŋ* 'message' which begins with a vowel underlyingly. In the surface form, the empty onset position is filled by the prothetic glottal stop. In (29b) the same word forms the base for the prefixation of the possessive prefix *ku-*. The glottal stop is still inserted to provide an onset for the vowel-initial stem. This shows that the prefix is not included into the domain referenced by the word-based rule of glottal stop

[20] Note that in a limited number of cases, where stem combinations have not yet been reanalyzed complex stems, the second stem initiates its own prosodic word and thus allows the realization of [l]. See Hildebrandt (forthcoming) for discussion.

[21] Another regularity that is likely to be restricted by the same domain is a ban on velar nasals from word-initial position. However, there are no prefixes with a velar nasal onset, and so we cannot know whether the ban extends to all prefixes or only to word-initial prefixes.

[22] Apart from the position discussed here, the glottal stop also appears as a contrastive (lexical) segment in word-medial and word-final position (van Driem 1987: 7).

insertion, cf. also (29c). Unlike prefixes, suffixes and enclitics are integrated into the word domain referenced by glottal stop insertion. Therefore, if a vowel-initial suffix or clitic follows a stem or another suffix, no glottal stop is inserted. In these positions, hiatus is not resolved by glottal insertion,[23] but by diphthongization (or, trivially, by resyllabification if a vowel-initial suffix follows a consonant or by glide formation if the suffix follows a vowel that has a glide alternant). The following data shows this with minimal pairs of /u-e/, /a-ɛ/, and /a-i/ sequences; the forms on left involve prefix-stem, the forms on the right stem-suffix and host=clitic boundaries, respectively.

(30) Glottis stop insertion and diphthongization across different morpheme boundaries

a. /k**u-e:**k/ [k**uʔe:**k]	vs.	/a-mph**u-e:**/ [amph**ue:**]
3POSS-back		1POSS-brother-VOC
'its/his/her back'		'Brother!'
b. /**a-e:**k/ [ʔ**aʔe:**k]	vs.	/yum**a-e:**/ [yum**ae:**]
1POSS-back		grandmother-VOC
'my back'		'Grandma!'
c. /k**ɛ-i**m/ [k**ɛʔi**m]	vs.	/naks-**ɛ=i:**/ [naks**ɛ̌i:**]
2-sleep		go.crazy-PST=Q
'You sleep.'		'Has he gone cary?'
d. /**a-i:**r-ɛ/ [ʔ**aʔi:**rɛ]	vs.	/nu-b**a=i:**/[nu-b**ai:**]
1-wander-PST		be.alright-NOM=Q
'We wandered.'		'Is this good?'

[23] There is one context in which glottal hiatus applies with the interrogative clitic *=i:*, namely when it is attached to a host ending in /i/. The application of the process seems to be conditioned by the impossibility of diphthongizing two identical vowels. Note, however, that this is still different from glottal stop insertion at prefix-stem boundaries. In the latter case, the rule applies irrespective of whether the vowel vowels are identical or different.

The only difference between the forms with prefixes and those with suffixes is that prefixes are outside the prosodic domain in which glottal insertion applies, while suffixes are inside this domain. Thus, the domain is the same as the one observed above for the l-alternation, i.e. prefix-(stem-suffix-clitic)$_{\omega}$.

To sum up, /l/-alternation and glottal prothesis evidence a prosodic word including stems and suffixes (and enclitics) but excluding prefixes. This is in conflict with other phonological processes of Limbu which reference a domain that includes prefixes, and in some regards, excludes suffixes. We first discuss evidence for domains spanning prefixes, stems, and suffixes, and then concentrate on processes that exclude suffixes to some extent.

One domain that includes prefixes along with stems and suffixes is referenced by rhythmic stress rules. Since stress in Limbu "is not very pronounced and […] non-distinctive" (van Driem 1987: 15), grammatical descriptions have so far only rudimentarily treated the distribution and placement of primary stress. In the majority of cases, stress placement is predicable in a straightforward manner from the morphological composition of the word. Whereas verbs and verbal derivatives are stressed on the root, nouns and other parts of speech are stressed on the first syllable; affixes are generally unstressed and unstressable. To substantiate the claim that the stress domain includes the stem, all its affixes and enclitics, we present a more thorough analysis of stress in Limbu, which is based on a detailed phonetic study.[24] The examples in (31) illustrate stress placement in grammatical words exhibiting varying degrees of morphological complexity.

(31) Stress in Limbu

a. /ku-la:p/ ['kula:p]

[24] For the purposes of these analyses, the texts 'An Untimely Death' and 'Father-in-Law' available at http://lacito.vjf.cnrs.fr/archivage/index.html have been analyzed using the PRAAT software for phonetic analysis (Boersma and Weenink 2006).

3POSS-wing

‘its wing’

b. /pe:g-i/ ['pe:gi]

go-1pS

‘We go.’

c. /a-oŋ-e:/ [ʔa'ʔoŋˌŋe:]

1POSS-brother.in.law-VOC

‘My brother in law!’

d. /ku-taŋ=mɛ/ [ku'taŋmɛ]

3POSS-horn=CTR

‘its horn, on the contrary’

e. /mɛ-thaŋ-e=aŋ/ [mɛ'tʰaŋˌjaŋ]

3ns-come.up-PST=and

‘they come up and …’

With respect to the distribution of stress, the forms in the examples above all take only one primary stress. This generalization holds true for combinations of prefix and stem (31a), stem and suffix (31b), prefix, stem and suffix (31c), prefix, stem and enclitic (31d) and finally prefix, stem, suffix and enclitic (31e). On the basis of this evidence we can postulate a prosodic word domain which is defined by the presence of one and only one primary stress and which references a morphosyntactic structure which contains the stem, its prefixes, its suffixes and enclitics, e.g. $(m\varepsilon\text{-}'thaŋ\text{-}e\text{-}aŋ)_{\omega}$.

The result of this is a clash with the extent of the prosodic word defined by the /l/-alternation and the rule of glottal stop insertion. The application of the latter rule can be inferred from example (31c), where a glottal stop is inserted at the left edge of the prefix and

at the left edge of the stem. If the prefix also constituted a prosodic word with respect to primary stress, we would expect two primary stresses in (31a), (31c), (31d) and (31e), one on the prefix and another one on the remaining portion of the grammatical word. Since this is not the pattern we encounter, we conclude that the prefix varies in its prosodic status with respect to the different phonological processes which are sensitive to word structure.

The data in (31) also allow us to analyze rules of stress placement within the stress-defined word. The examples (31b-e) show the default pattern, in which primary stress is realized on the stem-initial syllable. Depending on the morphological structure, this entails that stress will be word-initial if there is no prefix present (31b); and on the second syllable of the word if a prefix is present. A deviation from this default stress placement is illustrated in example (31a). Stem-initial stress would result in an iambic foot here, because there is no further suffix. If there is a prefix, iambic stress is avoided by shifting stress to the prefix. (We return to this issue in Section 4.2.3 below.)

In order to represent these observations about stress placement in terms of prosodic domains, we can recruit the same prosodic structure that we defined for the /l/-alternation. The prefix lies outside the prosodic word domain which delimits the stem, its suffixes and enclitics. In the latter domain structure, default stress is realized on the initial syllable of the prosodic word, e.g. *mɛ-('thaŋ-e-aŋ)*$_{\omega}$. In order to capture the distribution and placement of default stress we therefore need to postulate two prosodic word domains, one to the inclusion of the prefix with accounts for the 'one stress per word' generalization and one to the exclusion of the prefix which provides the domain for initial stress placement. For the deviant stress placement in (31a), the prosodic bracketing of the two word domains is restructured, i.e. the domain for initial stress placement, formerly at the left edge of the stem, is realigned with the left edge of the prefix, e.g. ('*ku-la:p*)$_{\omega}$. This prosodic restructuring is most likely caused by a general ban on iambic stress (cf. Section 4.2.3 below), and it does not therefore evidence

another prosodic word domain consisting of prefix and stem alone. However, it does reinforce the observation that stress rules treat prefixes as part of a regular word domain, despite the fact that they are strictly separated from the stem by the /l/-alternation and the glottal stop insertion rules.

Further evidence for this strong prosodic cohesion between the prefix and the stem comes from a process which operates on the output of glottal stop insertion. The underlying form /a-u:ŋ/ (1-pull) provides two domains for glottal stop insertion, one at the left edge of the prefix, one at the left edge of the stem. The application of glottal stop insertion results in the form [ʔaʔu:ŋ], which in turn is input to a rule which deletes the intervocalic glottal stop at the morpheme boundary and leaves a creaky voice quality on the stem vowel, i.e. [ʔaʔu:ŋ] → [ʔaṵ̆:]. This latter process appears to happen more often between a prefix and a vowel-initial verb stem than in other morphological contexts.

The prefix-including domain of stress rules is also referenced by at least one segmental rule, viz. a rule of regressive assimilation of coronals to labials which is very salient and productive.

(32) Regressive coronal to labial assimilation (van Driem 1987: 17)

$$\left\{ \begin{array}{l} /t/ \rightarrow [p] \\ /n/ \rightarrow [m] \end{array} \right\} \quad / \quad \_\_ \quad \left\{ \begin{array}{l} /m/ \\ /p/ \end{array} \right\}$$

The rules states that the coronal phonemes /t, n/ regressively assimilate for place of articulation to the bilabial phonemes /m, p/. This rule is sensitive to the prosodic word domain as defined above and its application includes stems, prefixes, suffixes and enclitics, as illustrated by the following data.

(33) Coronal to labial assimilation in Limbu (van Driem 1987: 17, 136, 230)

a. /ɔ:mɔ**t-m**aʔ/ [ʔɔ:mɔ**pm**aʔ]

look.at-INF

'to look at'

b. /mɛ-**n-m**ɛ**t-p**aŋ/ [mɛ**mm**ɛ**pp**aŋ]

nsA-NEG-tell-1s>3.PST

'I did not tell him'

c. /si-aŋ-mɛ**n-p**a/ [sjaŋmɛ**mb**a]

die-1sS.PST-COND-IPFV

'I might die'

d. /myaŋluŋ=phɛlle hɛ**n=p**hɛlle/ [mjaŋluŋbhɛlle hɛ**mb**hɛlle]

Myaŋluŋ=SUB what=SUB

'What does *Myaŋluŋ* mean?'

In (33a), the rule of regressive coronal to labial assimilation applies across the morpheme boundary of the stem *ɔ:mɔt* 'look at' and the nominalizer suffix *-maʔ*. In the second example, the application of the rule is demonstrated for a morphologically complex word consisting of a stem, two prefixes and a suffix. The coronal of the second prefix *n-* assimilates to the following labial of the stem *mɛt* and the stem-final coronal assimilates to the labial of the suffix *-paŋ*. Example (33c) shows that the rule also applies across the morpheme boundary of two adjacent suffixes. When the conditional suffix *-mɛn* is followed by the imperfective marker *-pa*, its final coronal assimilates to the labial of the following suffix. Note that in this example the labial of the second suffix also undergoes voicing assimilation from /p/ to [b]. (33d), finally, shows that clitics are integrated into the prosodic word domain for coronal to labial assimilation. The element *-phɛlle* is a subordinator cliticizing to the right margin of a

clause. Phonologically speaking, the element is bound to its host word by a number of word related processes, i.e. it is a clitic. In (33d) above, the initial labial of the clitic triggers regressive assimilation of the final coronal in the host word *hɛn* 'what'. Additionally, its initial labial is subject to voicing assimilation from /ph/ to [bh]. In terms of prosodic status, the phrasal subordinator behaves exactly like the imperfective suffix *-pa* in example (33c). We can sum up the discussion of coronal to labial assimilation thus by concluding that this morphophonological process applies across morpheme boundaries in the prosodic word domain which references the stem, its affixes and enclitics.

In the preceding paragraphs, we have concentrated on phonological processes which are sensitive to morphological structure at the word level and which can be considered 'purely phonological rules' in Prosodic Phonology research. An exhaustive description of the phonology of Limbu, however, should also include processes which are sensitive to morphological structure, but which are restricted to particular morphemes or apply optionally, for instance in allegro speech. The first such rule would be an assimilation rule which results in the homorganicity of consecutive nasal phonemes, i.e. /m/ → [ŋ] / /ŋ/__. This rule applies only at the morpheme boundary of a stem and a suffix, where only suffixes of the passive participle, the negative participle and the 1PS/PST suffix participate, e.g. /ha**ŋ-m**ʔna/ [ha**ŋ-ŋ**ʔna] (send-PART) 'being sent'. At other stem-suffix boundaries, such as in /ha**ŋ-m**aʔ/ [ha**ŋ-m**aʔ] (send-INF) 'to send', this rule of nasal assimilation does not apply. Another process is a rule by which /n/ assimilates to a following /k/ or /kh/ with respect to place of articulation. This rule applies optionally at the prefix-stem boundary in /kɛ-n-kho:s-u-n/ [kɛng^{ɦ}o:sun] ~ [kɛŋg^{ɦ}o:sun] (2-NEG-find-3P-NEG) 'you didn't find it' or /mɛn-gɛʔl-e:/ [mɛŋ-gɛʔl-e:] (CVB-arrive-CVB) 'arriving'. On the basis of the data available to us, we do not know how general this rule is. An optional rule of nasal assimilation converts the phonemes /m, n, ŋ/ to [l] in the surface form, if they are followed by /l/. Although the application of this rule is

described as rare by van Driem (1987), there are enough data to formulate the generalization that it applies within a domain which references the stem, its prefixes and its suffixes. Accordingly, the nasal prefix assimilates to /l/ in words such as /mɛ-**n-l**ɛ:-baŋ/ [mɛ-**l-l**ɛ:-baŋ] (NEG-NEG-know-1s>3.PST) 'I didn't know [it]', and the suffixed definite article /-ʔin/ assimilates to [-ʔil] when it precedes the ergative marker /-le/.[25] A final process which is sensitive to morphological structure is one in which a glottal stop may regressively assimilate to a following nasal. The rule applies in the plural infinitive suffix, which comes in the two surface variants *-aʔmɛʔ* and *-ammɛʔ*, and with the glottal stop-initial locative and definite suffixes, e.g. *him-ʔo· ~ him-mo·* 'in the house' and *nam-ʔin ~ nam-min* 'the sun (DEF)' (van Driem 1987: 17ff.)

4.2.3 Feet

The facts about the restructuring of the stress domain discussed above also suggest an additional level of prosodic organization, namely the foot. In the examples with default stress placement, the prosodic word, which starts at the left margin of the stem, constitutes a trochaic foot, e.g. *mɛ-('thaŋ-e-aŋ*). This suggests a general rhythmic pattern in Limbu in which syllables are parsed into trochaic feet. In a morphologically complex word which consists only of a prefix and a stem, the general rules of stress placement would result in an iambic foot structure in the surface form, e.g. *(*ku-*'la:p*). The prosodic organization of Limbu never shows iambic foot structures and the restructuring of the iambic prefix plus stem domain results from a dispreference for iambic rhythm. In this case, trochaic foot structure is ranked higher than prosodic word structure and the restructuring of the domain structure enhances the overall trochaic rhythm of the language.

[25] We have no data on which basis we could decide on the prosodic status of enclitics with respect to this domain.

4.2.4 The Phonological Phrase

Turning to higher levels of prosodic structure, there is at least one phonological process which seems to apply across word boundaries within the phonological phrase. Word-initial plosives optionally assimilate to the preceding word with respect to the feature voice (which is not distinctive in Limbu). The application of this rule is exemplified in the sentences in (34).

(34) Voicing assimilation in Limbu (van Driem 1987: 18f.)

A: *anige hɛn **j**o:kmaʔ?* cf. /co:kmaʔ/

'What shall we do?'

B: *pe:kmaʔ **b**o:ŋ .* cf. /po:ŋ/

'It's time [for you] to go.'

In the first turn of this conversational exchange, the word *co:kmaʔ* 'to do, make build' is realized following a word which ends in a voiced segment /n/. According to the phrasal rule of voice assimilation, the word-initial unaspirated voiceless lamino-postalveolar affricate /c/ [tɕ] is replaced by its voiced counterpart [dʑ] (written as <j>) in this context. The auxiliary word *po:ŋ* in the second sentence of (34) assimilates to the preceding word in the same fashion. Note that the glottal stop does not block voice assimilation in this example, cf. its vocalic status noted in (25).

Nominal compounds constitute two word domains for the sake of the /l/-alternation. For instance, in compounds such as *haʔ+luŋ* (fire+stone) 'fireplace' and *makhi+lam* (blood+road) 'artery' the initial segment of the second compound member always surfaces as [l], although it appears after a glottal stop in the first compound and intervocalically in the

second example. This suggests that /l/ in these examples does not appear in word-medial position, but in word-initial position, so that both stems appear to have prosodic word status, i.e. $(ha\text{ʔ})_{\omega}+(\textbf{\textit{l}}uŋ)_{\omega}$ and $(makhi)_{\omega}+(\textbf{\textit{l}}am)_{\omega}$. But the two prosodic words are conjoined into a single phonological phrase. Let us reconsider the nominal compound *cum+de:ŋ* 'buddy' which is composed of the two elements *cum* 'friend' and *te:ŋ* 'comrade'. Here, the initial plosive of the second member surfaces in its voiced counterpart in the compound. In an analysis which treats the two stems as two separate prosodic words which are joined in a phonological phrase, this fact is predicted by the application of the phrase-level rule of voicing assimilation, i.e. $[(cum)_{\omega}+(\textbf{\textit{d}}e:ŋ)_{\omega}]_{P}$. In summary, nominal compounds fit into the higher domain structures in constituting two prosodic words, which are in turn subsumed under a single phrase node.

Our knowledge of Limbu phonology is still too limited to propose an analysis of intonation and other phonological processes which might allow the postulation of further prosodic domains for the language, such as the intonational phrase and the utterance. However, even if we concentrate on the phonological processes which operate between the levels of the syllable and the phonological phrase we find highly specific and often overlapping domains whose structure is not be predicted by the Prosodic Hierarchy.

4.3. Summary

In Limbu, the syllable is the locus of a number of phonotactic generalizations. Stress facts point to a general preference for trochaic footing within the word, which leads us to conclude that the prosodic domain of the foot is effectively at work in Limbu. There is evidence for multiple prosodic word domains which reference different portions of the grammatical word. With respect to prosodic groupings which are mapped to morphological structure, we can at

least identify four different domains between foot and phrase, each associated with two phonological processes or generalizations. The first domain is defined by the restructured stress domain, nasal assimilation and glottal stop deletion which reference the combination of a prefix and a stem. A second grouping which singles out the stem and a suffix is evidenced by two segmental assimilation, one in which /m/ becomes [ŋ] after/ŋ/, and one in which /ʔ/ becomes a nasal following a nasal. Under closer scrutiny, the phonological processes which reference this morphological construction might not stand the test of 'purely phonological rules', because the /m/ → [ŋ] is tied to individual morphemes and the glottal assimilation rule is optional. Nevertheless, the strong phonological cohesion we find in these constructions is considerable in the light of the other word related processes of the language, in particular with respect to the prosodic status of the prefix. A third word domain is characterized by the [l] ~ [r] alternation and [ʔ]-insertion. Both processes apply within the morphological structure delimited by the stem, its suffixes and enclitics. With respect to [ʔ]-insertion, prefixes constitute their own prosodic word domain. The stress domain, the domain for the coronal to labial assimilation and the domain of the nasal to lateral assimilation converge on the prosodic word domain which is mapped to the stem, its affixes and enclitics and therefore forms the largest word domain. Voicing assimilation, which optionally applies across words in phrases, references the phonological phrase. The domains which are evidenced be motivated on the basis of the available evidence are summarized in schematized prosodic hierarchy for Limbu in (35).

(35) A Prosodic Hierarchy for Limbu

Prosodic Domain	Phonological Patterns	Mapping
[…]		
|		

P	voicing assimilation	phrases
|		prefix stem suffix enclitic
ω_4	stress, coronal → labial,	———————————
|	nasal → lateral	
ω_3	[l] ~ [r], [ʔ]-insertion	——— ———————————
|		
ω_2	/m/ → [ŋ], /ʔ/ → [N],	————————
|	initial stress	
ω_1	initial stress, /n/ → [ŋ],	————————
|	[ʔ]-deletion	
φ	trochaic rhythm	
|		
σ	phonotactics	

The observed prosodic structure challenges the theory of the Prosodic Hierarchy in many ways. First, the evidence from Limbu shows that prosodic domains need not cluster on the finite set of prosodic domains posited by the Prosodic hierarchy. At the level of the word, Limbu phonology distinguishes four different levels of structure which reference different portions of the word. On the other hand, the overlapping nature of some of the encountered domains does not allow us to rule out Improper Bracketing. Even if the two word domains (prefix-stem)ω_1 and (stem-suffix)ω_2 cannot be motivated in terms of 'purely phonological rules' their very relevance in the application of phonological processes alludes to the fact that, in principle, it should be possible for a language to phonologize rules on overlapping domains.

Essentially the same picture as Limbu is offered by other Eastern Kiranti languages. In Belhare, for example, there is an intervocalic voicing rule applying within stem-suffix

strings but not across prefix-stem sequences; and a rule of deleting velar stops at the end of a domain including prefixes along with the stems and suffixes (Bickel 1996; Bickel and Hildebrandt 2005). In Chintang, a rule of glottal insertion (similar to the one in Limbu) and the host definition of endoclitics identifies a domain excluding prefixes; rules of stress assignment and the host definition of enclitics identifies a domain that includes prefixes (along with stems and suffixes); a third domain is referenced by intervocalic voicing which optionally applies within sequences of prefixes, or within sequences of stems and suffixes, but not across prefix-stem boundaries (Bickel et al. 2007).

5. Discussion

The question that now arises is to what extent languages like Vietnamese and Limbu can be handled by the mechanisms which have been proposed to account for deviations of the Prosodic Hierarchy.

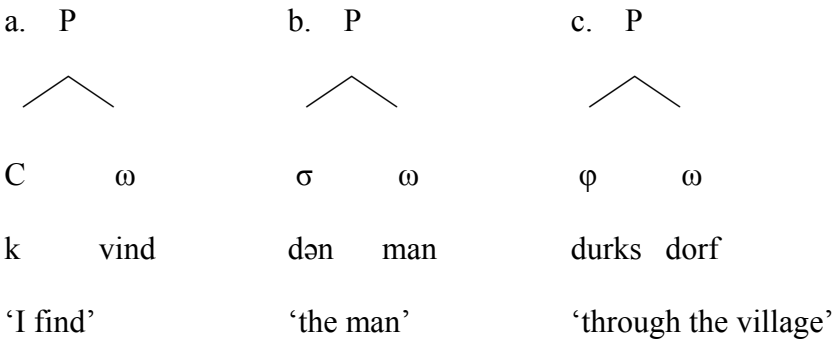
5.1 Skipping Levels of Prosodic Structure

In our analyses of Vietnamese, we found that there is only one prosodic constituent, the syllable, and this constituent appears to be the direct daughter of the phonological phrase. This suggests that the building of prosodic structure in this language has to consistently skip the level of the word (and the foot), i.e. Strict Succession has to be violated in every prosodic tree.

Within the literature on prosodic domains, a number of prosodic structures have been proposed and defended which violate Strict Succession, and it has been shown that only such

structures can correctly predict the application of the domain-specific rules involved. For instance, a number of prosodic structures violating Strict Succession can be motivated for procliticization in Dutch and German.

(36) Violations of Strict Succession (Kabak and Schiering 2006: 82)



The examples above show that proclitics can constitute single segments, syllables or feet which are adjoined to the prosodic word at the level of the phonological phrase. In each case, the left branch of the tree violates Strict Succession in skipping the level of the word (36c), the level of the word and the level of the foot (36b), and the level of the word, the level of the foot, and the level of the syllable (36a). The prosodic trees nevertheless correctly predict the facts which are encountered in the various languages. For instance, the structure in (36c) correctly predicts the application of foot-based processes such as trochaic rhythm and syllabification within function word contractions but rules out the application of processes applying across word boundaries within a phonological phrase in such constructions (see Kabak and Schiering 2006 for details). Note that it is still true that a node *L* dominates one *L-1* constituent.

Data like these, where only one element is dominated by *L+1*, motivate Itô and Mester's (1992) version of Weak Layering. In order to account for word structures such as $((tere)_{\varphi}bi)_{\omega}$ 'television' in Japanese, in which the final syllable is included in the prosodic

word without constituting a prosodic foot, the authors present a restatement of prosodic layering which relies on three subcomponents. First, the strong interpretation of strict layering is restricted to the two lowest levels of the prosodic hierarchy by the principle of *mora confinement*, which says that morae can only be licensed by syllables. Secondly, *proper headedness* ensures that every prosodic constituent must have a head, defined as an immediately dominated category of the immediate subordinate prosodic rank. Thirdly, *maximal parsing* forces prosodic structures to be maximally parsed within the limits imposed by other constraints on prosodic form. In this revised conception of Layering, violations of Strict Succession are allowed as long as they do adhere to these three principles. Accordingly, the prosodic trees in (36) are acceptable because they fulfill *proper headedness*, such that every phonological phrase contains at least one prosodic word. But the Vietnamese facts challenge this weakened interpretation of Layering since the phonological phrases in (20) do not contain any single prosodic word and thus violate *proper headedness*. In this respect, the structures which have been discussed in the literature differ significantly from the counterevidence to Strict Succession we surveyed in Section 3.[26]

In Section 2 we noted that positing recursive domains entails another relaxation of Strict Succession, one which allows succession of level *L* by *L-1* as well as by *L* itself. The Vietnamese data could be made compatible with the Strict Succession Hypothesis by further relaxing it, so that the theory would also allow succession of *L* by *L-k*, where *k* is an arbitrary number between *L* and the terminal level *L=0*. But that would make the theory empirically vacuous, and extremely unconstrained.

As a last resort, finally, one could stipulate a language-particular principle which assigns every syllable in Vietnamese word status by default. This *ad hoc* mechanism could at

[26] Note that the problem won't disappear under an optimality-theoretic approach in which various competing prosodic structures are evaluated with respect to the number of Strict Succession violations (Selkirk 1995). Contrary to the predicted output of such an OT grammar, Vietnamese phonology regularly chooses the prosodic tree with the most violations of the *Exhaustivity* constraint.

least provide an analysis for Vietnamese phonology which makes it adaptable to the predictions and formalisms of the Prosodic Hierarchy. In face of the lack of empirical evidence for the word domain in the language, such an approach would force assumptions about Universal Grammar into the description of particular languages and would have the undesirable effect of widening the gap between phonological theory and empirical finding.

5.2 Multiplying Word Domains

Limbu is one of many languages (43 in our 60-languages survey) in which multiple non-isomorphic word domains can be motivated, i.e. domains that each reference different portions of the morphological structure of grammatical words. This challenges the Clustering Hypothesis because it necessitates more than one domain between foot and phrase, and as we will see, to some extent it also challenges the Proper Bracketing Hypothesis.

A number of phonological processes ([ʔ]-deletion, /m/ → [ŋ], /ʔ/ → [N], voicing assimilation) reviewed in Section 4 are sensitive to lexical class membership or are optional (or both). Such processes do not necessarily challenge the theory of the Prosodic Hierarchy because under standard theoretical assumptions, lexically restricted phenomena can be analyzed as strata effects (as in Lexical Phonology), and optional rules are conventionally assumed to be handled by some other component of the grammar (Nespor and Vogel 1986; Peperkamp 1996). However, even if we restrict our evidence to lexically general and obligatory processes, we are still left with at least two domains, ω3 and ω4 in (35), which reference difference portions of morphological structure. As noted in Section 2, one answer to such deviations from the Prosodic Hierarchy, simply lists them by specifying which morpheme strings (e.g. stem-suffix vs. stem-clitic vs. stem-clitic strings) support which prosodization. This is obviously not a theoretically appealing solution to begin with, but,

worse, any solution along these lines fails to account for the fact that in Limbu, one and the same morpheme string can simultaneously support two non-isomorphic prosodic structures. In a string like *ku-la:p* (3POSS-wing) 'its wing', which surfaces as ['kula:p], both ω3 and ω4 are present simultaneously. Domain ω3 parses the string as '*ku*(***l***a:*p*)$_{\omega 3,}$ and this accounts for the fact that the stem-initial /l/ surfaces with its word-initial allophone [l]. Domain ω4 parses the same string as ('***ku***la:*p*)$_{\omega 4}$, and this accounts for initial stress.

Another solution found in the literature and reviewed in Section 2 is to posit an additional domain. One such additional level is the Clitic Group (C), and one might want to assign ω3 and ω4 to this level, e.g. ('*ku*(*la·p*)$_{\omega}$)$_{C}$. In Nespor and Vogel's (1986) origin proposal, the C domain references clitic elements which can be identified by morphosyntactic criteria and binds them to their phonological host. The crucial evidence for the motivation of such an intermediate domain comes from regular phonological processes which specifically apply in host-clitic combinations, such as enclitic stress in Latin. The Limbu domains ω3 and ω4 cannot be resolved along these lines because the prefix in *kula·p* is not a clitic, under any conception of this term: as noted in Section 4.1, Limbu possessive agreement prefixes, like all other nominal affixes, strictly subcategorize for nominal stems, they are regular elements of noun inflection, they cannot be gapped under identity, they systematically co-occur with agreement-triggering argument NPs, and, as agreement markers, one would conventionally analyze their scope as being over the head, not the phrase. Moreover, those elements in Limbu, which are *bona fide* clitics, are regularly included in both word domains under discussion, as we observed in (35). This suggests that equating one of the domains ω3 and ω4 with the Clitic Group would not reconcile Limbu with the Prosodic Hierarchy.

Another alternative is to equate one of the two domains with the phonological phrase, e.g. ('***ku***(*la·p*)$_{\omega}$)$_{P}$. This would eliminate the complexity at the word level by appealing to a prosodic structure which has already been defended in the literature, as noted with regard to

(36b). In the case of Limbu, however, such an analysis would simply shift the problem of multiple domains from the word level to the phrase because there already is clear evidence from intervocalic voicing (reviewed in Section 4.2.4) for a phonological phrase that encompasses longer sequences that any of the domains ω3 or ω4.

Yet another formal mechanism which has been proposed in the literature to account for multiple domains is recursion. One such analysis is Peperkamp's (1996) analysis of stress assignment in Neapolitan Italian, reported in Section 2. Applied to Limbu, one would then posit a stacked structure like ('***ku***(*la·p*)$_{\omega}$)$_{\omega}$. In such an approach the smaller domain would first be built, and in a second step, the larger domain would be constructed by the recursive application of the domain-defining processes. But, in contrast to the Italian stress data, the evidence for two domains in *kula·p* does not come from recursive application of one and the same phonological process, but from very distinct processes: /l/-alternation and glottal insertion for ω3, and stress and coronal assimilation for ω4. Put differently, a recursive structure entails that ω3 and ω4 are one and the same domain. This would then predict that they have the same phonological properties - a prediction that is patently false.

Yet another possible solution discussed in Section 2 is to assign different domains to different phonological tiers, such as the tone and quantity domains in Luganda. Again, this solution can not be carried over to Limbu because different domains are associated with exactly the same kind of segmental phonology: for example, one segmental assimilation rule is limited by domain ω2, which excludes prefixes, but another segmental assimilation rule references domain ω4, which includes prefixes.

A final solution is to assume a much more fine-grained theory of prosodic structure (Downing 1999) or to replace the theory by morpheme-bound prosodic subcategorization frames (Inkelas 1989). Although much of the apparent complexity in the phonological structure of Limbu can no doubt be handled well by these approaches, there remain crucial

problems. For instance, stress placement in Limbu seems to be tightly connected to the stem in appearing in the stem-initial syllable. This might be a motivation to regard stress as a feature of the prosodic stem and would resolve the ambiguous status of the stress domain which arises in an analysis which only considers prosodic words. However, the prosodic stem still has to cope with the restructuring of the stress domain in the case of disyllabic words which only consist of prefix and stem. The varying status of the prefix across the different word domains would be an equal challenge for prosodic subcategorization. A Limbu prefix is phonologically either cohering or non-cohering. The prefix would therefore have to come with two simultaneous subcategorization frames, specified for the relevant phonological processes: one frame selecting prosodic words would have to be specified for the /l/-alternation and glottal insertion, while another frame selecting some smaller prosodic constituents (e.g. prosodic stems) would have to be specified for stress and coronal assimilation rules.

5.3 Typological approaches

One possible typological approach would conceptualize the prosodic hierarchy as a repertoire of possible domain types (an 'etic' grid like the IPA) from which individual languages may or may not draw. Languages can then be typologized on the basis of what domains they select, and how prominent this selection is for their phonologies. Auer (1993, 1994), for instance, reinterprets the rhythmic type of 'stress-timed languages' as a class of languages in which the word domain is of particular importance for the phonological organization of the language. English would be a prototypical representative of such a language. Other languages, like for instance Yoruba, may make use of other prosodic categories, such as the syllable, to impose prosodic structure on their phonology. Fleshing out this idea, Kleinhenz (1996) enriches the

typology with a third class of languages in which the phonological phrase is the most salient prosodic domain. Such a constellation is presumably found in French. This methodology would provide us with a measure of typological variation and would allow us to situate the languages on a typological cline from syllable-based to word-based. In Vietnamese, the syllable is the major prosodic category and the word domain is not effective. Limbu makes use of both syllable and word phonology but the latter is arguably more salient.

Although this approach offers a more natural way of looking at cross-linguistic diversity within prosodic domains and allows us to typologize languages in a coherent way, it is still problematic: first, it does not account for the distribution of word domains, so that both a language with one word domain and one with multiple domains would be subsumed under the vague notion 'word-based'. Second, it is unclear what the ontological status of a universal inventory of domains would be: if it is part of UG it would need to be present in all languages; but if it is not part of UG, it is difficult to imagine what realm of entities it could possibly be assigned to. Unlike, say, the IPA inventory, domains have no language-independent phonetic grounding.

We propose a radical alternative, following recent advances in typological theorizing. Typological research in syntax, specifically on grammatical relations, has shown that grammatical relations vary widely within and across languages, i.e. the precise definition of grammatical relations in, say, Tagalog, Chechen, and English, are very diverse (e.g. Van Valin 2005 or Bickel 2007 for recent surveys) and have continued to challenge universal definitions of 'subject', 'object' etc. In a radical turn, Dryer (1997) suggested that the very search for universal definitions is flawed because there is no evidence that grammatical relations exist in a universal sense, i.e. dissociated from their language-particular properties. What exists are language-particular and construction-specific phenomena (e.g. the pivot of relativization in Tagalog, the controller of verb agreement controller of Chechen etc.),

observable similarities between these phenomena, and explanations for the observed similarities. Bickel (2005) proposes that the proper way of capturing observable similarities is by systems of variables, i.e. by analytical instruments measuring and classifying phenomena comparatively - in exactly the same way as similarities are captured or measured in any other discipline (cf. the analytical instrument of a meter that allows measuring length and thereby allows comparing the length of phenomena; there is no sense that the meter exists as anything else than an analytic instrument).

For research on word domains this suggests that instead of assuming an aprioristic, UG inventory of domains, we analyze language-specific and process-specific domains. In order to measure their similarity and study the distribution of these similarities with regard to areal or genealogical patterns, or with regard to the nature of processes (e.g. segmental vs. tonal processes), we need to develop suitable variables. One such variable which we currently examine quantitatively is *coherence*, a value which is defined by the number of the morpheme types (prefix, stem, suffix, clitic etc.) of a language that is included in a process-specific domain (e.g. the Limbu domain ω3 would have a coherence value 3, domain ω4 would have a value 4 etc.). Another variable is *diversity*, defined by the number of attested non-isomorphic domains in a language (relative to the logically possible number of such domains, as constrained by the morphology and phonology of the language). Yet another variable concerns the way in which domains are *interrelated* in a language: by properly bracketed hierarchies, by overlapping hierarchies, by tier-specific hierarchies, etc.

There may well be universal constraints on how these three variables combine, and cluster analyses on variables coded for many languages may unearth universal trends in prosodization. These are research issues we are currently exploring. But for present purposes, our conjecture is that universal constraints and trends are best seen as the result of cross-linguistic, quantifiable research rather than as pre-existing UG objects that are defined *a*

priori. The evidence for this conjecture is that the aprioristic constraints enshrined in the Prosodic Hierarchy fail to predict the observed diversity, just like aprioristic definitions of grammatical relations failed to predict the observed diversity of grammatical relations.

6. Conclusion

In this paper, we discussed the prosodic structure of two languages which challenge the theoretical assumptions of the Prosodic Hierarchy. Vietnamese is a language in which a prosodic word domain cannot be motivated on the basis of purely phonological rules. The phonology of the language thus exhibits less structure than would be predicted by Prosodic Phonology. For the architecture of prosodic structure this entails violations of Clustering and a consistent violation of Strict Succession. Limbu is a language in which multiple word domains can be motivated which overlap in non-trivial ways by referencing different portions of the grammatical word. The phonology of this language thus exhibits more structure than would be predicted by Prosodic Phonology. For the architecture of prosodic structure this entails violations of Clustering. The problems this evidence poses can neither be solved by the standard theory nor by more recent versions which allow more flexibility by weakening the Strict Layer Hypothesis or by providing more fine-grained inventories of prosodic domains or prosodic subcategorization.

We conclude that word domains cannot be postulated as universally pre-existing entities. What we can and should do instead is to typologize structures by measuring similarities between language-particular and process-particular domains. Similarities can be measured by variables of coherence (size of domains), diversity (range of domains) and relationships (bracketing types), and others. We discuss some these variables and their

quantitative distributions across linguistic areas and genealogical families in a companion paper. For current purposes, the conclusion we draw is that there is much more diversity in prosodic domains than theories make us believe, and that it is far from evident that domains should converge on a universal list like the one enshrined in the Prosodic Hierarchy.

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