ISSUES IN DZONGKHA PHONOLOGY:

AN OPTIMALITY THEORETIC APPROACH

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Cheryl Lynn Downs

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The Undersigned Faculty Committee Approves the

Thesis of Cheryl Lynn Downs:

Issues in Dzongkha Phonology: An Optimality Theoretic Approach

Robert Underhill

Robert Underhill, Chair
Department of Linguistics and Asian/Middle Eastern Languages

Jean Mark Gawron
Department of Linguistics and Asian/Middle Eastern Languages

Jessica Barlow
School of Speech, Language and Hearing Sciences

August 3, 2011

Approval Date

ABSTRACT OF THE THESIS

Issues in Dzongkha Phonology: An Optimality Theoretic
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by
Cheryl Lynn Downs
Master of Arts in Linguistics
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This thesis examines some phonological aspects of Dzongkha, the national language of Bhutan, through Optimality Theory (OT). In using OT to explain some language-particular phenomena, a set of constraints will be examined. These constraints, which either evaluate the markedness of output forms (markedness constraints) or disallow changes between input and output forms (faithfulness constraints) are universal, and, thus, are present in the grammars of all languages. It is the violability of these constraints along with their ranking which characterize the phonology of individual languages.

The specific phenomena examined here pertain to the relationship between syllable initials and tone as well as variation connected to underlying complex onsets and coda [k]. In regard to syllable initials and tone my analysis is such that faithfulness to lexical tone dominates faithfulness to the features of these segments, such as obstruent onset voicing and syllable-initial vowel breathiness, assuming an abundance of inputs (i.e. Richness of the Base). The result is an analysis which accounts for allophonic voicing of obstruent onsets and allophonic breathiness of vowel initials, both of which occur only in the low tone.

In addressing variation within Dzongkha, my consultant shows a preference for complex onset simplification, by way of either deletion or resyllabification of the initial consonant in the cluster, over faithfulness to the underlying representation. In the case of underlying coda [k] my consultant variably parses and deletes this segment.

In order to account for variation, two Optimality Theoretic approaches are examined. The first approach, known as the cophonologies approach, establishes distinct phonologies within the grammar which are indexed to different morphological constructions. The second approach, Stratal OT, also establishes multiple phonologies within the grammar; however, these phonologies are limited to three levels in the grammar: stem, word, and phrase. A comparison of the analysis under each approach shows very similar analyses.

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CHAPTER 1

INTRODUCTION

Dzongkha belongs to the Tibeto-Burman (TB) language family, a subgroup of the Sino-Tibetan (ST) family (Matisoff 1997, 2003). There are an estimated 160,000 speakers of Dzongkha living in the Kingdom of Bhutan (Lewis 2010, van Driem 1994). Furthermore, according to Ethnologue, there are an estimated 11,000 speakers in India and 300 speakers in Nepal (Lewis 2010). Thus, there are approximately 171,300 Dzongkha speakers worldwide. Interestingly, Dzongkha is spoken as a native language only in the western portion of Bhutan and, therefore, is the first language of less than half of the country's districts. While there are still many speakers of the language, van Driem (2007: 293-294) notes that:

> The position of English in education, government and daily life is such that even Dzongkha itself, the national language which is actively propagated by the Royal Government of Bhutan, occupies a precarious position alongside English…. [Additionally,] propagation of a standard form of the language [is] highly influenced by the Classical Tibetan liturgical language… 'Chöke.'

Further emphasizing the instability of Dzongkha in Bhutan, the Prime Minister of Bhutan, Lyonchoen Jigmi Y. Thinley, recently stated that English is the primary language of choice in informal and familial communications (as cited in "Simplifying, preserving Dzongkha" 2009). Clearly, the status of Dzongkha is threatened by the influences of both English and Chöke.

To my knowledge, previous work on Dzongkha has all been descriptive in nature. For example, work by Mazaudon and Michailovsky (1989/2006) and Watters (2002) provide descriptions of the sound system and tone in Dzongkha. In addition, Michailovsky (1989) has also published work briefly discussing the history of the Dzongkha writing system and its modern phonological differences from Central Tibetan. Going a step further, van Driem (1998) wrote an entire book on Dzongkha. Although he designed the textbook primarily for language learners, he does provide a more in-depth discussion of the sound system and tone in Dzongkha along with an explanation of Dzongkha orthography, and a "first exploration" of Dzongkha grammar. Lastly, Mazaudon (1985) has also published work documenting the Dzongkha number systems.

At present, there has been not been any analytical research of Dzongkha which employs contemporary phonological theory. As discussed above, the primary role of previous research on the language has been that of description and documentation.

The purpose of this thesis is to examine some aspects of Dzongkha phonology through Optimality Theory (OT) (Prince & Smolensky 1993/2002). In doing so, I will be providing an analysis of tone and obstruent voicing/vowel quality as well as an account of the variable means of complex onset simplification and the variable treatment of coda [k]. This is done primarily through analysis of the number system; however, the analysis is extended to other, non-numeric, data within the language where available. Finally, in accounting for variation, I will be examining two different approaches within OT: the cophonologies approach (Anttila 1997, 2002) and Stratal OT (Kiparsky 2000).

The benefit of this analysis is that it contributes to the limited body of work on Dzongkha, especially by means of providing an analysis using a current method of phonological analysis. Furthermore, I will also be adding to the body of knowledge on language typology.

Finally, for this study I will be using native speaker data collected for a course in field methods at San Diego State University during the Fall 2009 semester. The consultant who provided the data used in this study comes from the capital of Bhutan, Thimphu, which is located in the western part of the country. Her mother is from Bumthang, located in central Bhutan, and is a native speaker of the local language, Bumthang. Her father is from Monggar, located in eastern Bhutan, and is a native speaker of Sharchop. Her parents learned Dzongkha when they began attending school as it is a requirement to learn the country’s lingua franca. In addition, it is worth noting that the consultant attended an English language boarding school in Northern India from ninth through twelfth grade and, at the time of data collection, had lived in the United States as a student for about four years.

CHAPTER 2

LITERATURE REVIEW AND STRUCTURE OF DZONGKHA NUMBERS

This chapter starts with an overview of Optimality Theory, which is employed throughout the thesis (Section 2.1). This is followed by a discussion of two Optimality Theoretic approaches compared in this thesis, the cophonology approach (Section 2.1.1) and Stratal OT (Section 2.1.2). Next, the Dzongkha phonemic inventory, syllable canon, and tone are reviewed (Section 2.2). Lastly, the Dzongkha number system and its relation to the Tibetan number system is described in detail (Section 2.3).

2.1 Optimality Theory

Optimality Theory (OT) (Prince & Smolensky 1993/2002) developed out of the need for a phonological theory which could directly address constraints on output structures while working within the generative model. It takes the view that constraints are universal and, at the same time, addresses the issue that these "universal constraints [do] not hold in every language all of the time" (McCarthy 2008: 6). With this, the two central concepts of OT took shape: (1) universal constraints are violable and (2) constraints are ranked in a language-specific way. In other words, while all constraints are present in all languages, it is the varied ranking from language to language that determines the output structures in each language. This is because ranking involves one constraint "dominating" or taking priority over another (Kager 1999: 12-13, McCarthy 2008: 10, Prince & Smolensky 1993/2002: 2). Furthermore, domination results in the lower-ranking constraint being violated in order to avoid violation of the higher-ranking constraint; however, "violation is never gratuitous; it must always be compelled by some higher-ranking, conflicting constraint" (McCarthy 2008: 10).

The collection of constraints present in all languages is known as CON. Within CON there are two types of constraints, markedness constraints and faithfulness constraints. As implied above, these constraints work in opposition to each other, being "intrinsically in conflict," and, therefore, "every logically possible output of any grammar will necessarily violate at least some constraint" (Kager 1999: 3).[1] The role of faithfulness constraints is to assign violation marks to candidates (i.e. possible outputs) which differ from the input. Meanwhile, markedness constraints, which are unable to look back at the input, assign violation marks based on the well-formedness of candidates, directly addressing marked forms in the language. For example, the markedness constraint *COMP disallows complex onsets and codas. Thus, this constraint assigns a violation mark for each occurrence of consonant clusters in any syllable of an output candidate. It is important to note that, while marked linguistic forms are universally avoided, markedness is still "inherently a relative concept:… a marked linguistic element is not ill-formed *per se*" when compared to other constraints in the hierarchy (Kager 1999: 3). Thus, in a language such as English, words with complex onsets and codas are not considered ill-formed, even though complex onsets and codas are universally understood to be marked linguistic structures. Therefore, the acceptability of complex onsets and codas in English is due to the language-specific ranking where the markedness constraint *COMP is ranked comparatively lower than the faithfulness constraint against segment deletion, MAX (Kager 1999: 4-5, McCarthy 2008: 13, Prince & Smolensky 1993/2002: 2).

There are two mechanisms which make up OT: GEN and EVAL. GEN, short for 'Generator', produces candidates based on the input (McCarthy 2008: 16, Prince & Smolensky 1993/2002: 4).[2] According to McCarthy (2008: 16), "The phonological GEN performs various operations on the input, deleting segments, epenthesizing them, and changing their feature values. These operations apply freely, optionally, and repeatedly to derive the members of the candidate set." Furthermore, candidates of a particular input "compete" with one another to be the realized output form. Given that GEN can apply in such an unrestricted manner, the list of possible output candidates for a given input is infinite (Kager 1999: 18, McCarthy 2008: 17, Prince & Smolensky 1993/2002: 6).

[1] Kager (1999: 8) later notes that the opposition between faithfulness and markedness is more "fine-grained," occurring as a conflict between specific constraints of each class. Thus, "a language may give priority to faithfulness over markedness with respect to some opposition, but reverse its priorities for another opposition."

[2] The input is generally understood to be the same as the underlying representation (McCarthy 2008: 16).

In discussing inputs, it is important to note that the inputs to GEN are not language-specific. In other words, there is no restriction on what can be an input (Kager 1999: 19, McCarthy 2008: 88, Prince & Smolensky 1993/2002: 209). This concept, known as Richness of the Base, originates from the theory that "constraint ranking is the *only* systematic difference between languages" (McCarthy 2008: 88).

With the availability of any input to the grammar, together with an infinite candidate set, the job of the other OT mechanism, EVAL, is very important. According to Prince and Smolensky (1993/2002: 5), "The burden of explanation falls principally on the function [EVAL]," so this "shifts the burden from the theory of operations (GEN) to the theory of well-formedness ([EVAL])." Specifically, EVAL, short for 'Evaluator', must assess the violation marks assigned by CON in order to determine the "optimal" or most "harmonic" candidate (i.e. the candidate with the least severe violations of the language-specific constraint ranking), otherwise known as the output (Kager 1999: 19, McCarthy 2008: 19, Prince & Smolensky 1993/2002: 5). To put it another way, McCarthy (2008: 19) states:

> In more procedural terms, EVAL starts with the constraint that is ranked highest, CONST1, and extracts the subset of {*cands*} that is most favored by CONST1. This subset is passed along to the next constraint in the ranking, CONST2, which does the same thing: it locates the subset of candidates that it most favors and discards the rest. This process continues until the set has been reduced to just one candidate. This is the optimal candidate. It does better on the constraints as ranked than any other candidate in the original candidate set.

In summary, OT rests on the assumption that constraints are universal and violable. Furthermore, while inputs to the grammar are the same across all languages, it is the language-specific ranking of opposing faithfulness and markedness constraints that determines how languages differ. Lastly, it is the two mechanisms of OT, GEN and EVAL, which respectively function by generating the infinitely possible candidate set for an input and finding the optimal candidate.

2.1.1 The Cophonology Approach

While the original thought behind OT was that constraints are strictly ranked in relation to one another, newer approaches have been posited which do not follow this assumption. These newer approaches are useful for analyzing phonological issues such as free variation, as is found in Dzongkha.

One such approach is a restricted version of cophonologies (referred to henceforth as simply 'cophonologies'). Anttila (1997) defines cophonologies as a single grammar that is made up of a set of partially ordered pairs of constraints (see also Anttila 2002, 2007, Inkelas 2008, Inkelas & Zoll 2007).[3] This single grammar is essentially a "Master Ranking," as coined by Inkelas and Zoll (2007), that consists of separate phonologies. Furthermore, these separate phonologies, or cophonologies, are subsets of the Master Ranking and, thus, must conform to it (Anttila 1997, 2002, 2007, Inkelas 2008, Inkelas & Zoll 2007). For example, if a hypothetical language has a master ranking where *COMP dominates both MAX and DEP, but MAX and DEP are unranked in relation to one another (i.e. * COMP » MAX, DEP), then one cophonology will be ranked such that MAX dominates DEP and another cophonology will rank DEP above MAX (but both cophonologies will maintain the ranking of *COMP above MAX and DEP).[4] This results in a "grammar lattice" (see Figure 2.1).

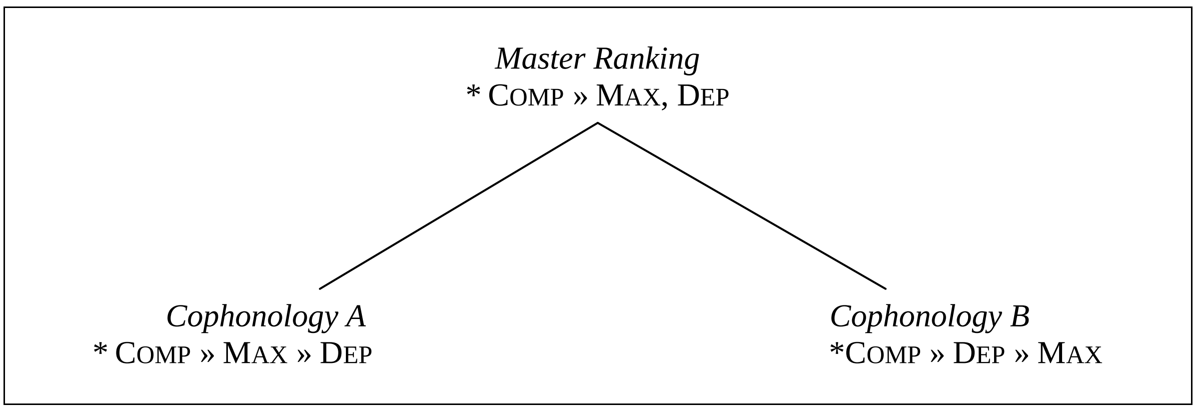

Figure 2.1. Grammar lattice.

The cophonology approach posits that each cophonology can be "indexed to such components of the language as register, lexical class, morphological category, [etc.]" (Inkelas & Zoll 2007: 135). Therefore, using the grammar lattice in Figure 2.1, it is possible for a hypothetical language to have one construction that is associated with Cophonology A, while

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[3] Anttila (1997: 36) cites Kiparsky's (1993) work on variation in OT as the central influence in development of the cophonology approach. Inkelas and Zoll (2007: 135) cite Orgun's (1996) dissertation and Anttila (1997) as leading to the development of the cophonology approach.

[4] Recall that *COMP is the markedness constraint against complex onsets and codas and MAX is the faithfulness constraint against segment deletion; DEP is the faithfulness constraint against epenthesis.

another is associated with Cophonology B. Additionally, although not obvious from the oversimplified grammar lattice above, where a cophonology has two or more constraints that are unranked in relation to one another it may have a subordinate cophonology of its own (Anttila 2002, 2007, Inkelas & Zoll 2007).

The reason for cophonologies resulting from partially ordered constraints comes from the abundance of freely varying forms occurring within languages. Under the original understanding of OT (Prince & Smolensky 1993/2002), where constraints are ranked in a strict dominance hierarchy, variation can only be accounted for when two candidates perform exactly the same on a constraint set; thus, EVAL is unable to choose between the two candidates and both candidates are selected as optimal (McCarthy 2008: 260-261). Free variation poses two important issues for traditional OT. First, in practical application to data, the traditional OT analysis of variation is improbable due to "rich" constraint sets whereby identical performance is highly unlikely (McCarthy 2008: 260-261). Second, according to Anttila (1997: 46), an analysis which explains variation as arising out of identical performance of candidates is "truly the poor man's way of dealing with variation" as a complete ordering of constraints would predict an equally split chance of either form occurring. Importantly, variation is not actually free: "Native speakers usually report that one variant sounds better than the other while agreeing that both variants are possible" (Anttila 1997: 37). Moreover, speaker preferences of variants are usually supported by large corpora, whereby the preferred variant occurs more frequently than the less preferred one (Anttila 1997: 37). Systems of completely ranked constraints, therefore, do not provide an accurate picture of variation.

In contrast with traditional OT, under the cophonology approach variation is understood as arising out of crucially unranked constraints; where constraints are unranked in relation to one another, violations of these constraints may occur: "However, no single violation is by itself bad enough to resolve the competition and the battle of constraints results in a gradient output" (Anttila 1997: 58). Moreover, unlike strictly ranked constraints, partial orderings can make predictions about the frequency of one variant's likeliness to occur over another, rather than predicting a fifty-fifty split (Anttila 1997: 47). In other words, in a given grammar with *x* constraints that are unranked in relation to one another, *y* outputs (equal to or less than *x*) are possible. Importantly, some rankings may lead to the same output, giving a stronger probability that that variant will occur over another.[5]

In order to assert the accuracy of the grammar in making predictions of variable outcomes, however, it is necessary to have access to corpus data: "The quantitative preferences that accompany variation are not easily accessible to intuition… In order to study phonological variation, especially its quantitative aspects, one will typically need large amounts of usage data" (Anttila 2007: 535). While variation is present in my consultant's dialect, it is worth noting here that the data from a single consultant is not sufficient to make quantitatively supported predictions of preferred variants. Instead, this will be reserved for a later date, with the hopes that a Dzongkha corpus will someday be available.

2.1.2 Stratal OT

Yet another approach to OT combines the ranked constraints of classic OT with the stratal approach of Lexical Morphology and Phonology (Kiparsky 1982). This approach is known as Stratal OT (Kiparsky 2000). Recall that traditional OT is focused on output structures. As such, potential outputs (candidates) are evaluated against a single level of concurrent constraints. The result is that, under its traditional framework, OT is unable to account for derivational effects without proposing "otherwise unneeded powerful new types of Faithfulness constraints… which have turned out to compromise the OT program very severely" (Kiparsky 2000: 351).

In contrast, Stratal OT is able to successfully handle such issues without additional constraints on the basis that phonology and morphology are interwoven. Under this framework, then, languages are comprised of sequential stem, word, and phrase strata whereby each level comprises a "phonological subsystem." Importantly, each stratum may have different constraint rankings from the other strata. Furthermore, the output of one stratum becomes the input of the next stratum.

Figure 2.2 provides a diagram, taken from Kiparsky (2010), which illustrates the process of Stratal OT. Starting with a stem (A), the stem is subjected to stem-level

[5] Notably, in cases where there are only two constraints that are unranked in relation to one another a fifty-fifty split is predicted; however, given that all constraints are present in all languages, the constraint sets would be so abundant that such an even split should not be theoretically possible.

$[A]_{\text{Stem}}$
↓ (phonological constraints on stems are enforced)
$[A']_{\text{Stem}}$
↓ (B affixed to A´)
$[A' + B]_{\text{Word}}$
↓ (phonological constraints on words are enforced)
$[A'' + B']_{\text{Word}}$
↓
⋮
↓
output

Figure 2.2. Stratal OT.

phonological constraints. An affix (B) is then attached to the output of this level (A´). Next, the stem and affix ([A´+ B]), which together form a word, undergo word-level phonology. The optimal output of the word-level phonology is then run through the syntax and becomes the input for the postlexical phonology (not shown in the diagram).

By positing a grammar in which the morphology, phonology and syntax all interact, the grammar is able to account for phenomena which would otherwise be problematic in a single-leveled, parallel analysis such as traditional OT. This is because, "the intrinsic seriality of strata gives rise to 'derivational' effects" (Kiparsky 2010: 1). The benefits of using this approach to account for my data are discussed in Chapter 6.

2.2 DZONGKHA

Dzongkha is derived from the colloquial dialect of Old Tibetan spoken in the region long ago; however, it is a separate language from Modern Tibetan due to "many centuries of independent linguistic evolution on Bhutanese soil" (van Driem 1998: 3). In fact, children of Tibetan immigrants living in Bhutan speak Dzongkha rather than Tibetan as they are "linguistically assimilated" (van Driem 1994: 90).

Prior to 1961 Dzongkha was a purely spoken language. Before this time, the literary language, which had been used for centuries in religious and scholarly texts, was Classical Tibetan, known in Bhutan as Chöke (Michailovsky 1989: 298, van Driem 1998: 5). While Dzongkha and Chöke are linguistically two separate languages, they were not commonly understood as such until the mid twentieth century. Before this time, Chöke was "considered… the literary form of Dzongkha" (van Driem 1998: 8).

Due to Bhutan's strong literary tradition, Chöke still has an influence on the vocabulary of modern Dzongkha (van Driem 1998: 4). Furthermore, because the reading pronunciation of Chöke texts uses modern Central Tibetan, or 'Chöke pronunciation,' and not Dzongkha, Chöke has a strong influence on the pronunciation of literary and religious vocabulary to this day (Michailovsky 1989: 298, van Driem 1998: 4-5). Additionally, modern Dzongkha writing has, for the most part, preserved Chöke spelling even in cases where two orthographically different words are phonologically identical in Dzongkha. The exception has been in cases where Dzongkha pronunciation differs drastically from that of modern Central Tibetan and has merged with the pronunciation of another modern Central Tibetan word (Michailovsky 1989: 289). Thus, the line between modern Dzongkha orthography and Chöke is blurred, clearly aiding the influence of Chöke on literary pronunciations.

The following is a discussion of the sound system of Dzongkha (Section 2.2.1), with a brief overview of some aspects of the phonology of the language. This is followed by a description of the Dzongkha syllable canon (Section 2.2.2) and an outline of Dzongkha tone (Section 2.2.3).

2.2.1 The Phonemic Inventory of Dzongkha

As discussed in Chapter 1, there has been limited descriptive work on Dzongkha over the years. More recently, Martine Mazaudon and Boyd Michailovsky (1989/2006) briefly outlined Dzongkha initials and also provided some descriptive work on Dzongkha tone and the syllable canon. Subsequent work by Watters (2002) provided a general description of the Dzongkha sound system and tone along with four other languages from the Tibetan language family. The most thorough notation of the Dzongkha sound system to date, however, was conducted by George van Driem (1998). His work discusses Dzongkha consonantal initials, consonantal finals, and vowels (in addition to tone and grammar). For reasons of thoroughness as well as conformity with my consultant's dialect, van Driem's and Mazaudon and Michailovsky's descriptive work will be used throughout this chapter.[6]

[6] Like my consultant, van Driem's consultant is from Thimphu; however, his consultant did spend time in the neighboring Dagana district as a child (Karma Tshering 2011). The consultants used in Mazaudon and Michailovsky's (1989/2006: 116) study come from Thimphu and the neighboring Chapcha district. Watters's

2.2.1.1 The Consonants

Van Driem (1998) reported the following forty-four consonants in his phonetic description of the Dzongkha sound system (as shown in Table 2.1): sixteen oral stops, six fricatives, two fricative trills, one lateral fricative, seven affricates, four complex bilabial-palatal affricates, four nasals, and four approximants. Van Driem found that the oral stops, the complex bilabial-palatal affricates, and the palatal affricates may be voiceless, voiceless aspirated, voiced, or devoiced at each place of articulation.[7] The fricatives, according to Van Driem, may be voiceless, voiced, or devoiced and the remaining affricates may be voiceless, voiceless aspirated, or voiced. Regarding the Dzongkha rhotics, van Driem (1998: 92) found that they may be either voiced or voiceless and have "a slightly fricative character reminiscent of Czech ř"; however, he states that the Dzongkha rhotics are frequently pronounced as "an approximant like [r]." Additionally, van Driem observed two laterals in Dzongkha: a voiced lateral approximant and a voiceless lateral fricative. The remaining consonants are shown in Table 2.1.

While van Driem gives a phonetic inventory, I provide a phonemic inventory (see Table 2.2). Notably, van Driem's book isn't expressly written for linguists and, as such, he does not explicitly differentiate between phonemes and allophones, only going so far as to allude to their complementary distribution: "Certain Dzongkha initial consonants (k, kh, p, ph, etc) are automatically in the high register tone, whereas syllables with other initials (g, g', b, b', etc.) are in the low register tone" (van Driem 1998: 70).[8] Considering that it is widely acknowledged that voiceless obstruents are the unmarked form (Kager 1999: 40, Ladefoged & Maddieson 1996: 90, Maddieson 1984: 27-45), and, moreover, that the distribution of voiced obstruents is predictable (occurring only in onset position in syllables with low tone), voiceless obstruents are indicated in my phonemic inventory of Dzongkha

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(2002: 1) consultant is from Pasakha, West Bengal, India.

[7] Van Driem (1998: 71) notes that devoiced consonants are termed as such in reference to their historical source. He describes these consonants as being "unvoiced, but, in contrast to the voiceless consonants, they are followed by a murmured or 'breathy voiced' vowel."

[8] An IPA transcription of van Driem's notation is, [k], [kʰ], [p], [pʰ], [g], [g̊], [b], and [b̥], respectively.

Table 2.1. Van Driem's Phonetic Inventory of Dzongkha Consonants

	Bilabial	Dental/ Alveolar	Retroflex	Palatal	Velar	Glottal
Stop	p b pʰ b̥	t d tʰ d̥	ʈ ɖ ʈʰ ɖ̊		k g kʰ g̊	
Fricative Trill		r̝̊ r̝				
Fricative		s z z̥		ɕ ʑ ʑ̥		
Lateral Fricative		ɬ				
Affricate		ts dz tsʰ		tɕ dʑ tɕʰ dʑ̥		
Complex Affricate				ptɕ bdʑ ptɕʰ b̥dʑ̥		
Nasal	m	n		ɲ	ŋ	
Approx.	w			j		h
Lateral Approx.		l				

Table 2.2. The Phonemic Inventory of Dzongkha Consonants

	Bilabial	Dental/ Alveolar	Retroflex	Palatal	Velar	Glottal
Stop	p pʰ	t tʰ	ʈ ʈʰ		k kʰ	
Fricative Trill		r̝				
Fricative		s		ʃ		
Affricate		ts tsʰ		tʃ tʃʰ		
Nasal	m	n		ɲ	ŋ	
Approximant	w			j		h
Lateral Approx.		l̥ l				

(for further discussion, see Chapter 3).[9,10] Thus, van Driem's phonetic inventory includes voiced and devoiced obstruents while my phonemic inventory does not.

There is, however, one exception to this generalization: the voiced alveolar fricative trill, [r̝]. Here, the voiced alveolar fricative trill is understood as the base phoneme while its voiceless counterpart is its allophonic variant. Support for this analysis comes from the predictable distribution of the voiceless alveolar fricative trill, which only occurs in onset position of syllables in the high tone. The voiced alveolar fricative trill, on the other hand is a possible coda, in addition to occurring in onset position of syllables in the low tone (see Section 2.2.3). Additionally, in Maddieson's (1984: 79-80) study, he notes that the majority of rhotics are voiced and, furthermore, this holds true for rhotic fricatives. Moreover, this categorization is consistent with the findings of Ladefoged and Maddieson (1996: 237) who note that the allophonic status of voiceless rhotics is "quite common" in the world's languages.

In regard to devoiced consonants, it is important to note here that although my consultant exhibits some evidence of devoiced consonants, they are extremely rare or inconsistently produced, and, sometimes, they do not match up with the devoiced consonants that van Driem reported in his study. The few examples of devoiced obstruents that I did note were [z̥], [ʒ̊] and one occurrence of [d̥ʒ]. For example, I transcribed 'eat' as [z̥ɑ] and 'bridge' as [z̥ɑm], both starting with a devoiced alveolar fricative. This is consistent with van Driem's transcription of the word. However, I also found that the obstruent onsets in 'body', [z̥uː], and, sometimes, 'four', [ʒ̊i], are also devoiced, contrary to what van Driem found. In addition I found that 'bird' varies between being voiced (e.g. [dʒɑ]) and devoiced (e.g. [d̥ʒɑ]). (Van Driem transcribes it as being devoiced.) Mazaudon (1985: 152) notes that

[9] Although I use broad transcriptions throughout the study, allophonic obstruent voicing is indicated in transcriptions, rather than tone, for reasons of simplification.

[10] Further support for this synchronic analysis comes from DeLancey's (2003) and Tournadre and Dorje's (2003) analysis of Lhasa Tibetan phonology where they acknowledge that obstruent voicing is not phonemic. Furthermore, DeLancey also acknowledges that modern tone reflects a diachronic voicing opposition in obstruents (among other indicators). This is due to Proto-Tibeto-Burman having a voiceless/voiced distinction in obstruents and, likely, a lack of contrastive tone (Matisoff 2003: 12, 15). In addition, Hayes (2009: 291) states that tone must be lexically marked in tone languages; clearly, this argues for the allophonic status of voiced obstruents due to lexical tone (synchronically speaking), and not the other way around.

in some Dzongkha dialects the devoiced consonants have merged with voiced consonants. This is quite possibly the case with my consultant. Because of my consultant's near non-existent production of these devoiced consonants, they will not be addressed in this current study.

Van Driem's inventory differs in three ways from the inventory obtained from my consultant. First, the alveolo-palatal fricatives ([ɕ] and [ʑ]) and the affricates ([tɕ], [tɕ^{h}], [dʑ], and [d̥ʑ]) will not be represented as such in this study. Instead, I transcribe them as palato-alveolar fricatives and affricates ([ʃ], [ʒ], [tʃ], [tʃ^{h}], [dʒ], and [d̥ʒ], respectively).[11] Although Mazaudon and Michailovsky (1989/2006) also use alveolo-palatal fricatives and affricates in their transcription of Dzongkha, these are not present in my consultant's dialect. One possibility for this disparity could be due to the amount of time my consultant has been living in the United States, speaking only English the majority of the time. Yet another possibility could be due to the pervasiveness of English in Bhutan, primarily in the younger generations. Whatever the reason, the difference in transcription is not such a far stretch as [ɕ] and [ʃ] have some similarities in manner of pronunciation; the main difference being that "the blade and the body of the tongue are higher in the mouth" for [ɕ] (Ladefoged & Maddieson 1996: 153). Nevertheless, further support for transcription of these consonants as palato-alveolar fricatives and affricates comes from Maddieson (1984: 53-54) who found that [s], [f], and [ʃ] are three of the most commonly occurring fricatives in the languages of the world and, moreover, the grouping of [s] and [ʃ] in languages with only two fricatives is very frequent, second only to [s] and [f] groupings. This is also consistent with the most common place of articulation for affricates being palato-alveolar (Maddieson 1984: 38).

A second difference is that my consultant does not use the complex onsets [ptɕ], [ptɕ^{h}], or [bdʑ] in colloquial speech.[12] Instead, she uses complex bilabial-palatal affricates

[11] All affricates (including [ts], [ts^{h}], and [dz]) are considered to be single units even though they are not connected by linking marks. This is used for reasons of transcription simplification as sequences of stop + fricative (e.g. t + s or d + ʒ) are not possible in Dzongkha.

[12] Additionally, she does not use the devoiced bilabial-palatal affricate, [b̥d̥ʑ], which is not included here, given the discussion above.

only in very formal speech.[13] Thus, in colloquial speech, these complex onsets are reduced to their affricated form (transcribed by me as [tʃ], [tʃʰ], and [dʒ], respectively), with the initial stop ([p] or [b]) not being said. Importantly, Mazaudon and Michailovsky (1989/2006: 117) note that this reduction of complex onsets is also present in the dialects of speakers west of Thimphu (e.g. Paro). This phonological simplification is more prevalent than van Driem's account would have us believe.

Finally, van Driem transcribes the Dzongkha voiceless lateral as a voiceless alveolar lateral fricative [ɬ]; however, for this study, I have chosen to note it as a voiceless alveolar lateral approximant [l̥]. While some field linguists do not distinguish between fricative and approximant laterals because they are not used contrastively in languages, Maddieson and Emmorey (1984) found that there are, in fact, acoustic differences between the two voiceless laterals. Furthermore, these differences have important phonological implications, as shown below, therefore, making it essential to distinguish which voiceless lateral is present in the Dzongkha phonemic inventory. The following is an outline of the argument in favor of my transcription of the voiceless lateral as [l̥].

First, although voiceless approximant laterals are not as common as voiceless lateral fricatives in the languages of the world, when present they always co-occur in phonemic inventories with their contrastive, voiced counterpart, [l] (Maddieson 1984: 74-75, Maddieson & Emmorey 1984: 187-188). Indeed, this is the case for Dzongkha, which has [l]. In contrast, Maddieson (1984: 75) found that "voiceless lateral fricatives are reported in inventories that contain no voiced lateral approximant." Furthermore, in languages that do have [ɬ], there is a high probability that these languages will have an affricate allophone (Maddieson 1984: 75). Notably, in Dzongkha this phoneme does not have an affricate allophone.

Next, Maddieson (1984: 78) notes that there is a tendency for voiceless approximant laterals to not be retained over time because they "are difficult to distinguish from their non-lateral counterparts (e.g. … [l̥] → [h])." Interestingly, the process of [l̥] becoming [h] is

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[13] However she notes that older generations (such as her parents) use the bilabial-palatal affricates.

present in my consultant's dialect. This is seen, for example, in the word 'learn' *lhab,* where it is still pronounced [l̥ɑp] in formal speech but is pronounced [hɑp] in colloquial speech.

Lastly, Ladefoged and Maddieson (1996: 198) note that it is common for languages with voiceless approximant laterals to have corresponding voiceless nasals. Although voiceless nasals are not present in my consultant's dialect, Mazaudon and Michailovsky (1989/2006: 117) found that the voiceless nasals [n̥] and [m̥] are, in fact, present in some dialects of Dzongkha. Furthermore, they note that, in the Thimphu dialect, the voiceless lateral and the voiceless nasals have mostly merged with [h]. Clearly, these many typological observations support the Dzongkha voiceless lateral as being transcribed as [l̥].

For this study, words will be transcribed using a phonemic inventory of the consonants produced by my consultant as shown in Table 2.2 (p. 12). The exception to this, however, is allophonic obstruent voicing which I indicate in transcriptions, rather than marking lexical tone, for reasons of simplification.

2.2.1.1.1 Onsets

The consonants inventoried in Table 2.2 (p. 12) are all possible onsets in both word-initial and word-medial contexts. Recall that complex onsets are not possible in my consultant's dialect; thus, they are not indicated in the table. As briefly touched on above, obstruent onset voicing is the allophonic reflex of low tone syllables (see Chapter 3 for further discussion). Furthermore, tone is distinctive after all onsets.

2.2.1.1.2 Codas

It is typical of many of the world's languages to have constraints on acceptable codas (Kager 1999). This is also true of Dzongkha. According to van Driem (1998: 94), the possible codas are [p], [k], [ʃ], [m], [n], [ŋ], [l], and [ɾ̥]. This, for the most part, corresponds to what was reported in this study. The following is a discussion of these possible codas.

An inventory of the data elicited from my consultant shows that [p], [k], [m], [n] and [ŋ] are the most common codas in the language. Interestingly, van Driem notes that both [n] and [p] are sometimes found as codas when not present in the orthography of the word (e.g.

sa-khra, [sɑp. ʈʰɑ] ‘map’).[14] The codas [p], [m], and [n] are very common and quite unnoteworthy.

The coda [ŋ] varies between being pronounced and producing nasalization when in word-final position; in the latter case, its only indication is a nasalization of the preceding vowel (van Driem 1998: 95). For example, my consultant varies in her pronunciation of ‘wood’ as either [ʃiŋ] or [ʃĩ]; however, she shows a clear preference for nasalizing the preceding vowel over pronunciation of coda [ŋ]. This is also noted by Mazaudon and Michailovsky (1989/2006: 129). It is my suspicion that the pronunciation of word-final [ŋ] occurs in more formal registers. If coda [ŋ] occurs in word-medial position, my consultant exhibits a preference for pronouncing it (e.g. ‘mountain’ [gɑŋ. ɽ̥i] and ‘hello’ [ku. zu. zɑŋ. po]). Again, this is likely due to a more formal pronunciation. In contrast, van Driem’s consultant does not exhibit this preference. Instead, his consultant shows a preference for place assimilation to the following onset if it is a possible nasal coda (e.g. *gangs-ri* [g̊ɑ̊ːn. ɽ̥i] ‘mountain’, *sku-gzugs-bzang-po* [ku. zu. zɑːm. bo] ‘hello’, *gzung-ni* [zuːn. ni] ‘to catch’, but *snying-rje* [ɲiŋ. dʒe] ‘mercy’) (van Driem 1998: 74, 427, 88, 78, respectively). It should be noted that van Driem does not address these variations; instead they are from my own observations in listening to the text’s accompanying audio recordings.

In regard to coda [k], van Driem (1998: 95) notes that “sometimes, a word has final ‘k’ in a literary pronunciation, but lacks final ‘k’ in colloquial Dzongkha.” The example van Driem (1998: 95-96) gives comes from the name of a sacred monastery called ‘Tiger’s Nest’ *stag-tshang* which is pronounced [tɑk. tsʰɑŋ] in the literary pronunciation, but [tɑ. tsʰɑ] in the colloquial pronunciation. (Coda [k] in [tɑk. tsʰɑŋ] occurs in word-final position.)[15] In contrast with word final coda [k], van Driem transcribed numerous instances of word-medial coda [k] in the speech of his consultant (e.g. ‘happy’ [gɑ. tok. to], ‘preventative measures’ [dok. tʰɑp], and ‘ink’ [nɑk. tsi] to give a few). Evidently, then, coda [k] does not occur word finally, except in formal pronunciations, but is acceptable word-medially. This is

[14] This point will prove to be important in later chapters.

[15] These transcriptions are based on van Driem’s transcription, which I have translated into IPA.

precisely the pattern found in my consultant's dialect. To illustrate, she says 'eye' as [mik. to] *mig-to*, but 'speech' as [ŋɑ] *ngag*. This points to the existence of different constraints on acceptable codas in word-medial position versus word-final position. This will be more thoroughly discussed in Chapter 5.

Next, van Driem asserts that Dzongkha words with a coda [l] come from Chöke. For example, he notes that there is a pronounced coda [l] in the Chöke-derived words *kun-gsal* [kʏn. sɛl] 'newspaper' and *glo-gsal* [lo. sɛl] 'journal, magazine'. Although there are many more words in the language with an orthographic *-l* final, van Driem (1998: 96) states that, for the most part, /-l/ is "never pronounced in colloquial speech." It is worth noting that my consultant does pronounce coda [l]; however, its occurrence is extremely rare and is reserved for careful speech. For example, she says 'bedroom' as [ɲɛl. sɑ] in careful speech, but [ɲɛ. sɑ] in fast speech. This clearly points to my consultant's use of a formal register, using the Chöke pronunciation, when responding to single-word elicitations.

Unlike coda [l], [ɾ̥] is a reading pronunciation which is fairly common in informal speech. Furthermore, van Driem states that literary pronunciations "reflect the profound extent to which the modern culture of Bhutan is influenced by the literary tradition" (van Driem 1998: 96). For example, van Driem (1998: 96) notes that the proper name, which is orthographically *karma*, may be pronounced as either [kɑː. mɑ] or [kɑɾ̥. mɑ] in colloquial speech. Another example produced by my consultant comes from the word for 'beef', literally 'cow meat', which is said as either [noɾ̥. ʃɑ] or [noː. ʃɑ]. According to my consultant, the variant with a coda [ɾ̥] comes from her mother's native language, Bumthang. A final example from my consultant is the proper name [doɾ̥. dʒi].

The final coda that van Driem (1998: 96) notes is [ʃ]. This coda "occurs in Dzongkha at the end of the familiar form of the imperative form of verbs where it corresponds to the urging particle... in traditional orthography" (van Driem 1998: 96). Indeed, the use of this coda is so specific to a particular context it was never encountered in my data.

To summarize, the codas [m], [n], [ŋ], and [p] are the most common and the least constrained. Next, [k] is also common; however, there are some restrictions on where coda [k] can occur. Namely, it may only occur word-medially, except for in the formal register where it may also occur in word-final position. The continuant finals [l], [ɽ̥], and [ʃ] are the least common codas, having very specific contexts in which they can occur (i.e. in formal/reading pronunciations or when saying a command). Table 2.3 provides an inventory of word-medial codas.

Table 2.3. Word-Medial Codas in Dzongkha

	Bilabial	Dental/ Alveolar	Retroflex	Palatal	Velar	Glottal
Stop	p				k	
Fricative Trill		ɽ̥				
Fricative				ʃ		
Affricate						
Nasal	m	n			ŋ	
Approximant						
Lateral Approx.		l				

Table 2.4 provides an inventory of word-final codas.

Table 2.4. Word-Final Codas in Dzongkha

	Bilabial	Dental/ Alveolar	Retroflex	Palatal	Velar	Glottal
Stop	p					
Fricative Trill		ɽ̥				
Fricative				ʃ		
Affricate						
Nasal	m	n			ŋ	
Approximant						
Lateral Approx.		l				

2.2.1.2 THE VOWELS

In van Driem's transcription of Dzongkha, he found that there are thirteen vowels. The first five of these vowels, [ɑ], [e], [i], [o], [u], are contrastive in length. The remaining three vowels, [ɛ], [ø], [ʏ], do not exhibit this contrast, as they are always long (van Driem

1998: 62).[16] Finally, van Driem (1998: 63) found that vowels are always long when followed by [ŋ]. Thus, contrastive vowel length is neutralized in this environment. Figure 2.3 gives an inventory of the thirteen vowels.

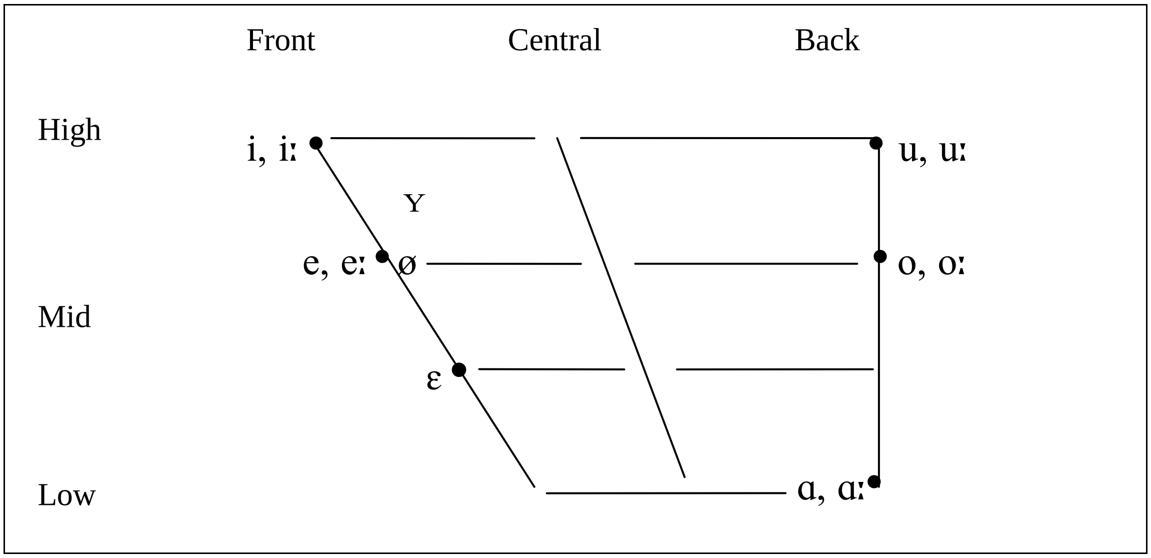

Figure 2.3. The Dzongkha vowel inventory.

Van Driem's notation of Dzongkha vowels is consistent with the findings in my study; however, there are two points of departure between my transcription and van Driem's. The first difference deals with allophonic 'breathiness' of vowels. While van Driem notes that syllable-initial vowels in the low tone have a "breathy phonation," breathy vowels were nearly non-existent in my consultant's dialect, with the exception of one minimal pair: 'milk' [oːm] and 'come' [o̤ːm]. (Vowel breathiness is indicated by the diacritic [̤].)

The second difference deals with the allophonic variation between tense and lax short vowels. In van Driem's (1998: 64-70) phonetic inventory, he notes that the pronunciation of [i] may freely vary between [i] and [ɪ] within a single word, that the pronunciation of [e] may vary between [e] and [ɛ], and that [ɑ] approaches [ʌ]. In contrast with the free variation between tense and lax vowels that van Driem found, my consultant produces these phones in complementary environments. Thus, while my consultant produces the phonemes [e], [i],

[16]Although I do not explicitly indicate length on [ɛ], [ø], and [ʏ], they should be understood as being long.

and [ɑ] in open, word-final syllables (e.g. *me* [me] 'fire', *mi* [mi] 'people'/'person', *nga* [ŋɑ] 'I'), she produces their respective allophones, [ɛ], [ɪ], and [ʌ] in closed syllables (e.g. *men* [mɛn] 'no'/'not', *khyim* [tʃɪm] 'house', *gnam* [nʌm] 'sky') and in open, word-medial syllables (e.g. *me-tok* [mɛ. to] 'flower', *byi-li* [dʒɪ. li] 'cat', [bʌ. ti] 'lamp').[17,18, 19]

In addition, it should be noted that the phonemes [ɛ], [ø], and [ʏ] were, historically speaking, allophones of [ɑ], [o] and [u], respectively. Mazaudon and Michailovsky (1989/2006: 118) were the first to note the fronting of back vowels before dental and alveolar finals; however, due to syllable edge erosion, the environment in which these allophones appeared (i.e. before */-l/, */-d/, */-n/, or */-s/) is no longer distinguishable (except for orthographically), leading to their status as separate phonemes. This contrast is seen in minimal pairs such as *glu* [lu] 'song' and *glud* [lʏ] 'dough effigy' (van Driem 1998: 65). The exception to this, however, is [n], which is the only consonant of this group that is still an acceptable coda. This is to say that, while [ɛ], [ø], and [ʏ] are distinct phonemes (synchronically speaking), this distinction is neutralized before [n] codas. Thus, [ɑ], [o] and [u] never occur before a coda [n]. Furthermore, recall that [ɛ], [ø], and [ʏ] are always long; thus, in addition to the fronting of back vowels, these finals also led to compensatory lengthening of the vowel.[20, 21]

Finally, an additional point of interest resides in the phonemic status of long vowels in Dzongkha. The historical finals */-r/, */-l/, and (usually) */-s/, which are no longer

[17] The orthographic forms, with the exception of 'house' and 'sky', come from the Dzongkha Development Commission (2010), which I have transliterated into Roman Dzongkha. The orthographic forms for 'house' and 'sky' come from van Driem (1998). Notably, I do not have an orthographic form for 'lamp' nor have I found one that matches my consultants output in van Driem (1998) or in the Dzongkha Development Commission's Dzongkha-English dictionary; thus, a transliteration is not provided for this form.

[18] However, we did find some examples in closed syllables which retain the tense phonemes. As it turns out, these are examples of long, tense vowels (e.g. 'yellow' [seːp], 'long' [riːm],and 'leg' [kɑːm]).

[19] In my transcriptions I do not indicate allophonic laxing of vowels.

[20] van Driem (1998: 105) states that [ɑ] fronting has some variation in its historical realization: before coda [n] it freely varies between [ɛ] and [e]; however, with historical 'd'finals the modern reflex is [eː]. Otherwise, historical 's' and 'l' finals have yielded modern [ɛ].

[21] Given that compensator y vowel lengthening in [ɛ], [ø], and [ʏ] is the result of the loss of the dental/alveolar finals */-l/, */-d/, */-n/, and */-s/, it is possible that [ɛ], [ø], and [ʏ] are phonetically less long before [n] finals, which are still possible codas.

possible codas, left a 'trace' in the form of compensatory vowel lengthening in modern Dzongkha (Mazaudon & Michailovsky 1989/2006: 127-128, van Driem 1998: 104).[22] This is seen, for example, in both van Driem and Mazaudon and Michailovsky's notation of words such as *ser-po* [seːp] 'yellow', *bsil* [siː] 'cold'/'cool', and *nyis* [ɲiː] 'two', though van Driem only discusses vowel lengthening in regards to historical */-r/ and */-s/ finals. Furthermore, some historical */-d/ and */-g/ finals have led to long vowels in modern forms (Mazaudon & Michailovsky 1989/2006: 125-126). Though not explicitly addressed by van Driem, this is seen, for example, in his transcription of words such as: *khyid* [giː] 'fist', *brjed* [dʒeː] 'forget', and *gzig* [ziː] 'leopard'. Unfortunately, many of the aforementioned words yielding a long vowel were not elicited from my consultant, with the exception of 'two' [ɲi] (which I transcribe with a short vowel) and 'yellow' [seːp]; thus, I am uncertain as to whether or not the correlation of historical finals and compensatory vowel lengthening is present in the dialect of my consultant.

The observant reader will notice that the examples of diachronic vowel lengthening given above only illustrate occurrences with [i] and [e]. However, recall that the vowels [ɑ], [o] and [u] became long (and fronted) where a historical */-l/, or */-d/ final once was. Thus, there are no examples of [ɑ], [o], and [u] before these historical finals. Notably, however, */-s/ sometimes gave rise to long, back vowels without fronting them. This is seen, for example, in *nas* [nɑː] 'barley' and *dgos* [goː] 'must' (van Driem 1998: 104). Thus, the historical */-s/ final had two different effects on back vowels: either fronting and lengthening or just lengthening. While historical */-r/ finals did not lead to fronting of back vowels, compensatory lengthening did occur. This is seen, for example, in van Driem's transcription of: *dkarpo* [kɑːp] 'white', *nor* [noː] 'cow', and *gur* [guː] 'tent'. Finally, vowel lengthening brought about by historical */-g/ finals is seen in *stag* [tɑː] 'tiger', *thog* [tʰoː] 'story', and *lug* [luː] 'sheep' (Mazaudon & Michailovsky 1989/2006: 126).

[22] While coda [n] results in lengthening (and fronting) of back vowels, it does not result in a long vowel in front vowels: *men* [mɛn] 'no', *mchin-pa* [tʃʰɪn. pɑ] 'liver' (orthographic form for 'liver' from Mazaudon and Michailovsky 1989/2006).

In addition to these diachronic causes for phonemic vowel lengthening in Dzongkha, van Driem (1998: 103) asserts that the historical collapse of disyllabic words into monosyllabic words is also frequently connected to the occurrence of long vowels in modern Dzongkha. For example, he points to this occurrence in words such as *dmar-po* [mɑːp] ‘red’ and *rtsis-pa* [tsiːp] ‘astrologer’. However, it is important to point out that Mazaudon and Michailovsky attribute the occurrence of long vowels in these cases not solely to the collapse of a historical disyllable into a monosyllable, but also to the occurrence of the historical finals of the first syllable, */-r/ and */-l/ and sometimes */-s/ and */-ŋ/. This is seen for example in *rkang-pa* [kɑːm] ‘leg’, where *–ng* corresponds to [ŋ] (Mazaudon & Michailovsky 1989/2006: 130-133).

While these are some conditions which have led to contrastive vowel length in modern Dzongkha, it is important to acknowledge that “the diachronic factors which conditioned lengthening are complex”; there is no one-to-one correspondence between the orthography and phonemic vowel length (van Driem 1998: 103-104). Furthermore, it is important to note that “many verbs and other parts of speech exhibit regular grammatical alternation between a form with a long vowel and one with a short vowel” (van Driem 1998: 104). This alternation apparently happens for reasons that are not fully understood.

2.2.2 The Dzongkha Syllable Canon

Many words in Dzongkha are monosyllabic. These syllables are generally of the form CVC, CV or VC (Dorjee 2007: 130). In addition, the vowels in any of these syllable structures may be long or short (e.g. ‘rain’ [tʃʰɑːp]; ‘earth’ [sɑ]; and ‘woman’ [ɑm]).[23] They can also take the shape Ṽ̌ː (e.g. ‘be’ [ĩː]) or CṼ̌ː (e.g. ‘music’ [dɑ̃ː]); this occurs when the final velar nasal consonant is not pronounced, causing the preceding vowel to become nasalized. More rarely, some syllables may take the shape CCV(C). This is seen in more formal registers where complex onsets are present (e.g. ‘bird’ [bdʒɑ], ‘wealthy’ [ptʃʰup]).[24]

[23] Unless otherwise stated, data in Section 2.2.2 comes from my consultant.

[24] Recall from Section 2.2.1 that my consultant only produces these forms in very formal speech.

As briefly touched on above, some monosyllabic words in Dzongkha come from historical disyllabic words. This was first observed by Mazaudon and Michailovsky (1989/2006) who note that certain Classical Tibetan disyllables are systematically reduced to monosyllables in Dzongkha.[25] One example of the process of disyllabic simplification to monosyllables comes from Classical Tibetan words of the shape CVN (where N represents the nasals [m], [n], and [ŋ]). When followed by any suffix, syllables of this shape will reduce to CV(ː)[m] (Mazaudon & Michailovsky 1989/2006: 133). To illustrate, Mazaudon and Michailovsky provide examples such as: *gyon-ma* [øm] 'left', *zam-pa*, [zɑm] 'bridge', and *srung-ba* [sum] 'charm'. It is worth noting that, although Mazaudon and Michailovsky indicate that this occurs with any suffix, their only examples are with bilabial consonants. Therefore, it seems that this disyllabic reduction coincides with place assimilation of the preceding nasal, though this is not addressed in their article.

On the other hand, there are also many disyllabic and polysyllabic words present in Dzongkha. This is particularly obvious in words formed from morpheme compounding. According to Matisoff (2003: 153), "Compounding has been a pervasive morphological process for a least the past two millennia of the history of the ST family," this occurs as, "part of the languages' response to the ever-present danger of homophony among their monosyllabic morphemes." Dzongkha compounding can be seen in examples such as: 'room' [ɲɛ. sɑ], literally 'sleep-earth'; 'tall' [zu. ɽiːm], literally 'body-long'; and 'hello' [ku. zu. zɑŋ. po], literally 'body-well being' with the honorific prefix for body parts, [ku], attached to the morpheme for body, [zu]. Disyllabic and polysyllabic words also come from loanwords. Examples of this come from Dzongkha borrowings of English words, discussed in Dorjee (2007: 130-131), such as 'school' [i. si. ku. li] and 'free' [pʰi. ɽi].

Thus, Dzongkha words may be monosyllabic, disyllabic, or even polysyllabic. The general syllabic shape of these words is CV(ː)C, CV(ː), or V(ː)C.

[25] Interestingly, Mazaudon and Michailovsky (1989/2006: 115, 130) found that this reduction results, for the most part, in a falling tone contour. For further discussion of the falling tone contour see Chapter 3.

2.2.3 Dzongkha Tone

The correlation between high and low register and obstruent onset voicing in Dzongkha was first recognized by Alfons Weidert (1986) over two decades ago (as cited in Mazaudon & Michailovsky 1989/2006: 115). This correlation, along with a contrasting falling tone contour in both the high and low register, is reported in Mazaudon and Michailovsky (1989/2006) as well as van Driem (1998).

In addition to this observation, van Driem also addresses the historical relationship between Dzongkha orthography and tone. While the traditional orthography reflects a much more complex ancient syllable canon, the modern Dzongkha reflex is simplified syllables where tone is distinctive. Specifically, words in the high tone with sonorant onsets are orthographically prefixed and superscripted. Thus, van Driem (1998: 100) found that words with nasal onsets which are orthographically prefixed or superscripted have a high tone while those that do not have an orthographic prefix or superscript have a low tone. This is seen in examples provided by van Driem such as *gnam* ^{H}[nɑm] ‘sky’ versus *nam* ^{L}[nɑm] ‘when’. (High tone is indicated by me with a superscript ^{H} and low tone by a superscript ^{L}.) Although not mentioned in van Driem, this correlation is also true of liquids and glides (e.g. *blo* ^{H}[lo] ‘mind’ and *gyag* ^{H}[jɑː] ‘yak’ versus *lo* ^{L}[lo] ‘year’ and *yab* ^{L}[jɑp] the honorific word for ‘father’).[26] This indicates that a loss of historical prefixes, which is a form of phonological simplification, has led to the tonal system present in Dzongkha. This process happens in order to assist in word distinctiveness (Hayes 2009: 291). Furthermore, it is not specific to Dzongkha as it has been noted in other TB languages (Matisoff 2003: 93).[27]

Table 2.5 (adapted from data collected by Mazaudon and Michailovsky 1989/2006 and van Driem 1998) shows the correlation between onset and tone in Dzongkha. Voiceless obstruent initials, both aspirated and unaspirated, occur only in the high tone while voiced

[26] Data comes from van Driem’s (1998) transcription.

[27] Van Driem (1998: 61, 102) also found a correlation between the orthography and modern tone in syllables with vowel initials. In contrast with sonorant onsets, however, differences in tone are not related to orthographic prefixes or superscripts; instead, the relationship between tone and orthography in vowel initials arises out of a different letter representing vowel initials in each tone (e.g. *om* ^{H}[oːm] ‘milk’ and *ḥongma* ^{L}[o̤ːm] ‘come’). Thus, where vowel initials in high tone syllables are orthographically represented by one letter (transliterated as vowel-initial), vowel initials in low tone syllables are orthographically represented by the other letter (transliterated as *ḥ*-initial).

Table 2.5. Onset Voicing Determined by High versus Low Tone

	Obstruents			Sonorants			
Onsets→ and Tones↓	Stops	Fricatives	Affric.	Nasals	Approx.	Glides	Vowels
High	p pʰ t tʰ ʈ ʈʰ k kʰ	s ʃ r̝̊	ts tsʰ tʃ tʃʰ	m n ɲ ŋ	l h l̥	w j	i u ʏ e ø o ɛ ɑ
Low	b d ɖ g	z ʒ r̝	dz dʒ	m n ɲ ŋ	l	w j	i̤ ṳ ʏ̤ e̤ ø̤ o̤ ɛ̤ ɑ̤

Note: breathy vowels are indicated by the diacritic [̤]

obstruent initials occur only in the low tone. In other words, they occur in complementary distribution. On the other hand, tone is contrastive after sonorant initials (with the exception of the vowels, /h/, and / l̥/) and may occur in both the high tone and low tone. In regard to vowels, ‘breathy vowels’ (indicated by the diacritic [̤]) are observed in the low tone (e.g. ‘come’ [o̤ːm]) while plain vowels occur in the high tone (e.g. ‘milk’ [oːm]) (Mazaudon & Michailovsky 1989/2006, van Driem 1998). The voiceless approximants /h/ and / l̥/ only occur in the high tone and do not have an allophonic variant. Lastly, I classify the alveolar fricative trill /r̝/ as an obstruent. This classification arises out of the fact that, like other Dzongkha obstruents, it is non-contrastive based on tone (it has a voiceless allophone in the high tone) and it is fricative in nature. In contrast with other obstruents, however, it is underlyingly voiced.

2.3 THE DZONGKHA NUMBER SYSTEM

Dzongkha uses two number systems: one vigesimal (base twenty) and the other decimal (base ten). Mazaudon (2007: 5) states that the vigesimal system was quite commonplace when she collected the data over thirty years ago. Contrastingly, in van Driem’s (1998: 161, 168) more recent study he states only that “the vigesimal system is widely used in counting amounts of houses, dogs, boxes, crates, and commodities” up to one hundred sixty thousand. Thus, van Driem’s account seems to point to the vigesimal system having far less prevalence now than thirty years ago. In fact, this is fairly consistent with my findings whereby, with the exception of the vigesimal form for ‘twenty’, [k^hɛ. tʃi], my consultant is completely unfamiliar with this system.[28] Moreover, according to my consultant, only the older generations use the vigesimal system.

The vigesimal system starts at twenty. For numbers smaller than twenty, the decimal system is always used; thus, it is not fully vigesimal. According to Mazaudon (1985: 126) this pattern is typical of vigesimal systems “since no purely vigesimal system… has yet been reported.” In regard to the construction of the vigesimal system, Mazaudon (1985: 127) states that, “The internal syntax of ‘20’ and of all the multiples of a base in the vigesimal system is multiplicand + multiplier, which is in agreement with the general word order of Dzongkha: Noun + Quantifier. The forms are not amalgamated and their internal syntax is transparent.” In other words, the numbers of this system do not function as a single phonological word (Mazaudon 2007: 7). As we will see below, this is different from some of the forms in the decimal system which function as a single phonological word.

A brief overview of the vigesimal system is given in Table 2.6. The table should be read as follows: the leftmost column gives the meaning of the number; the middle column gives the mathematical equation for building the number; and the rightmost column gives the IPA transcription of the output forms found in van Driem (1998) at the top of each row and the morpheme by morpheme translation below it.[29]

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[28] Notably, my consultant’s mother is also unfamiliar with the Dzongkha vigesimal system. This could be due to her mother’s native language being Bumthang. While Mazaudon (2007: 10) notes that Bumthang has a “very similar numerical system” to the Dzongkha vigesimal, they are still quite different. Compare the following Dzongkha and Bumthang examples (Dzongkha transcribed from van Driem (1998: 162) and Bumthang transcribed from Mazaudon (2007: 10); approximate translations are my own, with the exception of Dzongkha ‘thirty’ which is extrapolated from Mazaudon’s (1985: 140) translation of Dzongkha ‘fifty-five’ [k^he. ko. dɑ. sum] as “¾ of 20 on the way to (3 x 20)”):

Dzongkha:	‘thirty’	[k^hɛ.	ptʃ^{h}ɛ.	d̥ɑ.	ɲiː]	
		twenty	half	and	two	
		approximate translation ‘½ of twenty on the way to two score’				
	‘thirty one’	[k^hɛ.	tʃi.	d̥ɑ.	tʃuː.	tʃi]
		twenty -	one	and	ten -	one
		approximate translation ‘one score plus eleven’				
Bumthang:	‘thirty one’	[k^he.	p^he. dɑŋ.	zon.	niŋ.	t^he]
		twenty	half- and	two	and	one
		approximate translation ‘twenty plus halfway to two score plus one’				

[29] The “equation” column is adapted from Mazaudon’s (1985: 139) “structure” column.

Table 2.6. The Vigesimal System

Meaning	Approximate Translation[30]	Van Driem (1998) Output Forms
20	'one score'	kʰɛ. tɕi 20 - 1
23	'one score plus three'	kʰɛ. tɕi. d̥ɑ. sum 20 - 1 - and - 3
30	'½ of twenty on the way to two score'	kʰɛ. ptɕʰe. d̥ɑ. ɲiː 20 - ½ - and - 2
35	'¾ of twenty on the way to two score'	kʰɛ. ko. d̥ɑ. ɲiː 20 - ¾ - and - 2
38	'one score plus eighteen'	kʰɛ. tɕi. d̥ɑ. tɕoːp. gɛ 20 - 1 - and - 10 - 8
40	'two score'	kʰɛ. ɲiː 20 - 2
50	'½ of twenty on the way to three score'	kʰɛ. ptɕʰe. d̥ɑ. sum 20 - ½ - and - 3
55	'¾ of twenty on the way to three score'	kʰɛ. ko. d̥ɑ. sum 20 - ¾ - and - 3
60	three score	kʰɛ. sum 20 - 3
70	'½ of twenty on the way to fourscore'	kʰɛ. ptɕʰe. d̥ɑ. ʑi 20 - ½ - and - 4
80	'fourscore'	kʰɛ. ʑi 20 - 4
90	'½ of twenty on the way to five score'	kʰɛ. ptɕʰe. d̥ɑ. ŋɑ 20 - ½ - and - 5
100	'five score'	kʰɛ. ŋɑ 20 - 5

[30] Approximate translations of 'thirty', 'thirty-five', 'fifty', 'fifty-five', 'seventy' and 'ninety' are extrapolated from Mazaudon's (1985: 140) translation of 'fifty-five' [kʰe. ko. dɑ. sum] as "¾ of 20 on the way to (3 x 20)." However, it is worth noting that in later work Mazaudon (2007:7) translates 'thirty' as "'half in the second twenty-group'," stating that the numbers that are half way between each complete group of twenty is "expressed by reference to the higher limit of the interval concerned." For ease in understanding, I follow Mazaudon's original translations here.

As for the decimal system, Mazaudon (1985: 125, 127, 2007: 5) found that this system was borrowed from Tibetan for reasons of prestige and is reserved for formal speech. On the other hand, Van Driem's (1998: 158-160) account of the decimals only goes so far as to say that it is used for counting, percentages, prices, and dates. The use of the decimal system appears to be much more prevalent in the younger populations. According to my consultant, it is the only form used in written texts and informal speech. This is due to the decimal system's sociolinguistic status as being more formal and, likely, more "proper" than the vigesimal system; thus, this seems to point to the vigesimal system dying out. This is not surprising given the prestige associated with Classical Tibetan (Chöke), which uses this same decimal system (for a list of Classical Tibetan numbers see Beyer 1992: 221).[31] Moreover, preference for the decimal system is probably only further intensified by the pervasiveness of English, which also uses a base ten number system.

The focus of the next sections is on the decimal system. The section starts with a discussion of the decimal system's orthographic form in relation to its historical form (Section 2.3.1), then gives an overview of the interesting phonological patterns this number system exhibits (Section 2.3.2), and, finally, goes into an explanation of the system's possibility of being borrowed from Tibetan (Section 2.3.3).

2.3.1 Historical Reconstruction

The reconstructed form of the TB language family is known to have had prefixes. For example, Matisoff (2003: 126) writes that Proto-Tibeto-Burman (PTB) had (among others) voiced stops and liquid prefixes.[32] These prefixes, */r-/, */ l-/, */ b-/, */d-/, */g-/, "are attested directly in certain branches of TB." In Dzongkha, these historical prefixes are not directly preserved. As discussed above, they are, for the most part, only indirectly evident in

[31]Recall that Chöke is the "language in which sacred Buddhist texts, medical and scientific treatises and, indeed, all learned works have been written throughout the course of Bhutan's history" (van Driem 1994: 88).

[32] Matisoff (1997: 15, 99) states that "there is no evidence for a voicing contrast in stop prefixes at the PTB level," while the contrast was present in PTB root-initial stops. As such, these prefixes, Matisoff (1997: 99) writes, can be noted with "'archiphonemic' symbols like *B, *D, *G." However, in later work, Matisoff (2003: 93) refers to them as "voiced stop prefixes." For the purposes of this study, they will be noted as voiced prefixes.

syllable tone (see Section 2.2.3); however, they are preserved in the written form (e.g. *dngul* ᴴ[ŋʏ] 'silver' and *rma* ᴴ[mɑ] 'wound').[33]

Intriguingly, however, the prefixes */b-/ and */g-/ are phonologically realized in a particular subclass of the decimal number system, which I call the "morphological decimals" (see Section 2.3.2.1 for a more in depth discussion of the morphological decimals). As complex onsets are not permissible in Dzongkha (with the exception of stop + affricate combinations in the formal register—see below for further discussion), these archaic prefixes may only be realized through resyllabification. For example, the historical prefix */b-/, which is orthographically present on the morphemes for 'ten' *bcu* and 'hundred' *brgyad*, is phonologically realized on the coda of the preceding morpheme in the morphological decimals (Mazaudon 1985: 153). This is seen specifically in *bzhi-bcu* [ʒip. tʃu] 'forty' and *brgyad-brgya* [ɡɛp. dʒɑ] 'eight hundred' (for more examples see the tables addressing "The Tens" and "The Hundreds").[34] In support of this analysis, Matisoff (1997: 55) explains that "these forms are obviously resyllabifications of compounds where the second element began with prefixal b-."

This same process of resyllabification also happens with historical */ɡ-/ prefixes when the numbers 'one', 'two', and 'three' occur as the second morpheme of the morphological decimals. This is seen in numbers such as: *bcu-gcig* [tʃuk. tʃi] 'eleven', *bcu-gnyis* [tʃuk. ɲi] 'twelve', and *bcu-gsum* [tʃuk. sum] 'thirteen' (refer to the table on "The Teens" for further details).

In addition to */b-/ and */g-/, other historical prefixes, namely */l-/ and */d-/, also underwent this same resyllabification process in the morphological decimals. These prefixes are evidenced by the orthographic forms of 'five', *lnga*, and 'nine', *dgu*. The historical effect of resyllabification is attested by the fronted vowel of the morpheme 'ten' in the teens (e.g.

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[33] Both the transcription (which I have translated into IPA) and orthographic representation come from van Driem's (1998).

[34] Unless stated otherwise in this section, transcribed forms come from my consultant's output. Orthographic forms come from my transliteration of written Tibetan words in van Driem (1998), except where the transliteration is provided by van Driem.

bco-lnga [tʃɛ. ŋɑ], 'fifteen' and *bcu-dgu* [tʃʏ. gu] 'nineteen').[35] Thus, prefix resyllabification in to the coda of the morpheme 'ten' led to the same vowel fronting process discussed in Section 2.2.1.2 above. However, these two dental prefixes have long since vanished from the underlying forms of 'five' (^{H}/ŋɑ/) and 'nine' (^{L}/ku/) due to syllable edge erosion.

Aside from prefix resyllabification, another form of prefix preservation is attested in the Dzongkha number system. Unlike *dgu* [gu] 'nine' where the */d-/ prefix eroded, the prefix */d-/ is preserved in *druk* [ɖu] 'six'. In this case */d-/ has "fused" with the root-initial, */-r-/, leading to a modern retroflex initial (Matisoff 1997: 103, 2003: 95).

It is also worth noting that these prefixed numerals are different from words with complex onsets such as 'cat' [bdʒi. li] and 'glue' [ptʃi] (discussed in Section 2.2.1.1).[36] More specifically, while complex onsets are acceptable in the formal register, the initial clusters in prefixed numerals are never realized as complex onsets, regardless of register. For example, the morpheme 'hundred' *brgya* has a historical prefix */b-/; nevertheless, it is always pronounced as [dʒɑ] and never as [bdʒɑ]. In contrast, 'honey' *sbyang*, which does not have a historical prefix */b-/ (here *-b-* is the root initial consonant), is pronounced [bdʒɑ̃] in the formal register. The difference is that the modern reflex of orthographic bilabial root initials with *y* subscript (as in 'honey') is a bilabial-palatal complex onset (i.e. ^{H}/ptʃ/ and ^{L}/ptʃ/).[37] Contrastingly, the modern reflex of orthographic velar root initials with a *y* subscript (as in 'hundred') is a palatal affricate (i.e. ^{H}/tʃ/ and ^{L}/tʃ/) (van Driem 1998: 101).[38] Thus, the orthographic differences highlight the distinction between possible complex onsets (in formal registers) and initial clusters in prefixed numbers that are never phonologically realized as complex onsets; however, as touched on above, the prefix may be phonologically realized through resyllabification (this is discussed further in Section 2.3.2.1). Since I am

[35] The orthographic differences between 'ten' *bco* and *bcu* are discussed below.

[36] Examples of words with complex onsets are my transcription of van Driem's (1998: 86, 88) consultant.

[37] Recall from Section 2.2.1.1 that obstruents are underlyingly voiceless; thus, voiced obstruent onsets are allophonic, occurring only in syllables with low tone.

[38] Van Driem also notes that the modern reflex of orthographic velar consonants with a *y* subscript may also have no effect, yielding a velar initial.

only examining the informal register used by my consultant, whereby complex onsets are disallowed altogether, the distinction between bilabial-palatal complex onsets and prefixed onsets is not made in my analysis. Therefore, both forms look identical in their underlying representation and are indiscriminately referred to as complex onsets.

2.3.2 The Decimal System

Many of the words in the Dzongkha decimal system function as a single phonological word, although morphologically complex.[39] They are noted here as the morphological decimals. From 'eleven' through 'ninety' they act as a single phonological word. Between 'one hundred' and 'nine hundred thousand', however, they may take on two different constructions, acting as either a single phonological word, and, thus, belonging to the morphological decimals, or as a compound made up of separate phonological words, and, thus, belonging to a system which I call the "compound decimals." From 'one million' on, they are always of the latter structure. The following is a description of the morphological decimals and the phonological phenomena associated with them (Section 2.3.2.1). This is followed by a discussion of the compound decimals (Section 2.3.2.2).

2.3.2.1 The Morphological Decimal System

The morphological decimals are numbers which function as a single phonological word although morphologically complex.[40] As touched on above, these numbers include the units, teens, tens, hundreds, thousands, ten thousands, and hundred thousands. Above 'nine' these numbers are bimorphemic and exhibit an interesting phonological phenomenon. This

[39] Mazaudon (1985: 127) refers to these forms as being "more or less amalgamated."

[40] It is worth noting that in the literature, the term "compound" is often used to refer to what I call the morphological decimals or phonological words. These are units of more than one morpheme which act as a single phonological word. I have chosen to avoid referring to them as compounds as they exhibit phenomena that, according to Vogel (2010: 146-147), are not common across morphemes within a compound. Specifically, these phenomena are resyllabification and vowel harmony (see discussion in this section). According to Vogel (2010: 145-146) the lack of interaction between the members of a compound, which constitute distinct phonological words, is common among compounds of the world's languages. Specifically, Vogel (2010: 147) states that "it can be observed in many languages that syllabification processes observed within the individual PWs [phonological words] of a compound are not observed across the juncture of these items." This is quite different from what we find in the morphological decimals and other non-numeric phonological words. Thus, I have chosen to refer to them here by what I believe are less controversial terms: morphological decimals, phonological words, or, following Chang and Chang (1968), morphological units.

phenomenon, as discussed above, is the resyllabification of historical prefixes into the codas of the preceding morpheme; it is unique to the morphological decimal system. The following is an overview of these numbers. The tables give the following information: (1) the English translation; (2) the structure of the numbers (above nine); (3) the transliteration from written Dzongkha; (4) the underlying form and lexical tone (according to my consultant's output forms); and (5) columns showing the output forms of my consultant, van Driem's (1998) consultant, and Mazaudon's (1985) consultant, respectively.[41]

Table 2.7 lists the units. These forms include the proposed underlying forms with prefixes.

Table 2.7. The Units

	Transliteration Van Driem (1998)	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms	Mazaudon (1985) Output Forms
1	*gcig*	^{H} /ktʃik/	tʃi	tɕi	tɕiː
2	*gnyis*	^{H} /kɲi/	ɲi	ɲiː	ɲiː
3	*gsum*	^{H} /ksum/	sum	sum	sum
4	*bzhi*	^{L} /pʃi/	ʒi	ʑ̥i	ʑ̥i ~ ʑ̥e
5	*lnga*	^{H} /ŋɑ/	ŋɑ	ŋɑ	ŋɑ
6	*drug*	^{L} /ʈuk/	ɖu	ɖ̥uː	ɖ̥uː
7	*bdun*	^{L} /ptʏn/	dʏn	dʏn	dyn
8	*brgyad*	^{L} /pkɛ/	gɛ	gɛ	geː
9	*dgu*	^{L} /ku/	gu	gu	guː

Note: The underlying tone is indicated by a superscript ^{H} for high tone and a superscript ^{L} for low tone. Tone is not indicated in the output forms as it is assumed to be the same as the underlying forms. Free variation of forms is indicated by (~).

One point of interest in this chart is the occurrence of 'prefix runs' as seen in the underlying forms. According to Matisoff (1997: 100), "Prefix runs are a special kind of secondary prefixation, whereby adjacent numerals come to have identical (or very similar) prefixes… an assimilatory phenomenon [made by] analogical interinfluence between the prefixes on consecutive numerals." Furthermore, Matisoff states that these prefix runs were present in PTB. A "perfect run" is seen in 'one', 'two', and 'three', all of which start with

[41] Mazaudon's (1985) data is not included where space does not permit, where it is not provided, and/or when it is identical to van Driem's data. Data is not listed for van Driem where not provided in his text (i.e. Table 2.15, p. 44, and Tables 2.17-2.20, pp. 47-49).

the underlying prefix /k-/. These are historical prefix runs as reflected in the orthography. Importantly, while the prefix is transliterated as *g*-, the underlying form is transcribed as a voiceless obstruent as all obstruents are underlyingly voiceless in Dzongkha (refer to Section 2.2.1.1). In addition, there is a "broken run" with 'four', 'seven', and 'eight', which all have the prefix /p-/. (The run 'breaks' between 'four' and 'seven'.) This prefix corresponds to the historical */b-/ prefix, which is noted in the transliteration.

Table 2.8 lists the Dzongkha teens. These numbers are made up of two morphemes. The first morpheme, 'ten', is followed by the units. This order is unique to the teens in the morphological decimals. All other members of this category are of the reverse ordering whereby the units are the first element in the construction (e.g. 'four hundred' [ʒip. dʒɑ]). Notably, the teens match the ordering of the compound decimals (discussed in detail in Section 2.3.2.2), which are structured such that the units are the last element in the construction; however, unlike the compound decimals, the teens act as a single phonological word.

In examining the teens, we see the first evidence of the historical prefixes */g-/ and */b-/ in the output forms. Because voicing is non-contrastive in obstruents, these prefixes are underlyingly /k-/ and /p-/, respectively. As such, we take the synchronic underlying representation of these prefixes to be voiceless. Thus, in the teens we see the historical prefixes of the units surface in the output forms. Specifically, they surface on the coda of the preceding morpheme, 'ten' [tʃu], through resyllabification. For example, the historical prefix */b-/ is seen on the coda of the morpheme 'ten' in the numbers 'fourteen', [tʃup. ʒi], 'seventeen', [tʃup. dʏn], and 'eighteen', [tʃop. gɛ]; the historical prefix */g-/ is seen on the coda of the morpheme 'ten' in the numbers 'eleven', [tʃuk. tʃi], 'twelve', [tʃuk. ɲi], and 'thirteen', [tʃuk. sum].[42]

It is important to note that there are some morphologically conditioned allomorphs in Table 2.8.[43] They are seen in the different underlying forms of 'ten' in the numbers 'fifteen',

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[42] The morpheme 'ten' in 'eighteen', [tʃop. gɛ], is an allomorph and is discussed below.

[43] These allomorphs are an artifact of diachronic phonology (discussed briefly here and in Section 2.3.3); therefore, I will not be handling them in my analysis.

Table 2.8. The Teens

	Structure	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms	Mazaudon (1985) Output Forms
11	10 - 1	*bcu-gcig*	^{H}/ptʃu/ + ^{H}/ktʃik/	tʃuk. tʃi ~ tʃu. tʃi	tɕuː. tɕi	tɕu. tɕi
12	10 - 2	*bcu-gnyis*	^{H}/ptʃu/ + ^{H}/kɲi/	tʃuk. ɲi ~ tʃu. ɲi	tɕuː. ɲi	tɕu. ɲi
13	10 - 3	*bcu-gsum*	^{H}/ptʃu/ + ^{H}/ksum/	tʃuk. sum ~ tʃu. sum	tɕuː. su	tɕu. su ~ tɕu. sum
14	10 - 4	*bcu-bzhi*	^{H}/ptʃu/ + ^{L}/pʃi/	tʃup. ʒi ~ tʃu. ʒi[44]	tɕʏ. ʑi	tɕy. ʑi
15	10 - 5	*bco-lnga*	^{H}/ptʃɛ/ + ^{H}/ŋɑ/	tʃɛ. ŋɑ	tɕɛ. ŋɑ	tɕe. ŋɑ
16	10 - 6	*bcu-drug*	^{H}/ptʃu/ + ^{L}/ʈuk/	tʃu. ɖu	tɕuː. d̥u	tɕu. ɖu ~ tɕu. ru
17	10 - 7	*bcu-bdun*	^{H}/ptʃu/ + ^{L}/ptʏn/	tʃup. dʏn ~ tʃu. dʏn	tɕup. dʏ	tɕup. dỹ
18	10 - 8	*bco-brgyad*	^{H}/ptʃo/ + ^{L}/pkɛ/	tʃop. gɛ	tɕoːp. gɛ	tɕop. ge ~ tɕou. ge
19	10 - 9	*bcu-dgu*	^{H}/ptʃʏ/ + ^{L}/ku/	tʃʏ. gu	tɕʏ. gu	tɕy. gu

Note: Morpheme boundaries indicated by (+). Free variation indicated by (~).

'eighteen', and 'nineteen'. More specifically, instead of /ptʃu/, the underlying form of 'ten' in these words is /ptʃɛ/, /ptʃo/ and /ptʃʏ/, respectively. In 'eighteen', the underlying form of 'ten', /ptʃo/, is explained by Tibetan vowel harmony. Furthermore, the lowered vowel of 'ten', /ptʃɛ/, in 'fifteen' is also explained by Tibetan vowel harmony (see Section 2.3.3).

In addition to vowel lowering of the allomorph 'ten', /ptʃɛ/, in the number 'fifteen', there were other historical processes which led to the fronted vowel. This vowel fronting is also seen in the underlying form of the allomorph 'ten', /ptʃʏ/, in 'nineteen'. As reflected in the orthography, 'five' and 'nine' once had dental prefixes. Recall from the discussion in Section 2.3.1, that, like the historical prefixes */b-/ and */g-/, the same process of resyllabification into the coda of the preceding morpheme took place with */l-/ and */d-/.

[44] My consultant originally gave [tʃuk. ʒi] as a possible form, but later recanted. She notes that she prefers [tʃu. ʒi], but says that [tʃup. ʒi] is also possible.

Consequently, these resyllabified dentals caused the back vowel in 'ten' to front (see Section 2.2.1.2 for a discussion of vowel fronting). While the dental prefixes have long since vanished from the underlying forms due to both constraints on acceptable codas in Dzongkha as well as syllable edge erosion of prefixes, their presence is still noted in the fronted vowel of 'ten' in both 'fifteen' and 'nineteen'. Thus, with all three forms, diachronic processes have led to synchronic forms which are irregular. Accordingly, these three variants of 'ten' are synchronically understood as morphologically conditioned allomorphs; therefore, I will not be handling vowel harmony or vowel fronting through Optimality Theory.

Finally, there is free variation in some of the output forms below. This variation is seen in 'eleven' through 'fourteen' and 'seventeen'. These forms may either be said with or without the resyllabified prefix in coda position on the first morpheme. Interestingly, there is no free variant of 'eighteen', which always takes the resyllabified prefix (i.e. 'eighteen' is always said as [tʃop. gɛ] and never [tʃo. gɛ]). Additionally, since the historical prefix */d-/ in 'six' has "fused" with the following root onset */-r-/ to form a retroflex onset, free variation leading to the resyllabification of the prefix /d-/ into the coda of the preceding morpheme is entirely ungrammatical.[45]

Table 2.9 gives the tens, which are created by combining the units and 'ten' in the opposite order from the teens.[46] In other words, the units are the first element and 'ten' is the second element. This reverse ordering of morphemes from the teens allows us another perspective on the phonological realization of the historical prefixes. From this, we see that the prefix /p-/, from 'ten' *bcu*, resyllabifies into the coda of 'four' [ʒi], 'five' [ŋɑ], 'eight' [gɛ], and 'nine' [gu]. However, resyllabification does not take place if the underlying final of the first morpheme (i.e. the units) is an acceptable output coda. Thus, 'thirty', 'sixty', and 'seventy' all retain their underlying coda (/-m/, /-k/, and /-n/, respectively) and the prefix /p-/

[45] See Matisoff (2003: 95) for further elaboration on "prefix fusion" in TB languages.

[46] The number 'ten' is created by combining /ptʃu/, not with 'one', but with another morpheme. This morpheme, [tʰɑːm], is translated as 'full' (Mazaudon 1985: 132, Matisoff 1997: 56). According to van Driem (1998: 158), it is used to "punctuate the rounding off of a group of ten whilst counting or to accentuate the fact that the number is a round figure."

Table 2.9. The Tens

	Structure	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms	Mazaudon (1985) Output Forms
10	10 (full)	*bcu-tham*	^{H}/ptʃu/ + ^{H}/t^{h}ɑːm/	tʃu. t^{h}ɑːm	tɕu. t^{h}ɑːm	tɕu. t^{h}ãm
20	2 - 10	*nyi-shu*	^{H}/kɲi/ + ^{H}/ʃo/	ɲi. ʃo	ɲi. ɕu	ɲi. ɕu
30	3 - 10	*sum-cu*	^{H}/ksum/ + ^{H}/ptʃu/	sum. tʃu	sum. tɕu	sum. tɕu
40	4 - 10	*bzhi-bcu*	^{L}/pʃi/ + ^{H}/ptʃu/	ʒip. tʃu	ʑ̥ip. tɕu	ʑip. tɕu
50	5 - 10	*lnga-bcu*	^{H}/ŋɑ/ + ^{H}/ptʃu/	ŋɑp. tʃu	ŋɑp. tɕu	ŋɑp. tɕu
60	6 - 10	*drug-cu*	^{L}/ʈuk/ + ^{H}/ptʃu/	ɖuk. tʃu	ɖ̥uk. tɕu	ɖ̥uk. tɕu
70	7 - 10	*bdun-cu*	^{L}/ptʏn/ + ^{H}/ptʃu/	dʏn. tʃu	dʏn. tɕu	dyn. tɕu
80	8 - 10	*brgyad-cu*	^{L}/pkɛ/ + ^{H}/ptʃu/	gɛp. tʃu	gep. tɕu	gep. tɕu
90	9 - 10	*dgu-bcu*	^{L}/ku/ + ^{H}/ptʃu/	gup. tʃu	gup. tɕu	gup. tɕu

Note: Morpheme boundaries indicated by (+).

drops instead.[47] Interestingly, these numbers also lack an orthographic *b-* prefix in ‘ten’ (i.e. *cu* instead of *bcu*).

There are some irregularities in the morpheme ‘ten’ in the number ‘twenty’. First, this morpheme starts with a fricative instead of an affricate. Second, it is also irregular in that, since the morpheme [ɲi] lacks a coda, we would expect resyllabification of the prefix /p-/ to occur; however, this is not what we find (i.e. ‘twenty’ is never pronounced [ɲip. ʃu] or [ɲip. ʃo]). Notably, these irregularities are reflected in the orthography (i.e. *shu* instead of *bcu* or *cu*). Thus, in this number, ‘ten’ is clearly a morphologically conditioned allomorph.

It is interesting to note that, in looking at the orthography in Table 2.9, all forms which drop the orthographic prefix in ‘ten’ have an orthographic final in the preceding morpheme; the exception to this is ‘twenty’ (cf. ‘twenty’, ‘thirty’, ‘sixty’, ‘seventy’ and ‘eighty’). However, when looking at the orthography of ‘two’, g*nyis*, we see that this number did at some point have a coda.[48] The historical underlying form for ‘twenty’ was probably */kɲis/+/ptʃu/. The drop of the prefix */p-/ in ‘ten’ (due to the preceding

[47] Recall that [k] is an acceptable coda word medially, but not word finally.

[48] The final */-s/ can be found in the reconstructed form of ‘two’, *g-nis, given in Benedict (1972) (as cited in Matisoff 1997: 100).

morpheme having a coda), would have produced [ɲis. tʃu].[49] From there, lenition in the form of spirantization of the affricate would have occurred leading to [ɲis. ʃu]. Finally, given the more modern constraints on possible codas, the underlying /s/ was dropped, giving the output form [ɲi. ʃu] and the synchronic underlying form ^{H}/kɲi/ + ^{H}/ʃu/ (or ^{H}/kɲi/ + ^{H}/ʃo/).[50]

In contrast with the example ‘twenty’, where diachronic phonology has led to the loss of the historical prefix */b-/ in ‘ten’, we see that the prefix is still intact in the form ‘eighty’ [gɛp. tʃu], even though the preceding morpheme, ‘eight’, also had a historical root-final (*/-d/).[51,52] In my opinion, the difference between the loss of the historical prefix on the ‘ten’ morpheme in ‘twenty’ and the presence of it in ‘eighty’ is that both forms lost their historical */b-/ prefix; however, through analogy with ‘ninety’, the prefix was reapplied to the ‘ten’ morpheme in ‘eighty’. (This would have occurred sometime after the historical final */-d/ in ‘eight’ was lost due to constraints on possible codas.) Notably, restoration of the prefix in ‘twenty’ through analogy with nearby forms would be unlikely as the surrounding forms also lack the historical prefix in their output forms (i.e. ‘ten’ [tʃu. tʰɑːm] and ‘thirty’ [sum. tʃu]).

Table 2.10 gives the Dzongkha hundreds. The structure of these forms is such that the units are followed by the ‘hundred’ morpheme. In these forms we see the same patterns as discussed in Table 2.9 (p. 37): an underlying coda /-k/ surfaces in the output forms of ‘one hundred’ and ‘six hundred’, due to its word-medial position; the underlying prefix /p-/ resyllabifies into the coda of the first morpheme in ‘four hundred’, ‘five hundred’, ‘eight hundred’, and ‘nine hundred’; and ‘two hundred’ presents an allomorph where ‘hundred’ does not have a prefix (i.e. ^{L}/tʃɑ/). This is likely due to analogy with ‘twenty’, where ‘ten’ also presents a prefix-less allomorph (i.e. ^{H}/ʃo/).

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[49] I assume that the prefix /k-/ in ‘two’ was also dropped from the output form.

[50] I am uncertain as to the background story on [o] in my consultant’s form, [ɲi. ʃo]. Both Mazaudon (1985) and van Driem (1998) transcribe it as [ɲi. ʃu].

[51] This is seen in the prefix resyllabifying into the coda of the preceding morpheme, ‘eight’.

[52] The presence of this coda is noted by the fronting of the preceding vowel, as discussed in Section 2.2.1.2.

Table 2.10. The Hundreds

	Structure	Transliteration	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms	Mazaudon (1985) Output Forms
100	1 - 100	*gcig-brgya*	^{H}/ktʃik/ + ^{L}/ptʃɑ/	tʃik. dʒɑ	tɕik. dʑɑ	tɕik. dʑɑ
200	2 - 100	*nyis-brgya*	^{H}/kɲi/ + ^{L}/tʃɑ/	ɲi. dʒɑ	ɲi. dʑɑ	ɲi. dʑɑ
300	3 - 100	*gsum-brgya*	^{H}/ksum/+ ^{L}/ptʃɑ/	sum. dʒɑ	sum. dʑɑ	sum. dʑɑ
400	4 - 100	*bzhi-brgya*	^{L}/pʃi/ + ^{L}/ptʃɑ/	ʒip. dʒɑ	ʑip. dʑɑ	ʑip. dʑɑ
500	5 - 100	*lnga-brgya*	^{H}/ŋɑ/ + ^{L}/ptʃɑ/	ŋɑp. dʒɑ	ŋɑp. dʑɑ	ŋɑp. dʑɑ
600	6 - 100	*drug-brgya*	^{L}/ʈuk/ + ^{L}/ptʃɑ/	ɖuk. dʒɑ	ɖ̥uk. dʑɑ	ɖ̥uk. dʑɑ
700	7 - 100	*bdun-brgya*	^{L}/ptʏn/+ ^{L}/ptʃɑ/	dʏn. dʒɑ	dʏn. dʑɑ	dyn. dʑɑ
800	8 - 100	*brgyad-brgya*	^{L}/pkɛ/ + ^{L}/ptʃɑ/	ɡɛp. dʒɑ	ɡep. dʑɑ	ɡep. dʑɑ
900	9 - 100	*dgu-brgya*	^{L}/ku/ + ^{L}/ptʃɑ/	ɡup. dʒɑ	ɡup. dʑɑ	ɡup. dʑɑ

Note: Morpheme boundaries indicated by (+).

Table 2.11 gives the thousands. As both van Driem and Mazaudon have identical output forms for this section, Mazaudon's data has been omitted. In this construction the thousands are formed by combining the units with the 'thousand' morpheme, in that order. The occurrence of coda [p] on the first syllable in 'four thousand', 'five thousand', 'eight thousand', and 'nine thousand' is due to analogy with the prefix of the tens /ptʃu/ and hundreds /ptʃɑ/. Thus, analogy with these prefixed morphemes has lead to the synchronic underlying form /ptoŋ/ in Dzongkha.[53] In addition, the Dzongkha thousands show evidence of a 'suffix run'. Parallel to Matisoff's (1997) prefix runs, suffix runs refer to codas that are applied through analogy with other number sets, namely the tens and hundreds. This is seen in my consultant's output form for 'two thousand', [ɲik. toŋ], where there is a coda [k] which occurs through analogy with 'one thousand' [tʃik. toŋ].[54] Furthermore, this irregularity is a morphologically conditioned allomorph. As such, the underlying form for 'two' in 'two thousand' is /kɲik/; in all other cases it is /kɲi/.

[53] Benedict's (1972: 94) reconstruction of 'thousand' is */stoŋ/ which is based, in part, on Written Tibetan (as cited in Matisoff 1997: 61). However, evidence of a historical prefix */s-/ is not seen in the Dzongkha data (see Section 2.3.3 for implications of the historical prefix */s-/ and Section 2.3.3 for further discussion of this in Tibetan).

[54] This differs from both van Driem's (1998) and Mazaudon's (1985) notation of 'two thousand'.

Table 2.11. The Thousands

	Structure	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
1,000	1 - 1000	*gcig-stong*	^{H}/ktʃik/ + ^{H}/ptoŋ/	tʃik. toŋ	tɕik. toŋ
2,000	2 - 1000	*nyis-stong*	^{H}/kɲik/ + ^{H}/ptoŋ/	ɲik. toŋ	ɲi. toŋ
3,000	3 - 1000	*gsum-stong*	^{H}/ksum/ + ^{H}/ptoŋ/	sum. toŋ	sum. toŋ
4,000	4 - 1000	*bzhi-stong*	^{L}/pʃi/ + ^{H}/ptoŋ/	ʒip. toŋ	ʑ̥ip. toŋ
5,000	5 - 1000	*lnga-stong*	^{H}/ŋɑ/ + ^{H}/ptoŋ/	ŋɑp. toŋ	ŋɑp. toŋ
6,000	6 - 1000	*drug-stong*	^{L}/ʈuk/ + ^{H}/ptoŋ/	ɖuk. toŋ	ɖ̥uk. toŋ
7,000	7 - 1000	*bdun-stong*	^{L}/ptʏn/ + ^{H}/ptoŋ/	dʏn. toŋ	dʏn. toŋ
8,000	8 - 1000	*brgyad-stong*	^{L}/pkɛ/ + ^{H}/ptoŋ/	gɛp. toŋ	gep. toŋ
9,000	9 - 1000	*dgu-stong*	^{L}/ku/ + ^{H}/ptoŋ/	gup. toŋ	gup.toŋ

Note: Morpheme boundaries indicated by (+).

Table 2.12 gives the ten thousands. In this construction the units are followed by the ‘ten thousand’ morpheme. While both van Driem and Mazaudon list this construction, my consultant prefers to use the compound form, which is discussed below in Section 2.3.2.2.[55] Based on the forms provided by my consultant, we see that, in contrast with the thousands, the prefix /p-/ has not been extended through analogy to the ten thousands. Furthermore, we see that the analogy of coda /-k/ in ‘two’, as seen in the thousands, does not hold here. Notably, however, these numbers do allow free variation of coda /-k/ in the output of the first morpheme in the numbers ‘ten thousand’ and ‘sixty thousand’.

Table 2.13 lists the hundred thousands. As with all of the morphological decimals (except for the teens), the structure of these numbers is such that the units precede a morpheme which is a power of ten, in this case ten to the fifth power. As with the ten thousands above, my consultant prefers to use the compound form for the hundred thousands (see Section 2.3.2.2). Again, there is no evidence of an analogical prefix in these forms; however, as with the ten thousands there is free variation in the output of the underlying coda /-k/ in the numbers ‘one hundred thousand’ and ‘six hundred thousand’.

[55] For numbers greater than the thousands van Driem (1998) only provides data up to the first two forms and Mazaudon (1985) only provides the first form. Thus, only van Driem’s data is listed where provided in his text.

Table 2.12. The Ten Thousands

	Structure	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
10,000	1 - 10^4	*gcig-khri*	^{H}/ktʃik/ + ^{H}/ʈʰi/	tʃik. ʈʰi ~ tʃi. ʈʰi	tɕik. ʈʰi
20,000	2 - 10^4	*nyis-khri*	^{H}/kɲi/ + ^{H}/ʈʰi/	ɲi. ʈʰi	ɲi. ʈʰi
30,000	3 - 10^4	*gsum-khri*	^{H}/ksum/ + ^{H}/ʈʰi/	sum. ʈʰi	--
40,000	4 - 10^4	*bzhi-khri*	^{L}/pʃi/ + ^{H}/ʈʰi/	ʒi. ʈʰi	--
50,000	5 - 10^4	*lnga-khri*	^{H}/ŋɑ/ + ^{H}/ʈʰi/	ŋɑ. ʈʰi	--
60,000	6 - 10^4	*drug-khri*	^{L}/ʈuk/ + ^{H}/ʈʰi/	ɖuk. ʈʰi ~ ɖu. ʈʰi	--
70,000	7 - 10^4	*bdun-khri*	^{L}/ptʏn/ + ^{H}/ʈʰi/	dʏn. ʈʰi	--
80,000	8 - 10^4	*brgyad-khri*	^{L}/pkɛ/ + ^{H}/ʈʰi/	gɛ. ʈʰi	--
90,000	9 - 10^4	*dgu-khri*	^{L}/ku/ + ^{H}/ʈʰi/	gu. ʈʰi	--

Note: (--) indicates that data was not provided. Morpheme boundaries indicated by (+). Free variation indicated by (~).

Table 2.13. The Hundred Thousands

	Struct.	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
100,000	1 - 10^5	*gcig-ḥbum*	^{H}/ktʃik/ + ^{L}/pum/	tʃik. bum ~ tʃi. bum	tɕik. bum
200,000	2 - 10^5	*gnyis-ḥbum*	^{H}/kɲi/ + ^{L}/pum/	ɲi. bum	ɲi. bum
300,000	3 - 10^5	*gsum-ḥbum*	^{H}/ksum/+ ^{L}/pum/	sum. bum	--
400,000	4 - 10^5	*bzhi-ḥbum*	^{L}/pʃi/ + ^{L}/pum/	ʒi. bum	--
500,000	5 - 10^5	*lnga-ḥbum*	^{H}/ŋɑ/ + ^{L}/pum/	ŋɑ. bum	--
600,000	6 - 10^5	*drug-ḥbum*	^{L}/ʈuk/ + ^{L}/pum/	ɖuk. bum ~ ɖu. bum	--
700,000	7 - 10^5	*bdun-ḥbum*	^{L}/ptʏn/ + ^{L}/pum/	dʏn. bum	--
800,000	8 - 10^5	*brgyad-ḥbum*	^{L}/pkɛ/ + ^{L}/pum/	gɛ. bum	--
900,000	9 - 10^5	*dgu-ḥbum*	^{L}/ku/ + ^{L}/pum/	gu. bum	--

Note: (--) indicates that data was not provided. Morpheme boundaries indicated by (+). Free variation indicated by (~).

The morphological decimals stop at the hundred thousands. For numbers above the hundred thousands, only the compound construction is used. Thus, numbers larger than the hundred thousands are discussed in Section 2.3.2.2.

The three remaining tables discussed in this section address the ordinals, collectives, and intermediate tens, which are formed through affixing the respective marker to the appropriate morphological decimal.

The ordinal numbers are given in Table 2.14. These numbers are formed by affixing the ordinal morpheme, ^{L}/pɑ/ to the appropriate cardinal number. The exception, however, is 'first' which is formed in Dzongkha by combining ^{L}/tɑŋ/ (instead of ^{H}/ktʃik/) with ^{L}/pɑ/.

Table 2.14. The Ordinal Numbers

	Structure	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
1st	1-ordinal (irregular)	*dang-pa*	^{L}/tɑŋ/ + ^{L}/pɑ/	dɑŋ. bɑ	d̥ɑŋ bɑ
2nd	2-ordinal	*gnyis-pa*	^{H}/kɲi/ + ^{L}/pɑ/	ɲi. bɑ	ɲiː bɑ
3rd	3-ordinal	*gsum-pa*	^{H}/ksum/ + ^{L}/pɑ/	sum. bɑ	sum bɑ
4th	4-ordinal	*bzhi-pa*	^{L}/pʃi/ + ^{L}/pɑ/	ʒi. bɑ	ʑi bɑ
5th	5-ordinal	*lnga-pa*	^{H}/ŋɑ/ + ^{L}/pɑ/	ŋɑ. bɑ	ŋɑ bɑ
6th	6-ordinal	*drug-pa*	^{L}/ʈuk/ + ^{L}/pɑ/	ɖuk. bɑ ~ ɖu. bɑ	ɖ̥u bɑ
7th	7-ordinal	*bdun-pa*	^{L}/ptʏn/ + ^{L}/pɑ/	dʏm. bɑ	dʏn bɑ
8th	8-ordinal	*brgyad-pa*	^{L}/pkɛ/ + ^{L}/pɑ/	gɛ. bɑ	ge bɑ
9th	9-ordinal	*dgu-pa*	^{L}/ku/ + ^{L}/pɑ/	gu. bɑ	gu bɑ
10th	10-ordinal	*bcu-pa*	^{H}/ptʃu/ + ^{L}/pɑ/	tʃu. bɑ	tɕu bɑ
11th	10-1-ordinal	*bcu-gcig-pa*	^{H}/ptʃu/ + ^{H}/ktʃik/ + ^{L}/pɑ/	tʃuk. tʃi. bɑ ~ tʃu. tʃi. bɑ	tɕuː tɕi bɑ
12th	10-2-ordinal	*bcu-gnyis-pa*	^{H}/ptʃu/ + ^{H}/kɲi/ + ^{L}/pɑ/	tʃuk. ɲi. bɑ ~ tʃu. ɲi. bɑ	tɕuː ɲi bɑ

Note: Morpheme boundaries indicated by (+). Free variation indicated by (~).

It should be noted that while the affix ^{L}/pɑ/ has a low tone (being pronounced as [bɑ] in both van Driem and Mazaudon's transcription), it was pronounced as both [pɑ] and [bɑ] by my consultant. Perhaps [pɑ] is due to a literary pronunciation, as it is spelled with a 'p', especially given my consultant pronounced it as [bɑ] in quicker, more casual speech. Thus, it is transcribed with a [b].

While the majority of the ordinals follow a regular pattern, there are some points of interest that merit discussion. First, there is free variation, as would be expected, in the form of 'eleventh' (^{H}/ptʃu/ + ^{H}/ktʃik/ + ^{L}/pɑ/) and 'twelfth' (^{H}/ptʃu/ + ^{H}/kɲi/ + ^{L}/pɑ/). This is because 'eleventh' and 'twelfth' are combined in the same way as 'eleven' (^{H}/ptʃu/ + ^{H}/ktʃik/) and 'twelve' (^{H}/ptʃu/ + ^{H}/kɲi/); thus, the historical prefix */g-/ in the morphemes 'one' (^{H}/ktʃik/) and 'two' (^{H}/kɲi/) is able to surface as a word medial coda. Importantly, my consultant prefers both [tʃu. tʃi. bɑ] and [tʃu. ɲi. bɑ] over the forms which exhibit prefix resyllabification (i.e. [tʃuk. tʃi. bɑ] and [tʃuk. ɲi. bɑ]). Unexpectedly, however, there is also free variation in 'sixth' (^{L}/ʈuk/ + ^{L}/pɑ/) whereby coda /k/ is possible numeral-finally in the output form, [ɖuk. bɑ] ~ [ɖu. bɑ]. Notably, my consultant originally gave only [ɖu. bɑ] as a possible form, but later said that [ɖuk. bɑ] was also possible. In contrast with 'sixth' however, it is never possible to say 'eleventh' as [tʃuk. tʃik. bɑ] or [tʃu. tʃik. bɑ], even though coda [k] in [tʃik] would occur in the same environment as the coda [k] in 'sixth'.

Another point of interest is the coda of the morpheme 'seven' in 'seventh'. According to my data, the output form has a coda [m]. Recall that, when occurring in isolation, 'seven' is pronounced [dʏn]. Thus, it appears that nasal place assimilation is occurring due to the following consonant, [b].

Dzongkha forms collective nouns by affixing the collective morpheme /p/ to the corresponding cardinal number (see Table 2.15). Thus, for the numbers 'one' through 'ten', this results in a one-syllable word.[56] For numbers larger than ten, the morpheme combines

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[56] My consultant stated that conceptually the collective number 'the one' is strange (as by definition is expected). Nevertheless, she gave the form [tʃip], but also gave 'one' [tʃi] as less awkward way to portray a

Table 2.15. The Collective Nouns

	Structure	Trans-literation	Underlying Form	Consultant Output Forms	Mazaudon & Michailovsky (1989/2006)
the 1	1-pa	*gcig-pa*	^{H}/ktʃik/ + /p/	tʃɪp	--
the 2	2-pa	*gnyis-pa*	^{H}/kɲi/ + /p/	ɲip	ɲiːp
the 3	3-pa	*gsum-pa*	^{H}/ksum/ + /p/	sum	sum
the 4	4-pa	*bzhi-pa*	^{L}/pʃi/ + /p/	ʒip	ʐip
the 5	5-pa	*lnga-pa*	^{H}/ŋɑ/ + /p/	ŋɑp	ŋɑp
the 6	6-pa	*drug-pa*	^{L}/ʈuk/ + /p/	ɖup	ɖ̥up
the 7	7-pa	*bdun-pa*	^{L}/ptʏn/ + /p/	dʏm	dym
the 8	8-pa	*brgyad-pa*	^{L}/pkɛ/ + /p/	gɛp	gɛp
the 9	9-pa	*dgu-pa*	^{L}/ku/ + /p/	gup	gup
the 10	10-pa	*bcu-pa*	^{H}/ptʃu/ + /p/	tʃup	tɕup
the 11	11-pa	*bcu-gcig-pa*	^{H}/ptʃu/ + ^{H}/ktʃik/ + /p/	tʃuk. tʃip ~ tʃu. tʃip	--
the 14	14-pa	*bcu-bzhi-pa*	^{H} /ptʃu/ + ^{L} /pʃi/ + /p/	tʃup. ʒip ~ tʃu. ʒip	--
the 17	17-pa	*bcu-bdun-pa*	^{H} /ptʃu/ + ^{L}/ptʏn/ + /p/	tʃup. dʏm ~ tʃu. dʏm	--

Note: (--) indicates that data was not provided. Morpheme boundaries indicated by (+). Free variation indicated by (~).

with the last syllable of the cardinal number forming a two-syllable word. Interestingly, the ordinals and collective nouns are orthographically the same. It is also worth noting that, while the ordinal morpheme ^{L}/pɑ/ has a low tone, the morpheme of the collective nouns, /p/, does not have tone, due to the lack of a vowel in this morpheme. In the case of ‘the three’/‘all three’ and ‘the seven’/‘all seven’, the nasal coda remains intact; however, the nasal in ‘the seven’/‘all seven’ assimilates to the place of articulation of the ‘collective’ morpheme [p] (this is addressed in Chapters 5 and 6).

Unlike the tens discussed above (refer to Table 2.9, p. 37), which are used for rounded numbers (e.g. ‘fifty’, ‘sixty’, ‘seventy’, etc.) the intermediate tens (Table 2.16) are used to form numbers that are not round (e.g. ‘thirty-six’, ‘sixty-four’, ‘eighty-one’, etc.). There are two constructions associated with the intermediate tens. The first are the shortened forms which are used for counting (as seen in Table 2.16). They are formed by affixing the

similar concept.

Table 2.16. Usage Examples of the Intermediate Tens

	Structure	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
21	20-1	*rtsa-gcig*	^{H}/tsɑ/ + ^{H}/ktʃik/	tsɑ. tʃi	tsɑ. tɕi
22	20-2	*nyer-gnyis*	^{L}/ɲer̯/ + ^{H}/kɲi/	ɲer̯. ɲi	ɲe. r̯i. ɲiː
33	30-3	*so-gsum*	^{H}/so/ + ^{H}/ksum/	so. sum	soː. sum
44	40-4	*zhe-bzhi*	^{L}/ʃe/ + ^{L}/pʃi/	ʒe. ʒi	ʑ̥e. ʑ̥i
55	50-5	*nga-lnga*	^{L}/ŋɑː/ + ^{H}/ŋɑ/	ŋɑː. ŋɑ	ŋɑː. ŋɑ
66	60-6	*re-drug*	^{L}/r̯e/ + ^{L}/ʈuk/	r̯e. ɖu	r̯e. ɖ̥uː
66	60-6	--	^{L}/ ʈo/ + ^{L}/ʈuk/	ɖo. ɖu	--
77	70-7	*don-bdun*	^{L}/tøn/ + ^{L}/ptʏn/	døn. dʏn	d̥øn. dʏn
88	80-8	*gya-brgyad*	^{L}/tʃɑ/ + ^{L}/pkɛ/	dʒɑ. gɛ	d̥ʑɑː. gɛ
99	90-9	*go-dgu*	^{L}/ko/ + ^{L}/ku/	go. gu	g̊o. gu

Note: Word boundaries indicated by (#).

intermediate tens morpheme to the appropriate units. In other words, to form the number ‘thirty-seven’, one would affix the intermediate tens morpheme for ‘thirty’, ^{H}/so/, to the morpheme ‘seven’, ^{L}/ptʏn/, yielding the output [so. dʏn]. Notably, the grammatical structure of these intermediate tens is such that prefix resyllabification is not possible. Thus, it is never possible to say [sop. dʏn].

The second construction associated with the intermediate tens is the full forms. According to van Driem (1998: 159), the full forms are used “when stating an amount or a price to be paid which is over twenty and not a round number.” In order to form the unabbreviated intermediate tens, the corresponding shortened form is combined with the rounded tens (see Section 2.3.2.1). For example, the shortened number ‘thirty-seven’ given above, [so. dʏn], is said as [sum. tʃu. so. dʏn] ^{H}/ksum/ + ^{H}/ptʃu/ + ^{H}/so/ + ^{L}/ptʏn/ (literally ‘three-ten-thirties-seven’) when stating a price.

Two forms are given for the ‘twenties’ in Table 2.16.[57] Van Driem (1998: 159) notes that [ɲer̯] is used for calendar dates between twenty-one and twenty-nine; however, some

[57] In contrast with my consultant, van Driem’s (1998: 159) consultant epenthesizes [i] in some forms of the twenties but not in others (cf. ‘twenty-one’ [ɲe. r̯i. tʃi] and ‘twenty-seven’ [ɲer̯. dʏn]; based on my transcription of van Driem’s consultant).

people use it as a counting form in place of [tsɑ]. Such is the case for my consultant who prefers to use [ɲer̥] over [tsɑ]. Additionally, my consultant gave two forms for the 'sixties', [r̥e] and [ɖo], the latter of which was not discussed in the literature.[58]

With the exception of [tsɑ], the intermediate tens are clearly related to the corresponding units. Interestingly, all vowels of the intermediate tens exhibit vowel lowering from their corresponding units: the vowel [u] in 'three'[sum], 'six' [ɖu], and 'nine' [gu] lowers to [o] in the intermediate tens, resulting in [so], [ɖo], and [go], respectively; the vowel [i] in 'two' [ɲi] and 'four'[ʒi] lowers to [e], producing [ɲer̥] and [ʒe], respectively; [ɛ] in 'eight' [gɛ] lowers to [ɑ], resulting in [dʒɑ]; and the fronted vowel [ʏ] in 'seven' [dʏn] lowers to [ø] in [døn]. Most notably, the intermediate tens for the 'sixties', [r̥e], lowers as well as fronts, losing its rounding from the vowel of the corresponding units, [ɖu]. The intermediate tens for the 'fifties', [ŋɑ], does not lower as the vowel of the corresponding units, [ɑ], is already low. For our purposes in this study, I assume that vowel lowering in these forms is historical; thus, I have listed the underlying forms with the vowel lowered and will not be examining this phonological process in my analysis.

2.3.2.2 The Compound Decimal System

Unlike the morphological decimals discussed above, the phonology of the compound decimals leads to prefix deletion everywhere. In other words, in this subcategory of the Dzongkha decimal system, prefix resyllabification is not possible. According to Vogel (2010: 145-146) the lack of interaction between the members of a compound, which are treated as distinct phonological words, is common among compounds in the world's languages. Specifically, Vogel (2010: 147) states that "it can be observed in many languages that syllabification processes observed within the individual PWs [phonological words] of a compound are not observed across the juncture of these items." This is quite clearly what we find across the subcategory of decimals which I have chosen to call the compound decimals.[59]

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[58] My consultant notes that [ɖo] is not common; instead [r̥e] is the commonly used form.

[59] In the literature, the term "compound" is frequently used to loosely refer to what I call the

The compound decimals start with the hundreds and go to the hundred millions.[60] The compound form of the hundreds takes the reverse construction of the morphological hundreds (see Table 2.17). As with all of the compound decimals, resyllabification of the prefixes does not occur. Thus, neither [dʒɑk. tʃi] nor [dʒɑp. gɛ] are possible and, furthermore, the numbers are predictable from their surface forms when pronounced in isolation.

Table 2.17. The Hundreds: An Alternative Construction

	Structure	Transliteration	Underlying Form	Consultant Output Forms
100	100 - 1	*brgya-gcig*	^{L}/ptʃɑ/ # ^{H}/ktʃik/	dʒɑ. tʃi
200	100 - 2	*brgya-gnyis*	^{L}/ptʃɑ/ # ^{H}/kɲi/	dʒɑ. ɲi
300	100 - 3	*brgya-gsum*	^{L}/ptʃɑ/ # ^{H}/ksum/	dʒɑ. sum
400	100 - 4	*brgya-bzhi*	^{L}/ptʃɑ/ # ^{L}/pʃi/	dʒɑ. ʒi
500	100 - 5	*brgya-lnga*	^{L}/ptʃɑ/ # ^{H}/ŋɑ/	dʒɑ. ŋɑ
600	100 - 6	*brgya-drug*	^{L}/ptʃɑ/ # ^{L}/ʈuk/	dʒɑ. ɖu
700	100 - 7	*brgya-bdun*	^{L}/ptʃɑ/ # ^{L}/ptʏn/	dʒɑ. dʏn
800	100 - 8	*brgya-brgyad*	^{L}/ptʃɑ/ # ^{L}/pkɛ/	dʒɑ. gɛ
900	100 - 9	*brgya-dgu*	^{L}/ptʃɑ/ # ^{L}/ku/	dʒɑ. gu

Note: Word boundaries indicated by (#).

Table 2.18 gives the compound construction of the thousands where the ‘thousand’ morpheme is followed by [ʈʰɑ] which is then followed by the appropriate unit.[61] Note that the transliterated orthographic representation of these forms is extrapolated from the one

morphological decimals; however, the morphological decimals allow resyllabification and, furthermore, exhibit vowel harmony across morphemes within a number (as seen in the Dzongkha teens ‘fifteen’ [tʃɛ. ŋɑ] and ‘eighteen’ [tʃop. gɛ]). Both of these phenomena, according to Vogel (2010: 146-147), are not typical of compounds. As such, I have refrained from referring to them as compounds at this point in the discussion.

It is also worth noting that in discussing the compound thousands (specifically ‘one thousand’), Mazaudon (2007: 7) states that the thousands are “counted according to the normal Dzongkha syntax: noun + quantifier, /tõ-ʈʰa ciː/ ‘10^3-group one’.” In contrast, Mazaudon (1985: 127) found that other decimals (i.e. what I refer to as the morphological decimals) “follow the order multiplier + multiplicand… and are more or less amalgamated.” Thus, Mazaudon is acknowledging that these two forms function in a different manner from one another.

[60] Mazaudon (2007: 7) indicates that the decimals end at the hundred millions and, furthermore, my consultant is unfamiliar with any forms above ‘nine hundred million’.

[61] Mazaudon (1985: 132, 2007: 7) states that [ʈʰɑ] is a suffix meaning ‘interval’. Consequently, I assume that [toŋ. ʈʰɑ] forms a single phonological word.

Table 2.18. The Thousands: An Alternative Construction

	Structure	Transliteration	Underlying Form	Consultant Output Forms
1,000	1000-suffix - 1	*stong-phrag-gcig*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{H}/ktʃik/	toŋ. ʈ^{h}ɑ. tʃi
2,000	1000-suffix - 2	*stong-phrag-gnyis*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{H}/kɲi/	toŋ. ʈ^{h}ɑ. ɲi
3,000	1000-suffix - 3	*stong-phrag-gsum*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{H}/ksum/	toŋ. ʈ^{h}ɑ. sum
4,000	1000-suffix - 4	*stong-phrag-bzhi*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{L}/pʃi/	toŋ. ʈ^{h}ɑ. ʒi
5,000	1000-suffix - 5	*stong-phrag-lnga*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{H}/ŋɑ/	toŋ. ʈ^{h}ɑ. ŋɑ
6,000	1000-suffix - 6	*stong-phrag-drug*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{L}/ʈuk/	toŋ. ʈ^{h}ɑ. ɖu
7,000	1000-suffix - 7	*stong-phrag-bdun*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{L}/ptʏn/	toŋ. ʈ^{h}ɑ. dʏn
8,000	1000-suffix - 8	*stong-phrag-brgyad*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{L}/pkɛ/	toŋ. ʈ^{h}ɑ. gɛ
9,000	1000-suffix - 9	*stong-phrag-dgu*	^{H}/ptoŋ/ + ^{H}/ʈ^{h}ɑ/ # ^{L}/ku/	toŋ. ʈ^{h}ɑ. gu

Note: Word boundaries indicated by (#). Morpheme boundaries indicated by (+).

example of this construction given by van Driem, [toŋ. ʈ^{h}ɑ. tɕi]. Additionally, according to my consultant, the older generations tend to use this construction more than younger generations who use the morphological thousands.

Table 2.19 gives an alternate construction of the ten thousands. The compound ten thousands takes the reverse construction of the morphological ten thousands. Although this construction is discussed in neither van Driem nor Mazaudon, my consultant gave these forms. Again, as with all compound constructions in the number system, there is no surface evidence of the historical prefixes.

The hundred thousands through the hundred millions follow the same compound construction whereby a morpheme indicating a power of ten is followed by the units (see Tables 2.20, 2.21, 2.22, and 2.23). From 'one million' through 'nine hundred million' only the compound construction is possible. In other words, the morphological decimals end with the hundred thousands. The structure of these forms presents no complex phonological phenomena and, thus, no further discussion is required.

Table 2.19. The Ten Thousands: An Alternative Construction

	Structure	Transliteration	Underlying Form	Consultant Output Forms
10,000	10,000 - 1	*khri-gcig*	^{H}/ʈ^{h}i/ # ^{H}/ktʃik/	ʈ^{h}i. tʃi
20,000	10,000 - 2	*khri-gnyis*	^{H}/ʈ^{h}i/ # ^{H}/kɲi/	ʈ^{h}i. ɲi
30,000	10,000 - 3	*khri-gsum*	^{H}/ʈ^{h}i/ # ^{H}/ksum/	ʈ^{h}i. sum
40,000	10,000 - 4	*khri-bzhi*	^{H}/ʈ^{h}i/ # ^{L}/pʃi/	ʈ^{h}i. ʒi
50,000	10,000 - 5	*khri-lnga*	^{H}/ʈ^{h}i/ # ^{H}/ŋɑ/	ʈ^{h}i. ŋɑ
60,000	10,000 - 6	*khri-drug*	^{H}/ʈ^{h}i/ # ^{L}/ʈuk/	ʈ^{h}i. ɖu
70,000	10,000 - 7	*khri-bdun*	^{H}/ʈ^{h}i/ # ^{L}/ptʏn/	ʈ^{h}i. dʏn
80,000	10,000 - 8	*khri-brgyad*	^{H}/ʈ^{h}i/ # ^{L}/pkɛ/	ʈ^{h}i. gɛ
90,000	10,000 - 9	*khri-dgu*	^{H}/ʈ^{h}i/ # ^{L}/ku/	ʈ^{h}i. gu

Note: Word boundaries indicated by (#).

Table 2.20. The Hundred Thousands: An Alternative Construction

	Structure	Transliteration	Underlying Form	Consultant Output Forms
100,000	10^{5}-1	*ḥbum-gcig*	^{L}/pum/ # ^{H}/ktʃik/	bum. tʃi
200,000	10^{5}-2	*ḥbum-gnyis*	^{L}/pum/ # ^{H}/kɲi/	bum. ɲi
300,000	10^{5}-3	*ḥbum-gsum*	^{L}/pum/ # ^{H}/ksum/	bum. sum
400,000	10^{5}-4	*ḥbum-bzhi*	^{L}/pum/ # ^{L}/pʃi/	bum. ʒi
500,000	10^{5}-5	*ḥbum-lnga*	^{L}/pum/ # ^{H}/ŋɑ/	bum. ŋɑ
600,000	10^{5}-6	*ḥbum-drug*	^{L}/pum/ # ^{L}/ʈuk/	bum. ɖu
700,000	10^{5}-7	*ḥbum-bdun*	^{L}/pum/ # ^{L}/ptʏn/	bum. dʏn
800,000	10^{5}-8	*ḥbum-brgyad*	^{L}/pum/ # ^{L}/pkɛ/	bum. gɛ
900,000	10^{5}-9	*ḥbum-dgu*	^{L}/pum/ # ^{L}/ku/	bum. gu

Note: Word boundaries indicated by (#).

Table 2.21. The Millions

	Struct.	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
1,000,000	10^{6} - 1	*saya-gcig*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{H}/ktʃik/	sɑ. jɑ. tʃi	sɑi. tɕi
2,000,000	10^{6} - 2	*saya-gnyis*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{H}/kɲi/	sɑ. jɑ. ɲi	sɑi. ɲiː
3,000,000	10^{6} - 3	*saya-gsum*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{H}/ksum/	sɑ. jɑ. sum	--
4,000,000	10^{6} - 4	*saya-bzhi*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{L}/pʃi/	sɑ. jɑ. ʒi	--
5,000,000	10^{6} - 5	*saya-lnga*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{H}/ŋɑ/	sɑ. jɑ. ŋɑ	--
6,000,000	10^{6} - 6	*saya-drug*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{L}/ʈuk/	sɑ. jɑ. ɖu	--
7,000,000	10^{6} - 7	*saya-bdun*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{L}/ptʏn/	sɑ. jɑ. dʏn	--
8,000,000	10^{6} - 8	*saya-brgyad*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{L}/pkɛ/	sɑ. jɑ. gɛ	--
9,000,000	10^{6} - 9	*saya-dgu*	^{H}/sɑ/ + ^{H}/jɑ/ # ^{L}/ku/	sɑ. jɑ. gu	--

Note: (--) indicates that data was not provided. Word boundaries indicated by (#). Morpheme boundaries indicated by (+).

Table 2.22. The Ten Millions

	Struct.	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
10 million	10^{7} - 1	*bye-ba-gcig*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{H}/ktʃik/	dʒi. wɑ. tʃi	ʥ̥i. wɑ. tɕi
20 million	10^{7} - 2	*bye-ba-gnyis*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{H}/kɲi/	dʒi. wɑ. ɲi	ʥ̥i. wɑ. ɲiː
30 million	10^{7} - 3	*bye-ba-sum*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{H}/ksum/	dʒi. wɑ. sum	--
40 million	10^{7} - 4	*bye-ba-bzhi*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{L}/pʃi/	dʒi. wɑ. ʒi	--
50 million	10^{7} - 5	*bye-ba-lnga*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{H}/ŋɑ/	dʒi. wɑ. ŋɑ	--
60 million	10^{7} - 6	*bye-ba-drug*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{L}/ʈuk/	dʒi. wɑ. ɖu	--
70 million	10^{7} - 7	*bye-ba-bdun*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{L}/ptʏn/	dʒi. wɑ. dʏn	--
80 million	10^{7} - 8	*bye-ba-brgyad*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{L}/pkɛ/	dʒi. wɑ. gɛ	--
90 million	10^{7} - 9	*bye-ba-dgu*	^{L}/dʒi/ + ^{L}/wɑ/ # ^{L}/ku/	dʒi. wɑ. gu	--

Note: (--) indicates that data was not provided. Word boundaries indicated by (#). Morpheme boundaries indicated by (+).

Table 2.23. The Hundred Millions

	Struct.	Trans-literation	Underlying Form	Consultant Output Forms	Van Driem (1998) Output Forms
100 million	10^8 - 1	*dung-phyur-gcig*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{H}/ktʃik/	duŋ. dʒu. tʃi	d̥uŋ. ʥu. ʨi
200 million	10^8 - 2	*dung-phyur-gnyis*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{H}/kɲi/	duŋ. dʒu. ɲi	d̥uŋ. ʥu. ɲiː
300 million	10^8 - 3	*dung-phyur-sum*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{H}/ksum/	duŋ. dʒu. sum	--
400 million	10^8 - 4	*dung-phyur-bzhi*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{L}/pʃi/	duŋ. dʒu. ʒi	--
500 million	10^8 - 5	*dung-phyur-lnga*	^{L}/duŋ/ + ^{L}/dʒu/ # # ^{H}/ŋɑ/	duŋ. dʒu. ŋɑ	--
600 million	10^8 - 6	*dung-phyur-drug*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{L}/ʈuk/	duŋ. dʒu. ɖu	--
700 million	10^8 - 7	*dung-phyur-bdun*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{L}/ptʏn/	duŋ. dʒu. dʏn	--
800 million	10^8 - 8	*dung-phyur-brgyad*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{L}/pkɛ/	duŋ. dʒu. gɛ	--
900 million	10^8 - 9	*dung-phyur -dgu*	^{L}/duŋ/ + ^{L}/dʒu/ # ^{L}/ku/	duŋ. dʒu. gu	--

Note: (--) indicates that data was not provided. Word boundaries indicated by (#). Morpheme boundaries indicated by (+).

2.3.3 A Comparison of Dzongkha and Tibetan Decimals

In this section I will discuss the similarities and differences between Dzongkha and Tibetan decimals. In doing so, I will be showing that the phonological processes (specifically, variable complex onset simplification) attested in the Dzongkha decimal system pertain to Dzongkha (rather than being relics of a borrowed system). This is done in order to justify the Optimality Theoretic account presented in the following chapters. As mentioned above, Mazaudon (1985: 127) states that the decimal system was likely borrowed into Dzongkha from Tibetan for reasons of prestige. However, it is important to note that, given that the vigesimal system uses decimals to express numbers smaller than twenty (among other uses), at the very least, the numbers ‘one’ through ‘nineteen’ had to have been in the language before the rest of the decimals.[62]

Hildebrandt (2007: 292) notes that, although the decimal system of Manange (a TB language spoken in Nepal) was borrowed, it “has probably been in place for awhile, as the phonotactic alternations between simple and complex numerals indicate.” In other words, codas that are not present in the units of Manange appear in larger numbers, which are formed by combining the units with a multiple of ten, much like Dzongkha. (In Manange, ‘six’ is [ʈʰu] and ‘sixty’ is [ʈʰuk. tʃu], where the coda [k] appears only in word medial position (Hildebrandt 2007: 292).) Hildebrandt goes on to say that:

> Coda consonants are rare in Manange, due to diachronic erosion of syllable-edges (this diachronic development is frequently attested in many other Tibeto-Burman languages) and these alternations suggest that the lexicalization of these numerals in such a decimal structure took place at a stage when final codas were still present.

Clearly, this analysis also applies to Dzongkha as evidenced by the alternation between the lack and presence of codas in the units and larger numbers of the morphological decimals (e.g. ‘one’ [tʃi] vs. ‘one hundred’ [tʃik. dʒɑ] and ‘six’ [ɖu] compared to ‘sixty’ [ɖuk. tʃu]). As discussed above, this follows the Dzongkha pattern of coda [k] being permissible word medially but not word finally (see Section 2.2.1.1.2).

Similarly, there is additional evidence in favor of the numbers ‘one’ through ‘nineteen’ having been in use in Dzongkha before syllable edge erosion took place. This support comes from vowel fronting in the teens, specifically ‘fifteen’ [tʃɛ. ŋɑ] *bco-lnga* and ‘nineteen’ [tʃʏ. gu] *bcu-dgu*. As discussed in Sections 2.3.1 and 2.3.2.1, the presence of the historical prefixes */l-/ and */d-/, respectively, led to fronting of the preceding back vowels, a prevalent historical process in Dzongkha (also see Section 2.2.1.2). Therefore, in order for vowel fronting to have occurred in this environment, it indicates that these prefixes once

[62] As seen in van Driem (1998: 161-168) and Mazaudon (2007: 7-9) the numbers ‘one’ through ‘nineteen’ are necessary to form numbers in the vigesimal system. Mazaudon (2007: 7) states, “From 1 to 9 in each score (or 20-group), the unit is added to the multiple of the score.... The same applies to numbers equal to a multiple of 20 plus a number from 11 to 14 and from 16 to 19.” Thus, these decimals are essential to creating vigesimal forms such as ‘twenty-five’ [kʰe. tʃiː. dɑ. ŋɑ] or ‘thirty six’ [kʰe. tʃiː. dɑ. tʃu. ɖu] (examples taken from Mazaudon 2007: 8).

followed the process of resyllabification into the coda of the preceding morpheme at a time when they were still acceptable codas before syllable edge erosion took place.

The next nine tables show a comparison of Dzongkha numerals and Tibetan numerals. It should be noted that the Tibetan numerals and Dzongkha numerals are orthographically identical; their pronunciation, however, does differ. Just as in Dzongkha, DeLancey (2003: 273) notes that the phonological realization of the historical prefix */b-/ "and a handful of others," surface only within what he refers to as "compounds" and, specifically, only when the preceding syllable is coda-less. Furthermore, DeLancey states that the "phenomenon shows limited productivity, being mostly limited to specific lexical items." Importantly, this is also true of Dzongkha, perhaps even more so.[63]

Table 2.24 compares the Dzongkha and Tibetan units.[64] In looking at the three Tibetan sources, we see that Tibetan has free variation in the pronunciation of coda [k] in the number 'one' and, possibly, 'six'. (The sources show different transcriptions of this word.)[65] This is different from Dzongkha, where coda [k] is not pronounced due to its word-final position. In addition, we see that the Tibetan obstruent initial in 'six' is a voiced aspirate (with the exception of Roerich and Lhalungpa who transcribe it as a voiceless unaspirated stop). While I did not note aspiration in my consultant's voiced initial, the Tibetan voiced aspirate initial in 'six' is perhaps similar to the Dzongkha devoiced consonants. Recall from Table 2.7 (p. 33) that van Driem (1998) and Mazaudon and Michailovsky (1989/2006) transcribe this initial as devoiced in their consultants' output forms. Thus, the Tibetan units are very similar to Dzongkha, the only real difference residing in the variable pronunciation of word-final coda [k] in Tibetan.

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[63] Shefts and Chang (1967) and Chang and Chang (1968) note many non-numeric bimorphemic words in Tibetan in which an underlying prefix surfaces. Importantly, I have only found very limited examples in Dzongkha outside of the number system.

[64] Differences in vowel length of the units in Tibetan and Dzongkha are not addressed as this is a matter of difference in transcription. While I did not note long vowels in my transcription of the numbers (with the exception of 'seven' and 'eight', which have inherently long, front vowels), van Driem (1998: 152) notes them in 'two', 'six', 'seven', and 'eight' Mazaudon (1985: 125) notes them in 'one', 'two', 'six', 'eight' and 'nine'. Thus, vowel length is relatively similar across both Tibetan and Dzongkha and, therefore, does not constitute a significant difference.

[65] Three sources are used in Tables 2.24-2.27 (pp. 54-59) as there is some disagreement in the transcription of Tibetan numbers. Above the tens only one source is used as it is the only one which provides data on these numbers in Tibetan.

Table 2.24. Dzongkha vs. Tibetan Units

	Dzongkha	Tibetan[66]		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)[67,68]
1	tʃi	tɕi	tʃik ~ tʃi	tʃiq
2	ɲi	ɲi	ɲiː	ɲiː
3	sum	sum	sum	sum
4	ʒi	ʑi	ʃi	ʒi
5	ŋɑ	ŋa	ŋa	ŋa
6	ɖu	ɖ^{h}u	ʈuk	ɖ^{h}uː
7	dʏn	dyn	dỹː	dỹː
8	gɛ	ɟɛ	g^{j}ɛ	gɛː
9	gu	gu	gu	ɢu

Notably, there are some discrepancies in the Tibetan transcriptions: first, 'seven' varies between the pronunciation of coda [n] and nasalization of the vowel; second, the Tibetan coda in 'one' is reported as either a voiceless velar, [k], or uvular stop, [q];third, the onset in 'eight' is noted with either a voiced palatal, [ɟ], a palatalized velar stop, [g^j], or a plain velar stop, [g]; fourth, 'nine' is transcribed with either a voiced velar, [g], or uvular stop, [ɢ]; and finally, there is some variability in the transcription of the obstruent voicing in 'four' and 'six' (cf. Roerich and Lhalungpa with the other sources). This is not a phonemic

[66] Keeping with the transcription used throughout this paper, I indicate allophonic obstruent voicing instead of tone in the Tibetan transcriptions (which I have also translated into IPA). The exception to this is Roerich and Lhalungpa (1972) which do not indicate tone, but do transcribe using obstruent voicing. It is important to note that Tournadre and Dorje (2003: 432) state that "one of the phonological features of Standard Tibetan is the absence of a clear opposition between voiced and voiceless consonants. *In a high tone*, all consonants are voiceless, whereas in a low tone we find slightly aspirated voiced consonants as well as partial or complete voicing." While Tournadre and Dorje indicate where an obstruent is clearly voiced in the low tone, they make no such assertion for the phonemes [ɕ] and [ʈ^h]. Thus, voicing is assumed on these consonants in the low tone, which are allophonically [ʑ] and [ɖ^h], respectively; however, their voicing is likely not as clear as with other obstruents.

[67] Where I have indicated [tʃ] in Chang and Shefts's (1964) data, they transcribed the phone as [c], using the American notation system. In IPA this translates to [ts] according to Pullum and Ladusaw (1996: 27); however, I assume that they mean [tʃ], especially since they indicate [ts] as such in the text.

[68] In addition to high level and low level tone indicated in Tournadre and Dorje (2003), Chang and Shefts (1964) indicate high falling and low falling tone on words. For our purposes here I do not differentiate between level and falling tone. Furthermore, I only indicate tone (high versus low) through obstruent voicing.

difference, however, as Tibetan obstruents are allophonically voiced in the low tone (just as in Dzongkha), but voicing may not always be clear (Tournadre & Dorje 2003: 432). Importantly, these transcription discrepancies seen in the Tibetan numerals carry out to the higher numbers as well.

In Table 2.25 there are several important differences between the Dzongkha teens and the Tibetan teens. First, while Dzongkha has free variation in ‘eleven’ through ‘fourteen’ and ‘seventeen’, the Tibetan sources do not show free variation in these numbers (with the exception of Chang and Shefts’s transcription of ‘seventeen’ by two different speakers). The Tibetan sources do, however, differ in their transcription of these numbers. In contrast, two of the Tibetan sources show that Tibetan has free variation in the pronunciation of ‘nineteen’, where a coda [r] may appear on the first morpheme; however, variation does not occur in this number in Dzongkha. Interestingly, there is no orthographic *r* in the spelling, which is the same across both languages (‘nineteen’ *bcu-dgu*).

Table 2.25. Dzongkha vs. Tibetan Teens

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
11	tʃuk. tʃi ~ tʃu. tʃi	tɕu. tɕi	tʃuk. tʃi	tʃuq. tʃiː
12	tʃuk. ɲi ~ tʃu. ɲi	tɕu. ɲi	tʃu. ɲiː	tʃuŋ. ɲiː
13	tʃuk. sum ~ tʃu. sum	tɕuk. sum	tʃuk. sum	tʃoq. som
14	tʃup. ʒi ~ tʃu. ʒi	tɕup. ɕi	tʃup. ʃi	tʃyp. ʃi
15	tʃɛ. ŋɑ	tɕø. ŋa	tʃø. ŋa	tʃøː. ŋa
16	tʃu. ɖu	tɕu. ʈu	tʃu. ʈuk	tʃu. ʈuː
17	tʃup. dʏn ~ tʃu. dʏn	tɕup. tyn	tʃub. dỹː	tʃup. tỹː ~ tʃyp. tỹː
18	tʃop. gɛ	tɕop. cɛ	tʃob. gʲɛ	tʃop. kɛː
19	tʃʏ. gu	tɕur. ku	tʃur. gu ~ tʃu. gu	tʃur. qu ~ tʃuː. qu

A second difference is that there is no vowel fronting in Tibetan ‘nineteen’ while there is in Dzongkha. Given that ‘nineteen’ surfaces with a resyllabified prefix /r-/ in the Tibetan forms, but not in Dzongkha, it seems that the two languages have different underlying forms for ‘nine’. Thus, ‘nine’ is underlyingly ^{L}/ku/ in Dzongkha, but in Tibetan it is ^{L}/rku/.[69] Since, according to DeLancey (2003: 271), coda [r] is not one of the consonants which led to historical fronting of back vowels in Tibetan, 'nineteen' does not exhibit fronting here. As a consequence, Dzongkha and Tibetan have different forms for this number. Contrastingly, both Tibetan and Dzongkha exhibit vowel fronting in 'fifteen'; however, the vowel remains round in Tibetan, whereas it is fronted and unrounded in Dzongkha.

Yet another difference is that the Tibetan teens do not exhibit allophonic voicing in any of the obstruent initials of the second morpheme (with the exception of Roerich and Lhalungpa's transcription). It is essential to note here Chang and Chang's (1968) distinction between "morphological units" and "syntactic sequences." According to Chang and Chang (1968: 54, 118), morphological units may be complex (i.e. made up of more than one morpheme) and when made up of more than one syllable may be identified by the following characteristics:

1. An aspirated onset in word-initial position that is alternately unaspirated when not in word-initial position.
2. A low tone word-initial syllable that is alternately high toned when not word-initial.
3. Vowel harmony.
4. The occurrence of a medial nasal feature or [p] which is not present in either member of the morphological unit when in isolation.

Syntactic sequences of morphological units, on the other hand, do not exhibit these phenomena.[70] Thus, the Tibetan teens act as a complex morphological unit, showing tone alternation, vowel harmony (discussed below), and a medial [p] in some forms. Therefore, they do not allophonically voice the second syllable of numbers comprising a single phonological word.[71]

[69] Recall from Section 2.3.2.1 that Dzongkha had a historical prefix */d-/ in 'nine' which led to diachronic vowel fronting. Synchronically speaking, that prefix is lost from its underlying form.

[70] To illustrate this difference, Chang and Chang (1968: 54) give the example 'five or six' which can be said as either a syntactic sequence or a morphological unit. As a syntactic sequence it is said [ŋa. ʈʰuː] where the first syllable ('five') has high tone and the second syllable ('six') has low falling tone. As a morphological unit it is said [ŋʌ. ʈuː] where the first syllable has high tone and the second syllable has high falling tone (cf. with the Tibetan units in isolation as seen in Table 2.24, p. 54).

[71] The lack of allophonic obstruent initial voicing on the second syllable of the Tibetan numbers constituting a single phonological word is seen throughout and, thus, is not addressed except for when noting

Additionally, the Tibetan numbers show varied notation of codas: Chang and Shefts (1964) transcribe 'twelve' with a coda [ŋ] on the first morpheme and Roerich and Lhalungpa (1972) (unexpectedly) transcribe 'seventeen' and 'eighteen' with voiced bilabial codas on the first morpheme. They also transcribe a coda [k] word finally in 'sixteen'. These differences are not present in Dzongkha.

One interesting similarity in both languages is seen in the morpheme 'ten' in the numbers 'fifteen' and 'eighteen'. Recall that 'ten' has an allomorph in these forms in Dzongkha, with a lower underlying vowel than the other forms (i.e. /ptʃɛ/ and /ptʃo/, respectively, instead of /ptʃu/). Tibetan also seems to have lowered vowels on these two numbers. This is due to regressive vowel lowering whereby mid and low vowels cause high vowels in the preceding syllable to lower (Zeisler 2004: 233). According to Chang and Chang (1968: 104) this phenomenon happens rather unpredictably in some concatenated nouns in Tibetan.[72,73] Thus, the vowel [u] in 'ten' /ptʃu/ is lowered to [o], /ptʃo/, by the following mid and low vowels in 'five' [ŋɑ] and 'eight' [gɛ].[74] Moreover, the fact that vowel harmony is reflected in the orthography hints at it having taken place long ago. Not surprisingly, Tournadre and Dorje (2003: 134) note that the orthographic differences between *bcu* and *bco* "represent a formalization, from the classical period, of different pronunciations of the numbers in question."

As a final point, it is worth noting some differences in the transcriptions of Chang and Shefts's (1964). First, the transcription of 'thirteen' [tʃoq. som] shows that the vowels of

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the distinction between morphological units and syntactic sequences in Tibetan in numbers from 'one thousand' and above.

[72] Chang and Chang (1968: 104) also note that regressive and progressive vowel raising is a much more common phenomenon of concatenated nouns in Tibetan. Examples of this are noted in larger Tibetan numbers below.

[73] Vowel harmony is a productive phenomenon of Tibetan morphological units (Chang & Chang 1968: 54). To my knowledge, Dzongkha has very little vowel harmony. Outside of the examples in the number system (i.e. 'fifteen' [tʃɛ. ŋɑ] and 'eighteen' [tʃop. gɛ]), vowel harmony in Dzongkha appears to be confined to words involving [ø]. This is seen, for example, in *slob-dpon* [lø. bø] 'teacher' (data from my consultant; orthographic form from van Driem 1998: 105, which I have transliterated into Roman Dzongkha) and *mchod-rten* [tʃʰø. tø] 'stupa' (transcription, which I have translated into IPA, and orthographic form, which I have transliterated into Roman Dzongkha, from van Driem 1998:105).

[74] Recall that in 'fifteen' historical vowel fronting also occurred due to resyllabification of the dental prefix */l-/ in 'five'.

both morphemes are lowered from [u] to [o]. This is quite interesting considering the underlying form of both vowels is high. Second, their transcriptions show vowel fronting on ‘fourteen’ [tʃyp. ʃi] and ‘seventeen’ [tʃyp. tỹː]. Fronting is unexpected in these forms.

Looking at the intermediate tens, the most distinct difference between Dzongkha and Tibetan, with the exception of Tournadre and Dorje’s (2003) data, is the evidence of prefix resyllabification present in Tibetan (see Table 2.26).[75] Furthermore, Chang and Shefts (1964) show evidence of vowel harmony in the Tibetan forms. Clearly, then the Tibetan intermediate tens are acting as morphological units, by Chang and Chang’s (1968) definition. In contrast, the Dzongkha forms do not exhibit prefix resyllabification nor do they exhibit vowel harmony. In other words, unlike Tibetan, Dzongkha does not treat the intermediate tens as a single morphological unit.

Table 2.26. Dzongkha vs. Tibetan Intermediate Tens

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
21	tsɑ. tʃi	tsa. tɕi	tsak. tʃik	tsʌq. tʃiː
22	ɲeɽ̠. ɲi	--	--	--
33	so. sum	--	so. sum	soː. som ~ sɔː.som
44	ʒe. ʒi	--	ʃep. ʃi	ʒip. ʃi
55	ŋɑː. ŋɑ	--	ŋa. ŋa	ŋɛː. ŋa
66	ɽ̠e. ɖu	--	re. ʈuk	ri. ʈuː
66	ɖo. ɖu	--	--	--
77	døn. dʏn	--	tø̃ː. dỹː	d^{h}ỹ. tỹː
88	dʒɑ. gɛ	--	dʒ^{j}ab. g^{j}ɛ	g^{h}ap.kɛː
99	go. gu	g^{h}o. ku	go. gu	ɢ^{h}ʊr. qu ~ ɢ^{h}ʊː. qu

Note: (--) indicates that data was not provided.

In Table 2.27 there are fewer differences between the Dzongkha and Tibetan forms. First, whereas my consultant says [ɲi. ʃo] for ‘twenty’, Tibetan speakers say [ɲi. ʃu]. (Recall, however, that van Driem (1998) and Mazaudon (1985) transcribe ‘twenty’ as [ɲi. ʃu].) Most notable, however, is the difference between the Dzongkha and Tibetan pronunciation of

[75] For a complete list of Dzongkha and Tibetan intermediate tens see Appendix A.

Table 2.27. Dzongkha vs. Tibetan Tens

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
10	tʃu. tʰɑm	tɕu	tʃu	tʃu
20	ɲi. ʃu	ɲi. ɕu	ɲi. ʃʲu	ɲi. ʃu
30	sum. tʃu	sum. tɕu	sum. tʃu	sum. tʃu
40	ʒip. tʃu	ʑip. tɕu	ʃip. tʃu	ʒip. tʃu
50	ŋɑp. tʃu	ŋap. tɕu	ŋap. tʃu	ŋʌp. tʃu
60	ɖuk. tʃu	ɖʰuk. tɕu	ʈuk. tʃu	ɖʰuq. tʃu
70	dʏn. tʃu	dyn. tɕu	dỹː. tʃu	dỹ. tʃu
80	gɛp. tʃu	ɟɛ. tɕu	gʲɛ. tʃu	gʌ. tʃu
90	gup. tʃu	gup. tɕu	gup. tʃu	ɢup. tʃu

‘eighty’. While Dzongkha exhibits prefix /p-/ resyllabification into the coda of ‘eight’, Tibetan does not. As discussed above, there is no orthographic prefix *b-* on the ‘ten’ morpheme *cu* for the number ‘eighty’. Recall from Section 2.3.2.1 that the lack of the prefix in the orthography is due to the preceding morpheme having a historical final (hence the prefix is missing in the orthographic forms of ‘twenty’, ‘thirty’, ‘sixty’ and ‘seventy’ as well). Since ‘eight’ had a historical */-d/ final, the prefix */b-/ was lost in ‘eighty’ as it was not able to resyllabify. The difference between the modern Tibetan and Dzongkha forms is that the prefix was restored in Dzongkha, likely through analogy, sometime after the historical */-d/ final was dropped; however, this analogy did not occur in Tibetan.

In addition, Chang and Shefts’s (1964) transcription of ‘fifty’ and ‘eighty’ show regressive vowel raising whereby the high vowel of the ‘ten’ morpheme causes the vowel of the preceding morpheme in ‘five’, [a], and ‘eight’, [ɛ], to raise to [ʌ]. Both regressive and progressive vowel raising is found “more often than not” in concatenated nouns (Chang & Chang 1968: 104). Thus, the Tibetan hundreds are clearly acting a “morphological unit” or a single phonological word, as in the Dzongkha morphological decimals. Importantly, however, while they are both acting as single phonological words, they exhibit different phonological phenomena. This is noted in particular in the lack of vowel harmony in Dzongkha.

There are two important differences between Dzongkha and Tibetan in Table 2.28. First is the difference in manner of articulation for the initial consonant of the morpheme 'hundred'. In Tibetan it is pronounced as a stop (being either velar or palatal depending on source), while in Dzongkha it is an affricate. Although 'hundred' is orthographically the same (*brgya*) in both Tibetan and Dzongkha (historically reconstructed as */b-r-gya/ in Proto-Tibeto-Burman according to Matisoff (2003: 162)), their modern phonological difference is due to historical language-specific phonological changes. Thus, in Dzongkha the historical interaction between the root initial consonant */-g-/ and the orthographically subscript consonant */y/ (i.e. IPA */j/) has led to palatalization, yielding modern [dʒ].[76,77] Meanwhile, in Tibetan the root-initial consonant has not been affected.

Table 2.28. Dzongkha vs. Tibetan Hundreds

	Dzongkha Consultant Output Forms	Tibetan Chang and Shefts (1964)
100	tʃik. dʒɑ	ga[78]
200	ɲi. dʒɑ	ɲi. kʌ
300	sum. dʒɑ	sum. kʌ
400	ʒip. dʒɑ	ʒip. kʌ
500	ŋɑp. dʒɑ	ŋap. ka
600	ɖuk. dʒɑ	ɖʰuq. kʌ
700	dʏn. dʒɑ	dỹ. kʌ
800	gɛp. dʒɑ	gɛ. ka
900	gup. dʒɑ	ɢup. kʌ

76 Note that the prefix */b-/ still remains intact, at least in the number system; however, the superscript */r-/, which Matisoff (1997: 60) notes is part of the "double prefix" in this word, was lost. Instead, the prefix */r-/ has indirectly manifested itself as low tone in syllables with obstruent initials (van Driem 1998: 101).

77 Interestingly, the interaction between */-g-/ and subscript */y/ (IPA */j/) gives rise to two different outcomes in modern Dzongkha: 'eight' (orthographically *brgyad* and historically reconstructed in Proto-Tibeto-Burman as */b-r-gyat/ by Matisoff (2003:149)) shows a stop and 'hundred' shows an affricate. The variable outcomes as a result of this interaction, which are common in Dzongkha, are also noted in Van Driem (1998: 101).

78 According to Tournadre and Dorje (2003) [tɕik. ca] is also a possible output for 'one hundred' in Tibetan. Notably, progressive vowel raising is not indicated in their transcription of this word.

Second, the Tibetan hundreds show progressive vowel raising. This is seen in all forms except ‘five hundred’, and ‘eight hundred’ as the vowels of the first morpheme, ‘five’ and ‘eight’, are low and mid, respectively.[79] In all other forms of the Tibetan hundreds, the vowel of the first morpheme is high and, thus, causes the vowel of ‘hundred’, [a], to raise to [ʌ]. Again, this points to the Tibetan hundreds functioning as a morphological unit. Although vowel harmony does not occur in the Dzongkha hundreds, they too function as a single morphological unit (or phonological word) as attested by prefix resyllabification.

The Dzongkha morphological thousands are different from their Tibetan counterparts in a few ways (see the leftmost columns of each language in Table 2.29). First, there is a ‘suffix run’ between ‘one thousand’ and ‘two thousand’ in the Dzongkha forms (see Section 2.3.2.1). This does not occur with the Tibetan thousands.

Table 2.29. Dzongkha vs. Tibetan Thousands

	Dzongkha Consultant Output Forms		Tibetan Chang and Shefts (1964)[80]	
	Morphological Decimals	Compound Decimals	Morphological Units	Syntactic Sequences
1000	tʃik. toŋ	toŋ. ʈʰɑ. tʃi	tʃʰeq. tõː	toŋ. ʈaː. tʃiː
2000	ɲik. toŋ	toŋ. ʈʰɑ. ɲi	ɲeː. tõː	toŋ. ʈaː. ɲiː
3000	sum. toŋ	toŋ. ʈʰɑ. sum	som. tõː	toŋ. ʈaː. sum
4000	ʒip. toŋ	toŋ. ʈʰɑ. ʒi	ʒe. tõː	toŋ. ʈaː. ʒi
5000	ŋɑp. toŋ	toŋ. ʈʰɑ. ŋɑ	ŋa. tõː	toŋ. ʈaː. ŋa
6000	ɖuk. toŋ	toŋ. ʈʰɑ. ɖu	ɖʰoq. tõː	toŋ. ʈaː. ɖʰuː
7000	dʏn. toŋ	toŋ. ʈʰɑ. dʏn	dø̃. tõː	toŋ. ʈaː. dỹː
8000	gɛp. toŋ	toŋ. ʈʰɑ. gɛ	gɛː. tõː	toŋ. ʈaː. gɛː
9000	gup. toŋ	toŋ. ʈʰɑ. gu	ɢu. tõː ~ ɢo. tõː	toŋ. ʈaː. ɢu

Second, there is regressive vowel harmony in the Tibetan forms. In this construction the mid vowel of the ‘thousand’ morpheme causes the preceding units morphemes with high

[79] While I am unsure why vowel harmony is not noted in Tournadre and Dorje’s transcription of ‘one hundred’, [tɕik. ca], it is not noted in Chang and Shefts’s transcription of the word as they only transcribe hundred as [ga] or [ga. tʰãpa]; thus, there are no high vowels to cause vowel raising to occur.

[80] Following Chang and Chang’s (1968) analysis, I will call the Tibetan counterparts to the Dzongkha morphological decimals the morphological units. Likewise, I will refer to the Tibetan counterparts to the Dzongkha compound decimals as syntactic sequences.

vowels (i.e. 'one' through 'four', 'six', 'seven' and 'nine') to lower.[81] For example, instead of [ɲiː], the Tibetan output for 'two', we find that the vowel of this morpheme is lower in the thousands construction, becoming [ɲeː. tõː], 'two thousand', in the Tibetan outputs. In contrast with the regressive vowel harmony seen in Dzongkha 'fifteen' and 'eighteen' (discussed above), Dzongkha does not exhibit regressive vowel lowering in the thousands. Finally, the onset in the Tibetan morpheme for 'one' is aspirated.[82] This difference between Tibetan and Dzongkha is maintained for the higher numbers as well.

There is one important way in which the Dzongkha morphological thousands are similar to the Tibetan forms. According to Benedict (1972: 94), the thousands had a historical prefix */s-/ (being reconstructed as */stoŋ/).[83] However, if this historical prefix were present in Dzongkha, we would expect to see either long, fronted vowels or long, back vowels in the morphemes 'nine' and 'five' (in 'nine thousand' and 'five thousand') due to resyllabification of the alveolar prefix */s-/ into the coda of these units morphemes (see Section 2.2.1.2 for a discussion of the historical effects of */-s/ on vowels); however, contrary to what one would expect, neither front nor long vowels are found on these forms. While Mazaudon and Michailovsky (1989/2006: 127) note that the connection between historical vowel fronting and */-s/ finals is inconsistent in Dzongkha, this process is regular in Central Tibetan. For example, the fronting of back vowels before a historical */s-/ final is seen in Tibetan words such as 'cloth' [rɛ] *ras*, 'really' [ŋø. nɛ] *dngos-nas*, and 'time' [tʰy. tsø] *dus-tshod* (Tournadre & Sangda 2003: 56, 58, 443-444). Therefore, one would reasonably expect vowel fronting to at least occur in the Tibetan forms of 'five thousand' and 'nine thousand'; however, neither [ŋɛ. tõː] nor [gy. tõː] ~ [gø. tõː] are possible. Therefore, in my opinion, the lack of vowel fronting (or, at the very least, vowel lengthening) in these

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[81] Notably, according to Chang and Shefts's transcription, 'nine thousand' has variable outputs where the vowel of the morpheme 'nine' may lower to [o] or remain high, [u].

[82] Mazaudon (1985: 133) notes that the onset in 'one' is aspirated in her consultant's speech when saying 'ten thousand' (i.e. [tʃʰik. ʈʰi]). Furthermore, she asserts that [tʃʰ] is evidence that the number is borrowed from Tibetan.

[83] Matisoff (1997: 61) states that this reconstructed form is based on written Tibetan (as well as written Burmese).

forms in both Dzongkha and Tibetan provides some debate as to whether the historical reconstruction of ‘thousand’ really had a prefix */s-/.

The Dzongkha compound thousands are very similar to their Tibetan counterparts as well (see the rightmost columns of each language in Table 2.29, p. 61). In fact, vowel length and aspiration appear to be the only differences. More specifically, the vowel length of the suffix [ʈʰɑ] differs between Tibetan and Dzongkha. Furthermore, this suffix is aspirated in Dzongkha; however, it is unaspirated in Tibetan.[84] In addition, it is important to note three characteristics of this construction in Tibetan (which are observed in the ten thousands and hundred thousands as well): (1) the units keep their underlying tone rather than replacing syllable tone with word tone; thus, in units with an underlying low tone, the obstruent onsets are voiced (e.g. ‘four’ [ʒi] in ‘four thousand’ [toŋ. ʈaː. ʒi]); (2) medial [p] does not surface; and (3) vowel harmony does not occur in these forms. Thus, following Chang and Chang’s (1968) distinction of morphological units from syntactic sequences, the Tibetan thousands of this construction (as well as the ten thousands and hundred thousands) are syntactic sequences and not morphological units. Importantly, this provides support to the analysis that numbers of the compound construction in Dzongkha do not function as a single morphological unit. Instead, they are made up of individual phonological words.

The Dzongkha ten thousands are quite similar to the Tibetan ten thousands, particularly when comparing the compound/syntactic constructions (see Table 2.30).

One difference, however, resides in the aspiration of ‘ten thousand’ in the morphological construction (see the leftmost column of each language). More precisely, the initial consonant of the Dzongkha morpheme for ‘ten thousand’ is aspirated in this construction, [ʈʰi], while in Tibetan it is not, [ʈi]. Recall from above that, according to Chang and Chang (1968), in Tibetan, the lack of onset aspiration when in non-initial position is an indicator of a construction comprising a single morphological unit (cf. the ‘ten thousand’ morpheme in Tibetan when in initial versus non-initial position). Moreover, in this

[84] The lack of aspiration in the Tibetan suffix [ʈɑ] (as compared to the Dzongkha suffix [ʈʰɑ]) may be an indicator of the suffix forming a morphological unit with the ‘thousand’ morpheme following Chang and Chang’s (1968) indicators (as discussed above); however, I cannot be certain without seeing this form in isolation.

Table 2.30. Dzongkha vs. Tibetan Ten Thousands

	Dzongkha Consultant Output Forms		Tibetan Chang and Shefts (1964)	
	Morphological Decimals	Compound Decimals	Morphological Units	Syntactic Sequences
10,000	tʃik. ʈʰi ~ tʃi. ʈʰi	ʈʰi. tʃi	tʃʰiq. ʈi	ʈʰi. tʃiː
20,000	ɲi. ʈʰi	ʈʰi. ɲi	ɲi. ʈi	ʈʰi. ɲiː
30,000	sum. ʈʰi	ʈʰi. sum	sum. ʈi	ʈʰi. sum
40,000	ʒi. ʈʰi	ʈʰi. ʒi	ʒi. ʈi	ʈʰi. ʒi
50,000	ŋɑ. ʈʰi	ʈʰi. ŋɑ	ŋʌ. ʈi	ʈʰi. ŋa
60,000	ɖuk. ʈʰi ~ ɖu. ʈʰi	ʈʰi. ɖu	ɖʰuq. ʈi	ʈʰi. ɖʰuː
70,000	dʏn. ʈʰi	ʈʰi. dʏn	dỹ. ʈi	ʈʰi. dỹː
80,000	gɛ. ʈʰi	ʈʰi. gɛ	gɪ. ʈi	ʈʰi. gɛː
90,000	gu. ʈʰi	ʈʰi. gu	ɢu. ʈi	ʈʰi. ɢu

construction the Tibetan ten thousands also show regressive vowel raising in ‘fifty thousand’ and ‘eighty thousand’. Another difference is that Dzongkha has free variation in production of the coda [k] in the morphological ten thousands, as seen in ‘ten thousand’ and ‘six thousand’. In Tibetan, however, it appears that the coda (in this case the voiceless uvular [q]) must always be said.

While the Dzongkha hundred thousands are very similar to their Tibetan counterparts, there are still three distinctions worth making note of in the morphological construction (see the leftmost column of each language in Table 2.31).

First, in the morphological construction of the hundred thousands, the vowels of the units in the Tibetan numbers are all nasalized (except for ‘one’, which has a pronounced [ŋ]). This is a striking difference from the Dzongkha hundred thousands, which does not nasalize the vowels of the units in the hundred thousands. This is due to an underlying nasal prefix in the Tibetan morpheme for ‘hundred thousand’ (i.e. ^{L}/Npum/). Recall from above that a “medial nasal feature” which does not appear on the morpheme in isolation is an indicator of morphological units (Chang & Chang 1968: 54). It appears that, as a result of this underlying nasal, the coda [q] of ‘one’ in ‘one hundred thousand’ has coalesced with the nasal, becoming [ŋ]. Moreover, there is no coda [m] on ‘three’ in ‘three hundred thousand’. This is, perhaps, due to Tibetan constraints against strings of two consecutive nasals. Second, as

Table 2.31. Dzongkha vs. Tibetan Hundred Thousands

	Dzongkha Consultant Output Forms		Tibetan Chang and Shefts (1964)	
	Morphological Decimals	Compound Decimals	Morphological Units	Syntactic Sequences
100,000	tʃik. bum ~ tʃi. bum	bum. tʃi	tʃʰiŋ. pum	bum. tʃiː
200,000	ɲi. bum	bum. ɲi	ɲĩː. pum	bum. ɲiː
300,000	sum. bum	bum. sum	sũ. pum	bum. sum
400,000	ʒi. bum	bum. ʒi	ʒĩ. pum	bum. ʒi
500,000	ŋɑ. bum	bum. ŋɑ	ŋʌ̃. pum	bum. ŋa
600,000	ɖuk. bum ~ ɖu. bum	bum. ɖu	ɖʰũː. pum	bum. ɖʰuː
700,000	dʏn. bum	bum. dʏn	dỹ. pum	bum. dỹː
800,000	ɡɛ. bum	bum. ɡɛ	ɡĩː. pum	bum. ɡɛː
900,000	ɡu. bum	bum. ɡu	ɢũ. pum	bum. ɢu

is expected of this construction, the Tibetan forms exhibit an alternating high tone on the second morpheme as seen in the output [pum]. Finally, as is also expected in this construction, there is regressive vowel raising on ‘five hundred thousand’ and ‘eight hundred thousand’.

Table 2.32 gives the Dzongkha and Tibetan ordinals. First, Chang and Shefts’s data show that these forms function as single morphological units. This is seen in the progressive vowel raising in the ordinal morpheme [pa]. Thus, with the exception of ‘fifth’ and ‘eighth’, which have low or mid vowels in the units morpheme, the high vowels of the units morphemes causes the low vowel of the ordinal morpheme to raise to [ʌ]. Vowel harmony is not noted in Tournadre and Dorje’s data.

Second, ‘twelfth’ in Tournadre and Dorje’s data is transcribed as [tɕuː. tɕik. pa] where there is a coda [k] on the middle morpheme, ‘one’. Interestingly, there is no coda [k] in their transcription of ‘one’ when in isolation (see Table 2.24, p. 54). As discussed in Section 2.3.2.1 (see Table 2.14, p. 42) neither [tʃuk. tʃik. bɑ] nor [tʃu. tʃik. bɑ] are ever possible in Dzongkha; in contrast, however, [ɖuk. bɑ] is a possible form, even though the coda [k] occurs in the exact same environment in both forms. As we will see in Chapter 5, this poses an interesting analytical issue.

Table 2.32. Dzongkha vs. Tibetan Ordinals

	Dzongkha	Tibetan	
	Consultant Output Forms	Tournadre and Dorje (2003)	Chang and Shefts (1964)
1st	dɑŋ. bɑ	dʰaŋ. po	dʰã. qo
2nd	ɲi. bɑ	ɲiː. pa	ɲiː. pʌ
3rd	sum. bɑ	sum. pa	sũ. pʌ
4th	ʒi. bɑ	--	ʒi. pʌ
5th	ŋɑ. bɑ	--	ŋa. pa
6th	ɖuk. bɑ ~ ɖu. bɑ	--	ɖʰuq. pʌ
7th	dʏm. bɑ	--	dỹ. pʌ
8th	gɛ. bɑ	--	gɛ. pa
9th	gu. bɑ	--	ɢu. pʌ
10th	tʃu. bɑ	tɕuː. pa	tʃu. pʌ
11th	tʃuk. tʃi. bɑ ~ tʃu. tʃi. bɑ	tɕuː. tɕik. pa	tʃuq. tʃi. pʌ
12th	tʃuk. ɲi. bɑ ~ tʃu. ɲi. bɑ	--	tʃuŋ. ɲi. pʌ

Note: (--) indicates that data was not provided.

Finally, it is worth noting that the spelling of 'first' differs between Dzongkha and Tibetan. In Dzongkha it is written *dang-pa* (according to Van Driem 1998) while in Tibetan it is written *dang-po* (according to Tournadre & Dorje 2003); thus, the vowels of the output forms of the ordinal morpheme in 'first' in each language vary. In addition, Chang and Shefts transcribe 'first' with a uvular stop while Tournadre and Dorje transcribe it with a bilabial stop.

Based on the overall similarity between the Tibetan decimal system and the Dzongkha decimal system, it seems likely that it was borrowed, at least in part, into Dzongkha. Notably, Dzongkha and Tibetan are similar in that they distinguish between numbers that function as a single phonological word and numbers that are made up of separate phonological words; however, the phonological phenomena characteristic of morphological decimals differ slightly in Tibetan. (Both the Tibetan and Dzongkha morphological decimals exhibit prefix resyllabification, but the Tibetan numbers of this construction also show tone sandhi and much more extensive vowel harmony.) Additionally, the intermediate tens transcribed by Chang and Shefts (1964) vary considerably from Dzongkha; in Tibetan these forms act as morphological units, while in Dzongkha they do not. Finally, as discussed above, numbers smaller than twenty have been in the language for quite some time as Dzongkha has no other means of expressing these numbers. Moreover, these numbers are also present in the vigesimal system to express numbers such as 'thirty eight' [kʰɛ. tɕi. d̥ɑ. tɕoːp. gɛ] which is literally 'one score and eighteen' (van Driem 1998: 162). Thus, at the very least, we can be certain that the numbers 'one' through 'nineteen' have been in the language for a long time.

Given the similarities, however, a remark on the phonological analysis of loanwords is in order. In the past, rule-based theory has had difficulties in accounting for the 'nativisation' of loanwords. This is due to rule-based account's "duplication problem" which requires a redundant "morpheme structure constraint… [in order to] adapt loanwords to the native phonological system" (Jacobs & Gussenhoven 2000: 193). However, according to Jacobs and Gussenhoven, a theory which is based on rankable, violable constraints, such as OT has no need for the addition of rules to explain loanwords. Instead, the constraint ranking should be able to accurately predict loanword nativisation. Furthermore, Jacobs and Gussenhoven (2000: 205) note in their study that loanwords can provide important evidence of constraint rankings that might have otherwise been undetermined by the native lexicon. Thus, the Dzongkha number system, although likely borrowed in part, will be used as a means to view the ranking of constraints in force in the language.

2.4 SUMMARY

In this chapter I have discussed the theoretical framework in which the remainder of the thesis will be addressed. Furthermore, I have provided a detailed discussion of the Dzongkha phonemic inventory, syllable canon, tone system, and number system.

The remainder of this thesis is organized as follows: first I will provide an Optimality Theoretic analysis of Dzongkha tone (Chapter 3); next I will examine the compound decimals in Dzongkha through OT (Chapter 4); this is followed by an analysis of the variable means of complex onset simplification and coda [k] treatment (attested in the morphological decimals) through the cophonology approach (Chapter 5). After, I will reconsider the data using Stratal OT in order to compare this approach with the cophonology approach (Chapter 6). The final chapter will give some concluding remarks and directions for future research (Chapter 7).

CHAPTER 3

SYLLABLE INITIALS AND TONE IN DZONGKHA

This chapter provides an Optimality Theoretic analysis of the synchronic correlation between obstruent voicing and vowel quality in syllable-initial position and their corresponding register tone. This is done by assuming an abundance of available inputs to the grammar, known as Richness of the Base (McCarthy 2008: 88-94).[85] The constraints in force will work to evaluate the well-formedness of different output candidates by eliminating more marked combinations while still remaining as faithful to the input as possible. This analysis will be done using the documentation of Mazaudon and Michailovsky (1989/2006) and van Driem (1998). The organization of the chapter is as follows: Section 3.1 discusses the exemption of the falling tone contour from this study; Section 3.2 examines the relationship between tone and onset voicing in obstruents; and Section 3.3 addresses the constraints at work in predicting the optimal output between vowel-initial syllables and their corresponding tone.

3.1 The Falling Tone Contour

While the Dzongkha high and low register and falling tone contour have been documented by Mazaudon and Michailovsky as well as van Driem, only the high and low registers were observed in the dialect of the consultant used for this study. Thus, the falling tone contour will not be examined. This lack of a falling tone contour is consistent with the findings of van Driem (1998: 113-114) who found that these contour tones, which are "incipient tonal phenomena," are not found in all dialects of Dzongkha, nor are they consistently produced by those speakers of a dialect in which it has been observed. Furthermore, Mazaudon and Michailovsky (1989/2006) note an analysis by Sprigg (1993)

[85] Assuming Richness of the Base means that the constraint ranking must be able to predict only possible words in Dzongkha given any input to the grammar (McCarthy 2008: 89).

who found that the Dzongkha contour tone is merely a literary pronunciation occurring from single-word elicitations.

3.2 OBSTRUENT ONSET VOICING AND TONE

Recall from Chapter 2, Section 2.2.3 that voiceless obstruent onsets occur only in the high tone (indicated here with a superscript ^{H}) and that voiced obstruents occur only in the low tone (superscript ^{L}). In addition, tone is contrastive after sonorant initials as they occur in both the high and low tone (see Appendix B). In other words, tone is lexical.

In order to accurately account for the correlation between onset voicing and tone, the following constraints will be used:

Faithfulness Constraints

- **IDENT-IO(voice)**: Output segments preserve values of [voice] for input correspondents (Kager 1999: 340).
- **IDENT-IO(tone)**: Outputs must preserve the same tone value as the input.

Markedness Constraints

- **VOICED OBSTRUENT PROHIBITION (VOP)**: No voiced obstruents (Ito & Mester 1998, as cited in Kager 1999: 40).
- **$*^{L}{}_{\sigma}$[-VOI:** No syllables with voiceless onsets and low tone.

Before jumping directly into the tableaux, a word on their use and how to read them is in order. While the violation tableau is the most common type encountered in OT literature, here I will use the combination tableau, which utilizes both the violation tableau and the comparative tableau. Whereas the violation tableau focuses on only constraint violations made by a candidate, the comparative tableau focuses on the ‘favoring relation’ between the winner and loser candidate(s) (McCarthy 2008: 45). In other words, comparative tableaux provide an easy way for determining how any suboptimal candidate is favored against the optimal candidate. Thus, the combination tableau is extremely convenient as it allows the reader to see both the favoring relation of the winner over the loser as well as the violations leading to the favoring relation.

When reading the tableaux, the violations of any one constraint by a candidate are indicated by an asterisk (*). Furthermore, *x* number of violations of a constraint by a candidate will result in *x* asterisks being assigned in the box where the candidate and constraint meet in the tableau. Where the violation results in the candidate being eliminated from the competition (i.e. a fatal violation), an exclamation point (!) is indicated next to the asterisk(s).[86] In order to indicate the favoring relation between the winner candidate and the loser candidates, the letters W and L are used to denote: (a) where the winner performs better than the loser on a given constraint (W), and (b) where the loser performs better than winner on a given constraint (L). Furthermore, because the loser candidates are being compared to the winner, the W/L distinction is confined to rows with losing candidates. In addition to determining favoring relations, the benefit of using the comparative tableau is that it facilitates the process of finding direct ranking arguments. For example, in any one row a ranking argument can only be determined if there is only one W which ranks above any number of Ls. If there is more than one W, a direct ranking argument cannot be determined as it is unclear which constraint is active in eliminating the loser candidate(s) (unless, of course, it has already been determined that all but one W ranks below at least one L). Following McCarthy (2008: 47), the combination tableau will be used as it is “the ideal instrument for constructing and presenting ranking arguments.”

The input of the first tableau, Tableau 3.1, has an underlying high tone and a voiceless obstruent onset, ^{H} /siː/ ‘cold’. Based on the input, there are four candidates presented in the tableau: Cand (a) ^{H}[siː], Cand (b) ^{H}[ziː], Cand (c) ^{L}[siː], and Cand (d) ^{L}[ziː]. Starting at the bottom of the tableau, Cand (d) violates IDENT-IO(tone) and IDENT-IO(voice) as its tone and voicing have changed from the input form. Moreover, Cand (d) also violates VOP as [z] is a voiced obstruent.[87] Next, Cand (c) incurs one violation on IDENT-IO(tone) and one violation on $*^{L}{}_{\sigma}$[-VOI. These violations are due to Cand (c) having a different tone from the input and, also, for having a voiceless obstruent onset, [s], in a low tone syllable. Cand (b) violates VOP for having a voiced obstruent, [z], as well as IDENT-IO(voice), as the onset segment’s voicing differs from the input. Finally, Cand (a) does not violate any of the constraints. It is the fully faithful candidate (i.e. it does not violate IDENT- IO(tone) or

[86] Where it is unclear which constraint is active in eliminating a candidate (i.e. the constraint ranking is unknown), it is possible for a candidate to have more than one fatal violation.

[87] While I recognize that Cand (d) is harmonically bounded by Cand (b) and, therefore, cannot win under any ranking, it has been provided for completeness. Due to the simplicity of these tableaux, the harmonically bounded candidate will be included throughout this chapter.

Tableau 3.1.

input: 'cold' ^{H}/siː/	IDENT-IO(tone)	$*^{L}_{\sigma}$[-VOI	VOP	IDENT-IO (voice)
a. → ^{H}siː				
b. ^{H}ziː			*!W	*!W
c. ^{L}siː	*!W	*!W		
d. ^{L}ziː	*!W		*!W	*!W

IDENT-IO(voice)) and it does not violate any of the markedness constraints (i.e. $*^{L}_{\sigma}$[-VOI or VOP). Although Cand (a), is correctly predicted as optimal, it does not provide any ranking evidence. This is because, in order for ranking relations to be determined, the optimal candidate must incur more violations on at least one constraint than at least one other candidate.

Tableau 3.2 shows that, given an input with an underlying voiced onset and a high tone, the optimal output will have a voiceless onset. This is due to IDENT-IO(voice) being crucially ranked below VOP, as seen in the ranking argument between the winner, Cand (a), and Cand (b). Furthermore, Candidate (c) provides evidence of either one or both IDENT-IO(tone) and/or $*^{L}_{\sigma}$[-VOI ranking above IDENT-IO(voice); however, their exact ranking cannot be determined as there is no evidence to support which constraint is active on Candidate (c). Likewise, Cand (d) does not provide any additional ranking evidence as the ranking of VOP above IDENT-IO(voice)has already been established by Cand (b). Thus, it is undeterminable whether or not IDENT-IO(tone) is active in the elimination of Cand (d).

Tableau 3.2.

input: 'cold' ^{H}/ziː/	IDENT-IO(tone)	$*^{L}_{\sigma}$[-VOI	VOP	IDENT-IO (voice)
a. → ^{H}siː				*
b. ^{H}ziː			*!W	L
c. ^{L}siː	*!W	*!W		*
d. ^{L}ziː	*!W		*!W	L

The next two tableaux demonstrate that the constraints and their ranking can accurately account for the optimal output when applied to an input with low tone. Tableau 3.3 provides further ranking evidence. Given the already established ranking of VOP above IDENT-IO(voice), it is clear that both IDENT-IO(tone) and $*^{L}_{\sigma}$[-VOI must dominate

Tableau 3.3.

input: 'leopard' ^{L} /ziː/	IDENT-IO(tone)	$*^{L}{}_{\sigma}$[-VOI	VOP	IDENT-IO (voice)
a. → ^{L} ziː			*	
b. ^{L} siː		*!W	L	*W
c. ^{H} siː	*!W		L	*W
d. ^{H} ziː	*!W		*	

VOP in order to knock both Cands (b) and (c) out of the competition. In addition, Cand (c) makes it evident that faithfulness to lexical tone has higher priority than faithfulness to onset voicing. This is consistent with the analysis that tone is lexical, given that it is contrastive after sonorants.

In Tableau 3.4, the winning candidate violates both VOP and faithfulness to the input voicing. Moreover, due to $*^{L}{}_{\sigma}$[-VOI as well as IDENT-IO(tone) dominating IDENT-IO(voice), it is clear that the voicing of the obstruent onset is dependent on the lexical tone. In other words, voicing of obstruent initials is allophonic. This is seen in the context-specific markedness constraint, $*^{L}{}_{\sigma}$[-VOI, outranking the context-free markedness constraint on obstruent voicing, VOP, which, in turn, outranks faithfulness to input voicing, IDENT-IO(voice). That is, obstruents must never be voiced unless: (1) the obstruent is in onset position; and (2) the word carries a low tone.[88]

Tableau 3.4.

input: 'leopard' ^{L} /siː/	IDENT-IO (tone)	$*^{L}{}_{\sigma}$[-VOI	VOP	IDENT-IO (voice)
a. → ^{L} ziː			*	*
b. ^{L} siː		*!W	L	L
c. ^{H} siː	*!W		L	L
d. ^{H} ziː	*!W		*	*

In assuming Richness of the Base the posited constraints must be able to correctly predict the optimal candidate even when the onset voicing of the input differs. Keeping this

[88] The exception to this is [r̝] (voiced alveolar fricative trill) which is a possible coda (although infrequent) as it meets the requirements of the constraints on possible codas (see Chapter 4).

requirement in mind, these four constraints and their ranking are able to accurately predict the optimal output given inputs with both voiced and voiceless obstruent onsets. This is accomplished based on the faithfulness constraint IDENT-IO(tone) and the markedness constraint $*^{L}{}_{\sigma}$[-VOI crucially dominating VOP and faithfulness to input voicing. The product is a hierarchy of ranked constraints which account for the allophonic voicing of obstruent initials in the low tone.[89] The established ranking is as follows:

(1) IDENT-IO(tone), $*^{L}{}_{\sigma}$[-voi » VOP » IDENT-IO(voice)

3.3 VOWEL-INITIAL SYLLABLES AND TONE

In addition to the correlation between voicing and tone, van Driem (1998: 60) also documented the occurrence of 'breathy' syllable-initial vowels which emerge only in the low tone. It should be noted that he also observed an "abrupt glottal release" before syllable-initial vowels in the high tone; however, I did not observe this in my consultant's speech. Thus, high tone syllable-initial vowels are considered plain vowels for our purposes here. The following constraints will be used in this account along with the previously discussed constraint IDENT-IO(tone):

Faithfulness Constraint

- **IDENT-IO(Vqual)**: Outputs must preserve the same vowel quality as the input where quality varies over plain versus breathy.

Markedness Constraints

- ***V̤**: No breathy vowels.
- **$*^{L}{}_{\sigma}$[V**: No syllable-initial plain vowels in the low tone.

In Tableau 3.5, it is the fully faithful candidate that wins, thus there is no ranking evidence provided by this tableau.

Tableau 3.6 shows that, in order to correctly predict Cand (a) as optimal, IDENT-IO(Vqual) must be ranked below *V̤. This is seen in the ranking of Cand (a) against Cand (b). This tableau, however, does not provide evidence for the ranking of $*^{L}{}_{\sigma}$[V, IDENT-IO(tone), or *V̤ in relation to one another as there are no conflicting constraints to support

[89] The constraints also account for the occurrence of the phoneme [r̝], a fricative trill, and its voiceless, high tone allophone, [r̝̊] in syllable-initial position. Recall from Chapter 2 that I analyze this phoneme as an obstruent.

Tableau 3.5.

input: ‘milk’ ^{H}/oː/ + /m/	IDENT-IO(tone)	$*^{L}{}_{\sigma}[V$	*V̤	IDENT- IO (Vqual)
a. → ^{H} oːm				
b. ^{H} o̤ːm			*!W	*!W
c. ^{L} oːm	*!W	*!W		
d. ^{L} o̤ːm	*!W		*!W	*!W

Tableau 3.6.

input: ‘milk’ ^{H}/o̤ː/ + /m/	IDENT-IO(tone)	$*^{L}{}_{\sigma}[V$	*V̤	IDENT- IO (Vqual)
a. → ^{H} oːm				*
b. ^{H} o̤ːm			*!W	L
c. ^{L} oːm	*!W	*!W		*
d. ^{L} o̤ːm	*!W		*!W	L

their ranking. Furthermore, it is unclear which constraint (IDENT-IO(tone) or $*^{L}{}_{\sigma}[V$) is active on Candidate (c), leading to its fatal violation. Similarly, it is unclear whether one or both of IDENT-IO(tone) and *V̤ are active in the elimination of Cand (d); thus, there is no further ranking evidence provided.

Tableau 3.7, however, does provide further ranking evidence. While the ranking of *V̤ above IDENT- IO(Vqual) was established in the previous tableau, Cands (b) and (d) respectively establish the ranking of $*^{L}{}_{\sigma}[V$ and IDENT-IO(tone) above *V̤ here. Therefore, these two constraints crucially dominate both *V̤ and IDENT-IO(Vqual); however, as the optimal candidate will never violate either of these constraints, their ranking against one another cannot be determined.

Tableau 3.7.

input: ‘come’ ^{L} /o̤ːm/	IDENT-IO(tone)	$*^{L}{}_{\sigma}[V$	*V̤	IDENT-IO (Vqual)
a. → ^{L} o̤ːm			*	
b. ^{L} oːm		*!W	L	*W
c. ^{H} o̤ːm	*!W		*	
d. ^{H} oːm	*!W		L	*W

Finally, Tableau 3.8 reaffirms this ranking. Even when loser Candidates (b) and (d) perform better than the optimal candidate on *V̤ and IDENT-IO(Vqual), they do this at the expense of fatally violating the higher ranking constraints $*^{L}{}_{\sigma}[V$ and IDENT-IO(tone), respectively. Moreover, due to these two constraints dominating faithfulness to input vowel quality, IDENT-IO(Vqual), it is clear that syllable-initial vowel breathiness is dependent on the lexical tone.

Tableau 3.8.

input: ‘come’ ^{L} /oːm/	IDENT-IO(tone)	$*^{L}{}_{\sigma}[V$	*V̤	IDENT-IO (Vqual)
a. → ^{L} o̤ːm			*	*
b. ^{L} oːm		*!W	L	L
c. ^{H} o̤ːm	*!W		*	*
d. ^{H} oːm	*!W		L	L

This scenario closely resembles the allophonic variation of onset obstruent voicing discussed in Section 3.2. Here, it is seen in the context-specific markedness constraint $*^{L}{}_{\sigma}[V$ outranking the context-free markedness constraint *V̤, which, in turn, outranks faithfulness to the input vowel quality. In other words, vowels in Dzongkha are always plain unless they occur in initial position in a syllable with a lexical low tone. In such a case, the optimal output will be an allophonically breathy vowel.

To summarize, in order to satisfy faithfulness to IDENT-IO(tone) as well as to avoid violation of the markedness constraint $*^{L}{}_{\sigma}[V$, it is preferable to violate IDENT-IO(Vqual) and/or *V̤. In ranking the faithfulness constraint IDENT-IO(tone) and the markedness constraint $*^{L}{}_{\sigma}[V$ above *V̤ and IDENT-IO(Vqual) the constraints account for the allophonic breathiness of syllable-initial vowels in the low tone. The established ranking is as follows:

(1) IDENT-IO(tone), $*^{L}{}_{\sigma}[V$ » *V̤ » IDENT-IO(Vqual)

3.4 SUMMARY

In assuming Richness of the Base, the aforementioned constraints and their ranking can correctly predict optimal outputs given different initials in the input. This account of Dzongkha syllable initials and tone asserts that the language favors faithfulness to the input tone and avoidance of the context specific markedness constraints (i.e. $*^{L}{}_{\sigma}[$-VOI and $*^{L}{}_{\sigma}[V$)

over the general markedness constraints (i.e. VOP and *V̤).[90] Furthermore, these constraints take priority over faithfulness to segmental features of the input, such as onset voicing or vowel quality.

[90] It should be acknowledged that this is a working analysis. A future account might better generalize that, in Dzongkha, onsets in syllables with low tone have a particular kind of laryngeal structure (breathy or voiced) and onsets in syllables with high tone also have a particular kind of laryngeal structure (voiceless or plain voice).

CHAPTER 4

THE COMPOUND DECIMAL SYSTEM

The discussion in this chapter covers the active constraints, as well as their ranking, involved in determining the optimal output forms of the compound decimal system. In addition, the ranking of these constraints must capture the generalization of other compounds which eliminate complex onsets in the input through deletion of the first segment. Refer to Section 2.2.1 for the phonemic inventory of Dzongkha and Section 2.3.2.2 for an overview of the Dzongkha compound decimals. The organization of the chapter is as follows: Section 4.1 discusses the constraints involved in this analysis, Section 4.2 demonstrates the necessary ranking of these constraints in order to accurately account for the compound decimal system, and Section 4.3 addresses the generalizability of the established ranking to non-numeric compounds.

4.1 THE CONSTRAINTS

The analysis of the compound decimals will make use of the following constraints:

Faithfulness Constraints

- **SYLLDEPENDENCE (SYLLD)**: Assign one violation mark for every input segment in some syllable that has an output correspondent in a different syllable (if and only if that output syllable has a corresponding syllable in the input).[91, 92]
- **MAX**: Do not delete segments that are part of the input (Kager 1999: 205).
- **MAX$_{CV\sigma}$**: Do not delete a consonant that is adjacent to a vowel within the same syllable (adapted from Côté 2004: 188).[93]

Markedness Constraint

[91] Strictly speaking, there is no practical use for the qualification that SYLLDEPENDENCE is only violated if the output syllable has a corresponding syllable in the input; however, this condition is added in order to differentiate violations of DEP and *C^{unsyll} from violations of SYLLDEPENDENCE.

[92] It is possible that an ALIGN constraint (McCarthy 2008: 181) such as ALIGNRIGHT(morph, σ) would work better here; however, an analysis using such a constraint is reserved for a future study.

[93] Admittedly, a constraint such as CONTIGUITY-IO (Kager 1999: 135) is likely more widely used in the literature and, therefore, preferable for typological reasons. I reserve an analysis using such a constraint for a future study.

- ***COMP**: No more than one C may be associated with an onset or coda (McCarthy 2008: 261).

In addition, the following constraints should be assumed. They are undominated and, thus, no optimal output form will violate them; however, they are not presented in many of the tableaux for reasons of simplification:

Faithfulness Constraint

- **DEP**: Do not epenthesize (McCarthy 2008: 13).

Markedness Constraints

- **CODASTIPULATION (CODASTIP)**: A coda consonant can only be a voiceless bilabial or velar stop, a voiceless palatal fricative, a voiced fricative trill, or a bilabial, dental or velar nasal ([p, k, ʃ, r̝, m, n, ŋ]).[94, 95, 96]
- ***C^{unsyll}**: Assign one violation mark for every consonant that is not syllabified (McCarthy 2008: 8).[97]

Furthermore, the constraints and rankings involved in determining the output forms' voicing based on lexical tone are assumed; they too are omitted in order to keep the tableaux somewhat simple (see Chapter 3).

4.2 THE RANKINGS

This section establishes the ranking of the constraints discussed above. These rankings are presented in tableaux. It is the ranking of these constraints that will accurately account for the Dzongkha compound decimal system.

In Tableau 4.1 the ranking is such that *COMP and SYLLDEPENDENCE must crucially dominate MAX. This is because the onset-initial consonant in 'four', ^{L}/pʃi/, can neither remain part of the complex onset, nor resyllabify into the preceding syllable; thus, it must delete. Since there is no direct ranking evidence for *COMP and SYLLDEPENDENCE in relation to MAX$_{CV\sigma}$, it is unknown whether these constraints also rank above MAX$_{CV\sigma}$;

---

[94] Recall from Chapters 2 and 3 that all obstruents, with the exception of [r̝], are underlyingly voiceless in Dzongkha. Voicing only occurs as an allophonic variant in word-initial position based on lexical tone.

[95] The coda [ʃ] is limited to the imperative form of verbs and, thus, has an extremely limited use. The coda [r̝], while a possible coda in the informal register, is extremely limited in my data.

[96] This constraint is used simply as a placeholder for the set of possible codas in the language. Elaboration of the actual constraints in force which determine possible codas in Dzongkha is left for a future study.

[97] Refer to Chapter 2, Section 2.2.2, for information on Dzongkha syllable structure.

Tableau 4.1.

input: ‘forty thousand’ ^{H}/ʈʰi/ # ^{L}/pʃi/	*COMP	SYLLD	MAX	MAX$_{CV\sigma}$
a. → ʈʰi. ʒi			*	
b. ʈʰi. bʒi	*!W		L	
c. ʈʰip. ʒi		*!W	L	
d. ʈʰi. pi			*	*!W

however, as it is impossible to accurately portray all of these rankings in the tableau, it misleadingly appears to rank *COMP and SYLLDEPENDENCE above MAX$_{CV\sigma}$. It is also important to point out that MAX and MAX$_{CV\sigma}$ are in a stringency relation whereby MAX$_{CV\sigma}$’s violations are a proper subset of MAX’s violations; thus, they cannot be ranked in relation to one another.

In the tableau, a candidate which is harmonically bounded by the winner has been included.[98] Here, Cand (d) violates MAX$_{CV\sigma}$ and, therefore, MAX due to the stringency relation between these two constraints. Thus, Cand (d) accumulates more violations than the optimal candidate, leading to its elimination from the competition. While harmonically bound candidates are not typically included in tableaux, I have chosen to include one here in order to illustrate the importance of the constraint MAX$_{CV\sigma}$. Without this constraint, Cand (d) in each tableau would tie with Cand (a).

As a last point of interest, the ranking between *COMP and SYLLDEPENDENCE is undeterminable because both constraints are undominated. In other words, the optimal candidate must not violate either of these constraints and, thus, no ranking information is afforded.

Tableaux 4.2 and 4.3 give slightly more complex examples due to the fact that there are more candidates which could potentially be competition for the optimal candidate.[99] However, staying with the ranking established above, the optimal candidate is still correctly

[98] A harmonically bound candidate has violations that are a proper superset of some other candidate’s violations; thus, under no ranking can the harmonically bound candidate win as it will always do worse than the candidate that bounds it (McCarthy 2008: 80-81).

[99] Harmonically bound candidates have not been added here in order to help simplify the tableaux; however, MAX$_{CV\sigma}$ is still recognized as playing an important role in these candidates’ elimination.

Tableau 4.2.

input: ‘eight thousand’[100] ^{H}/ptoŋ/ + ^{H}/ʈʰɑ/ # ^{L}/pkɛ/	*COMP	SYLLD	MAX	MAX$_{CV\sigma}$
a. → toŋ. ʈʰɑ. gɛ			**	
b. ptoŋ. ʈʰɑ. bgɛ	*!*W		L	
c. toŋ. ʈʰɑp. gɛ		*!W	*L	
d. ptoŋ. ʈʰɑp. gɛ	*!W	*!W	L	
e. toŋ. ʈʰɑ. bgɛ	*!W		*L	
f. ptoŋ. ʈʰɑ. gɛ	*!W		*L	

Tableau 4.3.

input: ‘seven hundred’ ^{L}/ptʃɑ/ # ^{L}/ptʏn/	*COMP	SYLLD	MAX	MAX$_{CV\sigma}$
a. → dʒɑ. dʏn			**	
b. bdʒɑ. bdʏn	*!*W		L	
c. bdʒɑp. dʏn	*!W	*!W	L	
d. dʒɑp. dʏn		*!W	*L	
e. bdʒɑ. dʏn	*!W		*L	
f. dʒɑ. bdʏn	*!W		*L	

[100] I analyze ‘thousand’, [toŋ. ʈʰɑ] (literally ‘thousand-interval’) as a single phonological word. This follows Mazaudon’s (1985: 132, 2007: 7) analysis where [ʈʰɑ] is understood to be a suffix.

predicted in each tableau. Thus, the optimal candidates are ones which stay as faithful to the input as possible while eliminating complex onsets through deletion of the first segment instead of resyllabifying it.

For Tableau 4.4 there is an additional constraint added:

Markedness Constraint

- **CODASTIPULATION$_{\mathbf{word}}$ (CODASTIP$_{\mathbf{word}}$)**: A word-final coda consonant can only be a voiceless bilabial stop, a voiceless palatal fricative, a voiced fricative trill, or a bilabial, dental or velar nasal ([p, ʃ, r̝, m, n, ŋ]).

Tableau 4.4.

input: 'one hundred thousand' ^{L}/pum/ # ^{H}/ktʃik/	*COMP	*C^{unsyll}	DEP	CODA STIP$_{word}$	MAX	MAX$_{CV\sigma}$
a. → bum. tʃi					**	*
b. bum. ktʃik	*!W			*!W	L	L
c. bum. tʃik				*!W	*L	L
d. bum. ktʃi	*!W				*L	*
e. bum. tʃi. k		*!W			*L	L
f. bum. tʃi. kɑ			*!W		*L	L

It was not necessary to include this constraint in Tableaux 4.1-4.3 (pp. 79-80). However, its inclusion here is crucial in order to accurately account for the data by eliminating Cand (c) (and Cand (b)) as the final /k/ in 'one', ^{H}/ktʃik/, may not surface as a word-final coda. Without CODASTIPULATION$_{word}$, Cand (c) would incur fewer violations than Cand (a) and be incorrectly predicted as the optimal output. The ranking of CODASTIPULATION$_{word}$ is such that it crucially dominates both MAX and MAX$_{CV\sigma}$. This is because the optimal candidate must minimally violate MAX and MAX$_{CV\sigma}$ in order to avoid a fatal violation of the undominated constraint, CODASTIPULATION$_{word}$.

In addition, to CODASTIPULATION$_{word}$, this tableau also includes the undominated constraints DEP and *C^{unsyll}. In order for Cands (e) and (f) to be eliminated from the competition, these two constraints must crucially dominate MAX and MAX$_{CV\sigma}$. In addition, it is important to point out that the undominated constraints are unrankable in relation to one another. The established rankings are as follows:

(1) *COMP, SYLLDEPENDENCE, *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX

(2) *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX$_{CV\sigma}$

4.3 GENERALIZABILITY

Complex onset simplification and word-final coda [k] deletion are productive phenomena in my consultant's dialect. Thus, apart from the compound decimal system, the constraints and their ranking should be able to accurately predict the optimal output of other compounds in Dzongkha. Therefore, this section will extend the analysis to other data within the language, examples of which are given below.[101]

(1)	^{H}/l̥ɑm/	#	^{L}/jɑ/	#	^{H}/ktʃik/
	'shoe'		'single member of a pair'		'one'
			'one shoe of a pair'		
(2)	^{H}/l̥ɑm/	#	^{H}/tʃʰɑ/	#	^{H}/ktʃik/
	'shoe'		'pair'		'one'
			'a pair of shoes'		
(3)	^{H}/tsʰɑː/		#		^{H}/ktʃik/
	'time'				'one'
			'once'		
(4)	^{H}/tsʰɑː/		#		^{H}/kɲiː/
	'time'				'two'
			'twice'		

To illustrate the generalizability of this ranking across the language, Tableau 4.5 gives the compound, 'a pair of shoes', ^{H}/l̥ɑm/ # ^{H}/tʃʰɑ/ # ^{H}/ktʃik/. Here, prefix resyllabification is not possible; thus the prefix /k-/ in 'one', ^{H}/ktʃik/, is simplified via deletion. Moreover, coda [k] is not possible word-finally and, as such, does not surface as a coda. The rankings in this tableau are consistent with those established in Section 4.2:

(1) *COMP, SYLLDEPENDENCE, CODASTIPULATION$_{\text{word}}$ » MAX

(2) CODASTIPULATION$_{\text{word}}$ » MAX$_{\text{CV}\sigma}$

Using the same constraints and rankings as those established for the Dzongkha compound decimal system in Section 4.2, it is possible to accurately predict the optimal output in other compounds outside of the decimal system. Thus, the ranking of these constraints is generalizable to all compounds within the language.

[101] These examples, which come from van Driem (1998: 160), are taken to be compounds.

Tableau 4.5.

input: 'a pair of shoes' ^{H}/l̥ɑm/ # ^{H}/tʃʰɑ/ # ^{H}/ktʃik/ 'shoe' 'pair' 'one'	*COMP	SYLLD	CODASTIP word	MAX	MAX$_{CV\sigma}$
a. → l̥ɑm. tʃʰɑ. tʃi				**	*
b. l̥ɑm. tʃʰɑ. ktʃik	*!W		*!W	L	L
c. l̥ɑm. tʃʰɑ. ktʃi	*!W			*L	*
d. l̥ɑm. tʃʰɑ. tʃik			*!W	*L	L
e. l̥ɑm. tʃʰɑk. tʃik		*!W	*!W	L	L
f. l̥ɑm. tʃʰɑk. tʃi		*!W		*L	*

4.4 SUMMARY

In this chapter I have demonstrated the simple ranking of constraints that are active in Dzongkha complex onset simplification. In doing so, I have provided an analysis that can account for the optimal outputs found in the Dzongkha compound decimals as well as compounds in general. The ranking of these constraints is such that, since complex onsets are never optimal, deleting the first segment is preferable to resyllabifying it into the coda of the preceding morpheme, should there be a preceding, coda-less morpheme. To reiterate, the overall ranking of constraints established in this chapter are as follows:

(1) *COMP, SYLLDEPENDENCE, *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX

(2) *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX$_{CV\sigma}$

The following chapter will account for the phonological phenomena occurring within a single phonological word, focusing on the analysis of the morphological decimal system. We will see that different rankings are needed in order to accurately account for resyllabification of the first consonant of complex onsets. Free variation within this class of words will also be addressed.

CHAPTER 5

THE MORPHOLOGICAL DECIMAL SYSTEM

The discussion in this section covers an analysis of the variable phonological processes attested in the Dzongkha morphological numbers. Recall from Chapter 2 that the numbers pertaining to this class, although made up of two separate morphemes, function as a single phonological word. Thus, unlike the compound decimal system, complex onsets in the morphological decimals may simplify through resyllabification of the first segment into the coda of the preceding morpheme. Furthermore, some numbers within this class may also variably delete the first segment of complex onsets. Importantly, however, free variation of complex onset simplification occurs only with a very specific group of the morphological decimals: the teens. With other numbers of this class, specifically the tens, hundreds, and thousands, only resyllabification is possible, in the case that the preceding morpheme is coda-less.

In addition to variable means of complex onset simplification, a subset of the morphological decimals also exhibits variable word-medial coda [k] deletion. This occurs specifically with the ten thousands, hundred thousands, and, in one case, with the ordinals. With the tens, hundreds and thousands, however, deletion is not possible.

The analysis in this section follows the cophonologies approach, mainly through examples in the morphological decimal system. This is due to a lack of data on other non-numeric phonological words with complex onsets; however, the analysis will be extended to the very limited examples I have stumbled upon. Examples involving underlying coda [k] in non-numeric phonological words are also provided. Recall from Chapter 2 that under the cophonologies approach “each individual morphological construction has its own, potentially unique, cophonology; similarities among the cophonologies of constructions in the same language are captured with meta-generalizations formalized as a ‘grammar lattice’” (Inkelas 2008: 4). Thus, in creating a formal cophonology theoretic analysis, this chapter will set up different cophonologies for different morphological constructions and will illustrate how the different phonologies are related in a grammar lattice.

The chapter is organized as follows: Section 5.1 reviews the constraints used in this analysis; Section 5.2 illustrates the constraint rankings through tableaux, building on where Chapter 4 left off; Section 5.3 discusses the Dzongkha grammar lattice, an important part of the cophonologies approach; and Section 5.4 summarizes the findings from this chapter and discusses issues with the analysis. Refer to Section 2.1.1 for a review of the cophonologies approach, Section 2.2.1 for the phonemic inventory of Dzongkha, and Section 2.3 for an overview of the Dzongkha number system.

5.1 The Constraints

Below is a review of the constraints used in the analysis for Chapter 4. Recall the rankings established in Chapter 4:

(1) *COMP, SYLLDEPENDENCE, *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX

(2) *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX$_{CV\sigma}$

Furthermore, recall that obstruent onsets are allophonically voiced in the low tone (see Chapter 3). As in Chapter 4, the constraints and rankings involved in determining the output forms' voicing based on lexical tone are omitted.

Faithfulness Constraints

- **MAX**: Do not delete segments that are part of the input.
- **MAX$_{CV\sigma}$**: Do not delete a consonant that is adjacent to a vowel within the same syllable.
- **SYLLDEPENDENCE (SYLLD)**: Assign one violation mark for every input segment in some syllable that has an output correspondent in a different syllable (if and only if that output syllable has a corresponding syllable in the input).
- **DEP**: Do not epenthesize.

Markedness Constraints

- ***COMP**: No more than one C may be associated with an onset or coda.
- **CODASTIPULATION (CODASTIP)**: A coda consonant can only be a voiceless bilabial or velar stop, a voiceless palatal fricative, a voiced fricative trill, or a bilabial, dental or velar nasal ([p, k, ʃ, r̝, m, n, ŋ]).
- **CODASTIPULATION$_{word}$(CODASTIP$_{word}$)**: A word-final coda consonant can only be a voiceless bilabial stop, a voiceless palatal fricative, a voiced fricative trill, or a bilabial, dental or velar nasal ([p, ʃ, r̝, m, n, ŋ]).
- ***C^{unsyll}**: Assign one violation mark for every consonant that is not syllabified.

DEP, CODASTIPULATION, and *C^{unsyll} should be assumed as these constraints are never violated. Therefore, they are for the most part omitted from the tableaux for reasons of simplification. This is also true where other constraints have been omitted; in cases where a constraint does not play an essential role in a tableau, it is assumed to be present but is not included for reasons of simplification.

5.2 THE TABLEAUX

This section begins with tableaux which illustrate the necessary ordering for the units and the morphological teens exhibiting complex onset simplification through deletion of the first segment (Section 5.2.1). This is followed by tableaux presenting the ranking for accurately predicting the teens, tens, hundreds, and thousands which exhibit resyllabification of the first segment in a complex onset when in word-medial position (Section 5.2.2). Next, the discussion focuses on the rankings needed in order to account for the variable parsing and deletion of coda [k] that occurs in the ten thousands and hundred thousands (Section 5.2.3). After, my analysis is extended to non-numeric phonological words (Section 5.2.4). Finally, I address the interaction between morphology and phonology in the cophonologies approach drawing on the collectives, ordinals, and intermediate tens affixes for the discussion (Section 5.2.5).

5.2.1 The Ones and Teens: Complex Onset Simplification via Deletion

Just as with the compound decimal system, the units and teens also simplify the first segment of word-initial complex onsets through deletion. Furthermore, some of the teens may simplify word-medial complex onsets in the same way. This is achieved through the same constraint ranking as established in Chapter 4. Recall, however, that in addition to word-medial complex onset simplification via deletion of the first segment, the teens also exhibit variable complex onset simplification through resyllabification of this segment. (The exception to this is ‘eighteen’, ^{H}/ptʃo/ + ^{L}/pkɛ/ [tʃop. ɡɛ], which invariably simplifies its word-medial complex onset through resyllabification of the first segment.) Complex onset simplification via resyllabification will be addressed in Section 5.2.2.

Tableau 5.1 provides an example of complex onset deletion in a single phonological word.[102, 103] Recall from Chapter 2 that the underlying form, ^{L}/ptʏn/, has a complex onset as seen in ‘seventeen’, ^{H}/ptʃu/ + ^{L}/ptʏn/ [tʃup. dʏn], where the first segment of the complex onset resyllabifies into the coda of the preceding morpheme. This tableau shows that *COMP, DEP, and *C^{unsyll} must all dominate MAX; however, these three are all undominated and, therefore, unrankable in relation to one another.

Tableau 5.1.

input: ‘seven’ ^{L} /ptʏn/	*COMP	DEP	*C^{unsyll}	MAX
a. → dʏn				*
b. bdʏn	*!W			L
c. bɑ. dʏn		*!W		L
d. b. dʏn			*!W	L

The next tableau (Tableau 5.2) accounts for one of the possible outputs for ‘fourteen’: [tʃu. ʒi]. Recall that this word has two possible outputs, [tʃup. ʒi] ~ [tʃu. ʒi]. The other variant and the ranking needed in order to account for it will be addressed in Section 5.2.2. Here, deletion of the first segment in a complex onset is preferred to resyllabification. Just as in Chapter 4, *COMP must rank above MAX in order for complex onset simplification to occur. Furthermore, SYLLDEPENDENCE must dominate MAX in order to block word-medial resyllabification.

Tableau 5.3 provides an additional example of word-medial complex onset deletion, this time with a [k] prefix.[104] As with the previous example, the constraints *COMP and SYLLDEPENDENCE are sufficient to accurately predict the optimal candidate. Again, these two constraints must rank above MAX in order for complex onsets, both word-initially and word-medially, to be simplified.

[102] In an effort to simplify the tableau, MAX$_{CV\sigma}$ is not included as it is only violated by harmonically bound candidates like [bʏn].

[103] See Chapter 4 for tableaux which show complex onset simplification in a compound.

[104] Recall that ‘thirteen’ also has variable forms, [tʃu. sum] ~ [tʃuk. sum]. The ranking here can only account for one of the variants: [tʃu. sum].

Tableau 5.2.

input: ‘fourteen’ ^{H} /ptʃu/ + ^{L} /pʃi/	*COMP	SYLLD	MAX
a. → tʃu. ʒi			**
b. ptʃu. bʒi	*!*W		L
c. tʃup. ʒi		*!W	*L
d. ptʃup. ʒi	*!W	*!W	L
e. ptʃu. ʒi	*!W		*L
f. tʃu. bʒi	*!W		*L

Tableau 5.3.

input: ‘thirteen’ ^{H} /ptʃu/ + ^{H} /ksum/	*COMP	SYLLD	MAX
a. → tʃu. sum			**
b. ptʃu. ksum	*!*W		L
c. tʃuk. sum		*!W	*L
d. ptʃuk. sum	*!W	*!W	L
e. tʃu. ksum	*!W		*L

Tableau 5.4 presents a slightly more complex picture from Tableaux 5.1 (p. 87), 5.2, and 5.3. From this tableau, Cand (a), [tʃi], is correctly chosen as the optimal candidate. No new rankings are established from those previously determined in Chapter 4: *COMP must crucially dominate MAX (as observed in Cand (d)), and CODASTIPULATION $_{word}$, *C^{unsyll}, and DEP must crucially dominate both MAX and MAX$_{CV\sigma}$ (as seen in Cands (c), (e), and (f), respectively) in order to accurately predict the optimal candidate.

Tableau 5.4.

input: ‘one’ ^{H} /ktʃik/	*COMP	DEP	*C^{unsyll}	CODA STIP$_{word}$	MAX	MAX$_{CV\sigma}$
a. → tʃi					**	*
b. ktʃik	*!W			*!W	L	L
c. tʃik				*!W	*L	L
d. ktʃi	*!W				*L	*
e. tʃi. k			*!W		*L	L
f. tʃi. kɑ		*!W			*L	L

Finally, Tableau 5.5 illustrates the selection of the optimal candidate where word-initial and word-medial deletion of the first segment of a complex onset occurs. Recall, however, that ‘eleven’ has two possible outputs, [tʃu. tʃi] ~ [tʃuk. tʃi]. The output which leads to resyllabification of the first segment of a complex onset will be addressed in Section 5.2.2.

Tableau 5.5.

input: ‘eleven’ ^{H}/ptʃu/ + ^{H}/ktʃik/	*COMP	CODA STIP$_{word}$	SYLLD	MAX	MAX$_{CV\sigma}$
a. → tʃu. tʃi				***	*
b. ptʃu. ktʃik	*!*W	*!W		L	L
c. tʃuk. tʃi			*!W	**L	*
d. ptʃuk. tʃi	*!W		*!W	*L	*
e. tʃu. tʃik		*!W		**L	L
f. ptʃu. ktʃi	*!*W			*L	*

In addition to deletion in both complex onsets, the optimal candidate must also meet the requirement of CODASTIPULATION$_{word}$. In order to avoid violation of the three undominated constraints, then, the optimal candidate must violate MAX three times, leading to one violation of MAX$_{CV\sigma}$. However, by minimally violating MAX and MAX$_{CV\sigma}$, the optimal candidate has avoided violation of the undominated constraints, *COMP, SYLLDEPENDENCE, and CODASTIPULATION$_{word}$.[105]

The analysis presented in this section has accounted for complex onset deletion in the units and teens. This mirrors the complex onset deletion of Chapter 4, using the same constraints and rankings. However, unlike Chapter 4, which accounted for complex onset deletion at a word boundary, here the constraints and rankings lead to complex onset deletion in word-medial position too.

[105] Since it is impossible to accurately portray all of the rankings in the tableaux, Tableau 5.5 misleadingly shows that *COMP and SYLLDEPENDENCE rank above MAX$_{CV\sigma}$. The ranking of SYLLDEPENDENCE above MAX$_{CV\sigma}$ cannot be established. As we will see later, however, it is possible to establish an argument in favor of the ranking of *COMP above MAX$_{CV\sigma}$ (see p. 111 and p. 147)

5.2.2 The Teens, Tens, Hundreds, and Thousands: Complex Onset Simplification via Resyllabification

Building on the analysis in the previous section, this section proposes an alternative ranking in order to account for both word-initial complex onset deletion as well as word-medial complex onset resyllabification. Recall from Chapter 2 that word-medial complex onset resyllabification occurs in free variation with deletion (discussed above) in the teens and categorically in the tens, hundreds, and thousands. The necessary rankings in order to accurately predict the units, as established in Section 5.2.1, also hold here (see Tableaux 5.1, p. 87, and 5.4, p. 88):

(1) *COMP » MAX

(2) CODASTIPULATION $_{word}$, DEP, *C^{unsyll} »MAX, MAX$_{CV\sigma}$

Recall that there are two possible outputs for 'fourteen' [tʃu. ʒi] ~ [tʃup. ʒi]. Tableau 5.6 shows the result of the same input as Tableau 5.2 (p. 88); however, the ranking presented here results in word-medial resyllabification of the first segment of the complex onset. This is due to MAX crucially dominating SYLLDEPENDENCE. Therefore, the optimal candidate, Cand (a), resyllabifies the prefix [p] in the complex onset in order to avoid violation of higher ranking constraints against deletion and complex syllable margins. More specifically, note that Cand (c), [tʃu. ʒi], which was the optimal candidate under the ranking of Tableau 5.2 (p. 88), is now knocked out of the competition due to its extra violation of MAX compared to Cand (a). In addition to the ranking of MAX above SYLLDEPENDENCE, *COMP must dominate both MAX and SYLLDEPENDENCE in order to eliminate Cands (b), (d), (e), and (f).

Tableau 5.6.

input: 'fourteen' ^{H} /ptʃu/ + ^{L} /pʃi/	*COMP	MAX	SYLLD
a. → tʃup. ʒi		*	*
b. ptʃu. bʒi	*!*W	L	L
c. tʃu. ʒi		**!W	L
d. ptʃup. ʒi	*!W	L	*
e. ptʃu. ʒi	*!W	*	L
f. tʃu. bʒi	*!W	*	L

As with ‘fourteen’, ‘eleven’ also has two possible outputs [tʃu. tʃi] ~ [tʃuk. tʃi]. Tableau 5.7 starts with the same input as Tableau 5.5 (p. 89); however, now the optimal output differs due to resyllabification of the word-medial prefix [k] in the complex onset. Just as in Tableau 5.6 (p. 90), resyllabification occurs in order to avoid the higher ranking anti-deletion constraint, MAX. Thus, although the optimal candidate violates SYLLDEPENDENCE, it is Cand (c)’s fatal triple violation of MAX that determines Cand (a) as the winner. As with Tableau 5.5 (p. 89), the ranking of CODASTIPULATION$_{word}$ above MAX and MAX$_{CV\sigma}$ is essential to accurately predicting the optimal output (see Cand (g)). Furthermore, CODASTIPULATION$_{word}$ must crucially dominate SYLLDEPENDENCE as seen in Cand (e). It is also worth noting that, unlike the compound decimals, resyllabification of the prefix [k] into the coda of the previous morpheme does not lead to a violation of CODASTIPULATION$_{word}$ (see Cands (a) and (d)). This is due to numbers of this class constituting a single phonological word.

Tableau 5.7.

input: ‘eleven’ ^{H}/ptʃu/ + ^{H}/ktʃik/	CODA STIP$_{word}$	*COMP	MAX	MAX$_{CV\sigma}$	SYLLD
a. → tʃuk. tʃi			**	*	*
b. ptʃu. ktʃik	*!W	**W	L	L	L
c. tʃu. tʃi			***!W	*	L
d. ptʃuk. tʃi		*!W	*L	*	*
e. tʃu. tʃik	*!W		**	L	L
f. ptʃu. ktʃi		*!*W	*L	*	L
g. tʃuk. tʃik	*!W		*L	L	*

The tens, hundreds, and thousands also resyllabify the initial consonant of word-medial complex onsets into the coda of the preceding morpheme. Unlike all of the teens with word-medial complex onsets (with the exception of ‘eighteen’), resyllabification is invariant, given the proper environment. Thus, resyllabification of the prefix [p] in the complex onset of the second morpheme (i.e. /ptʃu/, /ptʃɑ/, and /ptoŋ/) always occurs in environments where the preceding morpheme does not have a coda. In cases where the first morpheme has an underlying coda [k], it will always surface in these forms. This is attested in examples such as: ‘sixty’, ^{L}/ʈuk/ + ^{H}/ptʃu/, [ɖuk. tʃu]; ‘one hundred’, ^{H}/ktʃik/ + ^{L}/ptʃɑ/, [tʃik. dʒɑ]; and ‘two thousand’, ^{H}/kɲik/ + ^{H}/ptoŋ/, [ɲik. toŋ].

Tableau 5.8 provides a relatively simple example where the first morpheme, ^{H}/ksum/, has a coda which is always realized in the output form. Accordingly, resyllabification of [p] in ^{H}/ptoŋ/ leads to harmonically bound, suboptimal candidates. For example, [sup. toŋ] and [sump. toŋ] are never optimal under any ranking and, thus, are not included in the tableau.[106] Furthermore, in order to avoid violation of *COMP, the optimal candidate must incur minimal violations of MAX. Cand (a) does just that.

Tableau 5.8.

input: ‘three thousand’ ^{H}/ksum/ + ^{H}/ptoŋ/	*COMP	MAX
a. → sum. toŋ		**
b. ksum. ptoŋ	*!*W	L
c. sum. ptoŋ	*!W	*L
d. ksum. toŋ	*!W	*L

Tableau 5.9 uses an example from the tens, ‘forty’. In this tableau, the optimal candidate is one which simplifies the first morpheme’s word-initial complex onset through deletion, but resyllabifies the prefix [p] of the second morpheme’s word-medial complex onset into the coda of the preceding morpheme. Thus, the winner violates SYLLDEPENDENCE, a lower ranking constraint, in order to avoid two violations of MAX, unlike Cand (c). Just as with Tableaux 5.6 and 5.7 (pp. 90-91), MAX must crucially dominate SYLLDEPENDENCE in order to accurately predict the optimal output; otherwise, Cand (c) would be incorrectly predicted as optimal. Moreover, *COMP must dominate both MAX and SYLLDEPENDENCE.

Due to the simplicity of Tableau 5.10, the harmonically bound candidates, Cands (c) and (d), are included. The crucial ranking in this tableau is that of *COMP above MAX. This is because Cand (a) incurs one violation of MAX in order to avoid violation of *COMP. It is

[106] [sump. toŋ] is harmonically bounded by Cands (c) and (d); [sup. toŋ] is harmonically bounded by Cand (a).

Tableau 5.9.

input: 'forty' L/pʃi/ + H/ptʃu/	*COMP	MAX	SYLLD
a. → ʒip. tʃu		*	*
b. bʒi. ptʃu	*!*W	L	L
c. ʒi. tʃu		**!W	L
d. bʒip. tʃu	*!W	L	*
e. bʒi. tʃu	*!W	*	L
f. ʒi. ptʃu	*!W	*	L

Tableau 5.10.

input: 'six hundred' L/ʈuk/ + L/ptʃɑ/	*COMP	MAX	$\text{MAX}_{CV\sigma}$	SYLLD
a. → ɖuk. dʒɑ		*		
b. ɖuk. bdʒɑ	*!W	L		
c. ɖu. dʒɑ		**!W	*!W	
d. ɖup. dʒɑ		*	*!W	*W

worth noting that this tableau successfully explains why word-medial complex onset resyllabification does not occur in this environment. This is because it is suboptimal under any ranking to delete a coda which meets the CODASTIPULATION in order to resyllabify the first segment of a complex onset (see Cand (d)).

In this section, I have provided an alternate ranking which allows for word-initial complex onset deletion but word-medial complex onset resyllabification. The ranking is as follows:

(1) *COMP »MAX

(2) *COMP, MAX, $\text{CODASTIPULATION}_{word}$ » SYLLDEPENDENCE

(3) $\text{CODASTIPULATION}_{word}$, DEP, $^*\text{C}^{unsyll}$ » MAX, $\text{MAX}_{cv\sigma}$

The word-medial resyllabification seen here is found specifically in the variant forms of the teens as well as in the invariant tens, hundreds, thousands, and 'eighteen', ^{H}/ptʃo/ + ^{L}/pkɛ/. In addition, this ranking also accounts for word-initial complex onset simplification in the units.

It should be acknowledged that the difference between the ranking established in this section and that of Section 5.2.1 (both of which pertain to the morphological decimals) differs only in the ranking relation between SYLLDEPENDENCE and *COMP, MAX, and CODASTIPULATION$_{word}$. In the ranking established in Section 5.2.1, SYLLDEPENDENCE crucially dominates MAX in order to account for complex onset simplification via deletion; the ranking between *COMP, SYLLDEPENDENCE and CODASTIPULATION$_{word}$ is undeterminable as these constraints are not violated by the optimal candidate. In the ranking established in this section, however, *COMP, MAX and CODASTIPULATION$_{word}$ must all rank above SYLLDEPENDENCE. These ranking differences aside, the overall ranking for the morphological decimals (i.e. the shared ranking between morphological decimals which simplify complex onsets via deletion and morphological decimals which simplify complex onsets via resyllabification) is as follows:

(1) *COMP, *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX

(2) *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX$_{CV\sigma}$

5.2.3 Variable Outputs with Underlying, Word-Medial Coda [k]

This next section examines the rankings determining variable outputs with underlying, word-medial coda [k]. There are relatively few examples of variable word-medial coda [k] parsing and deletion in the Dzongkha number system as it only occurs in two forms of the ten thousands and hundred thousands. They are: ‘ten thousand’, [tʃi. ʈʰi] ~ [tʃik. ʈʰi]; ‘sixty thousand’, [ɖu. ʈʰi] ~ [ɖuk. ʈʰi]; ‘one hundred thousand’, [tʃi. bum] ~ [tʃik. bum]; and ‘six hundred thousand’, [ɖu. bum] ~ [ɖuk. bum]. Because the second morpheme lacks a complex onset, there is no complex onset simplification occurring in these forms (except for word-initially, which invariantly leads to deletion as addressed above). In order to address coda [k] variation, a new constraint is required:

Markedness Constraint

- **$*k]_\sigma$**: Assign one violation mark for every coda [k].

This constraint, $*k]_\sigma$, is important to the analysis as it is the only constraint active in determining one form over the other (i.e. parsing vs. deletion of word-medial coda [k]). Notably, CODASTIPULATION$_{word}$ does not play a role here as variation occurs word-medially.

The next two tableaux show the variable optimal outputs for ‘ten thousand’. Tableau 5.11 illustrates the optimal output, [tʃi. ʈʰi], when $*k]_\sigma$ ranks above MAX and

Tableau 5.11.

input: 'ten thousand' ^{H} /ktʃik/ + ^{H} /ʈʰi/	*k]$_{\sigma}$	*COMP	MAX	MAX$_{CV\sigma}$
a. → tʃi. ʈʰi			**	*
b. ktʃik. ʈʰi	*!W	*!W	L	L
c. tʃik. ʈʰi	*!W		*L	L
d. ktʃi. ʈʰi		*!W	*L	*

MAX$_{CV\sigma}$. This ranking eliminates all candidates with coda [k] from the competition. In other words, under this ranking, deletion of coda [k] is preferable to parsing it. A sample tableau of the variable hundred thousands has been omitted since they mirror the examples provided here.

Tableau 5.12 illustrates the optimal output, [tʃik. ʈʰi], when *k]$_{\sigma}$ ranks below MAX/MAX$_{CV\sigma}$. Under this ranking it is preferable to parse word-medial coda [k] than to delete it. It is uncertain whether only one of the constraints or both MAX and MAX$_{CV\sigma}$ must dominate *k]$_{\sigma}$ as the winner performs better than Cand (c) on both of these constraints.

Tableau 5.12.

input: 'ten thousand' ^{H} /ktʃik/ + ^{H} /ʈʰi/	*COMP	MAX	MAX$_{CV\sigma}$	*k]$_{\sigma}$
a. → tʃik. ʈʰi		*		*
b. ktʃik. ʈʰi	*!W	L		*
c. tʃi. ʈʰi		*!*W	*!W	L
d. ktʃi. ʈʰi	*!W	*	*W	L

The focus of this section has been on the variable rankings involved in word-medial coda [k] outputs. As illustrated above, this variation is due to the ranking of MAX and MAX$_{CV\sigma}$ against *k]$_{\sigma}$. When MAX and/or MAX$_{CV\sigma}$ rank above *k]$_{\sigma}$, word-medial coda [k] is parsed; however, when *k]$_{\sigma}$ ranks above MAX and MAX$_{CV\sigma}$, word-medial coda [k] is deleted.[107] Notably, this issue and how it fits with the rest of the grammar will be addressed in Section 5.3.2 where the organization of the grammar will be reanalyzed and simplified.

[107] Admittedly, *k]$_{\sigma}$ is a questionable constraint. In fact, it is done away with later in the chapter; thus, the effects of this constraint in regard to previously established rankings in Sections 5.2.1 and 5.2.2 is ignored.

5.2.4 Generalizability

This next section provides an analysis of some examples of non-numeric phonological words. The examples examined here have either underlying forms with word-medial coda [k] or have underlying forms with word-medial complex onsets.

Unlike the numerals, which exhibit free variation, the non-numeric phonological words always parse underlying word-medial coda /k/. This is seen in the following examples in Table 5.1:[108, 109]

Table 5.1. Word-Medial Coda [k] in Phonological Words

Gloss	Transliteration[110]	Underlying Form	Output Form	Source
eye	*mig-to*	^{H} /mik/ + ^{H}/to/	mik. to[111]	My consultant
happy	*dgaḥ-tok-to*	^{L}/kɑ/ + ^{H}/tok/ + ^{H}/to/	gɑ. tok. to	My consultant
investigation, comparative study	*brtag-zíb*	^{H} /tɑk/ + ^{L}/ʃip/	tɑk. ʒip	van Driem (1998: 442)
threat, wrath	*ḥjigs-skrag*	^{L}/tʃik/ + ^{L}/ʈɑ/	dʒik. ɖɑ	van Driem (1998: 439)
motor scooter	*sbag-pa*	^{L}/pɑk/ + ^{H}/pɑ/	bɑk. pɑ	van Driem (1998: 174)

Drawing on this data, the following tableaux illustrate the constraint ranking necessary in order to accurately predict the optimal output. As discussed in Section 5.2.3, when $*k]_{\sigma}$ ranks below MAX and $\text{MAX}_{CV\sigma}$, medial coda [k] is parsed in the output (see Tableau 5.13).[112, 113]

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[108] With the exception of the first two examples, all examples come from my transcription of van Driem's consultant.

[109] See Section 5.3.2 for a discussion which, based on this insight, leads to a reorganization and simplification of the data.

[110] Transliterations are my own, based on the orthographic forms provided in van Driem (1998).

[111] While my consultant only says [mik. to], van Driem's consultant only says [mi. to].

[112] Recall that it is uncertain whether only one of the constraints MAX and $\text{MAX}_{CV\sigma}$ or both must dominate $*k]_{\sigma}$.

[113] *COMP and SYLLDEPENDENCE are not included as they do not play a role.

Tableau 5.13.

input: ‘eye’ ^{H}/mik/ + ^{H}/to/	MAX	MAX$_{CV\sigma}$	*k]$_\sigma$
a. → mik. to			*
b. mi. to	*!W	*!W	L

Tableau 5.14 gives another example with word-medial coda [k]. Again, these words rank *k]$_\sigma$ below MAX and MAX$_{CV\sigma}$.

Tableau 5.14.

input: ‘happy’ ^{L}/kɑ/ + ^{H}/tok/ + ^{H}/to/	MAX	MAX$_{CV\sigma}$	*k]$_\sigma$
a. → gɑ. tok. to			*
b. gɑ. to. to	*!W	*!W	L

Moving on to word-medial complex onsets, Table 5.2 presents some examples taken mostly from my transcription of van Driem’s (1998) consultant.[114] The exception to this is the first example, ‘milk powder’ [op. tʃi], which comes from my consultant. (Unfortunately, I only came across this one example with my own consultant.) Recall that in the dialect of van Driem’s consultant, complex onsets are acceptable. However, in these examples, word-medial complex onsets resyllabify into the coda of the preceding morpheme. To illustrate, compare the last two examples below where the complex onset is retained in word-initial position but resyllabified into the preceding coda word-internally. In contrast, resyllabification does not take place in the dialect of van Driem’s (1998: 87, 177) consultant when the preceding syllable has an acceptable coda (cf. [nɑm. bdʒɑː] ‘summer’ and [tøn. b̥d̥ʒin. ni] ‘explain’ or ‘instruct’). Judging from these examples, word-medial complex onset resyllabification is commonplace, even in dialects where complex onsets with [p]/[b] prefixes are acceptable.

[114] Notably, these examples are compounds; however, they differ from the compounds of Chapter 4 in that they function as a single phonological word. The difference between these two types of compounds is addressed in Chapter 6. Until then, they are referred to as phonological words.

Table 5.2. Word-Medial Complex Onset Resyllabification in Phonological Words

Gloss	Transliteration	Underlying Form	Output Form	Source
milk powder (literally ‘milk-flour’)	*o-phye*	^{H}/oː/ + ^{H}/ptʃi/	oːp. tʃi	My Consultant
to open (‘mouth’ [k^{h}ɑ])	*kha-phyi-ni*	^{H}/k^{h}ɑ/ + ^{H}/ptʃ^{h}i/ + ^{L}/ni/	k^{h}ɑp. tʃ^{h}i. ni	van Driem (1998: 390)
bees (literally ‘yellow flying insects’)	*ser-sbyangma*	^{H}/seː/ + ^{L}/ptʃɑːm/	sip. dʒɑːm	van Driem (1998: 87)
hoist a prayer flag	*dar-ḥphyar*	^{L}/tɑː/ + ^{H}/ptʃ^{h}ɑː/	dɑːp. tʃ^{h}ɑː	van Driem (1998: 87)
to make a stupid mistake	*źal-thag-dpyang-ni*	^{L}/ʃɛ/ + ^{H}/t^{h}ɑ/ + ^{L}/ptʃɑŋ/ + ^{L}/ni/	ʒ̊ɛ. t^{h}ɑp. dʒɑ̃. ni	van Driem (1998: 444)
to settle a matter	*phye-byin-ni*	^{H}/ptʃi/ + ^{L}/ptʃeːn/ + ^{L}/ni/	ptʃip. dʒeːn. ni	van Driem (1998: 327)
kitten (‘cat’ [bdʒi. li])	*byi-li-phyu-gu*	^{L}/ptʃi/ + ^{L}/liː/ + ^{H}/ptʃu/ + ^{L}/ku/	bdʒi. liːp. tʃ^{h}u. gu	van Driem (1998: 174)

In addition to these examples, there are a few more interesting examples taken from my transcription of van Driem’s (1998) consultant (Table 5.3). In these examples the prefix from the second morpheme resyllabifies into the coda of the preceding morpheme. Importantly, these prefixes are not necessarily indicated in the orthography.

Drawing on this evidence and maintaining a grammar that does not allow complex onsets, I will use these examples of complex onset simplification through resyllabification of the first segment in order to develop my analysis. As such, non-numeric phonological words with word-medial complex onsets follow the ordering discussed in Section 5.2.2. Under this ordering resyllabification of the first segment of a complex onset occurs whenever the preceding syllable is coda-less.

Tableau 5.15 gives the input ‘cat’. Here we see that the ranking of *COMP above MAX leads to complex onset simplification via deletion in word-initial position. In this example SYLLDEPENDENCE does not play a role in selection of the optimal candidate as resyllabification does not arise.

Tableau 5.16 illustrates the accurate prediction of the optimal candidate for non-numeric phonological words with word-medial complex onsets. In this tableau, the optimal

Table 5.3. Word-Medial Complex Onset Resyllabification in Phonological Words

Gloss	Transliteration	Underlying Form	Output Form	Source
shopping (literally 'buy-business')	*nyo-tshong*	^{L}/ɲo/ + ^{H}/ptsʰo/	ɲop. tsʰo	van Driem (1998: 255)[115]
metal nail (literally 'iron-nail')	*lcags-gzer*	^{H}/tʃɑː/ + ^{L}/ntse/	tʃɑːn. dze	van Driem (1998: 79)[116]
honorific 'presence' ([ku] is the honorific prefix)	*sku-mdun*	^{H}/ku/ + ^{L}/ntʏ/	kʏn. dʏ	van Driem (1998: 440)[117]

Tableau 5.15.

input: 'cat' ^{L}/bdʒi/ + ^{L}/li/	*COMP	MAX
a. → dʒi. li		*
b. bdʒi. li	*!W	L

[115] Compare with *nyo-ni* [ɲo. ni] 'to buy' (van Driem 1998: 77) which does not have a coda [p]. However, *btsong-ni* [tsõ. ni] 'sell' (van Driem 1998: 178), which is undoubtedly semantically related to 'business', shows evidence of an orthographic prefix *b-* (lack of aspiration on [ts] in 'sell' is not an indicator of the two words not being related; 'sell' is aspirated in some forms of Tibetan (Dai & Bufan 1992, H. Sun 1991, J. Sun 1985). Thus, there is clear evidence of prefix resyllabification into the coda of the preceding morpheme.

[116] Compare with *lcags* [tʃɑː] 'iron' and *lcags-kyu* [tʃɑː. tʃu] 'iron hook' (van Driem 1998: 75). In these forms there is no evidence of a coda [n] on the morpheme for 'iron'/'metal'. In contrast, while there is no indication of an orthographic *n-* prefix on 'nail' [dzeː], 'nail' is transcribed as [ndzer] and [ndze] in many Tibetan dialects (Dai & Bufan 1992, H. Sun 1991). Clearly, it is the case here that 'nail' has a prefix n- which resyllabifies into the coda of the previous morpheme.

[117] Compare the honorific prefix [ku], transliterated as *sku*, in other contexts: honorific 'body' [ku. zu]; honorific 'meat', 'flesh' [ku. ʃɑ]; honorific 'bone' [ku. rʏ]; and honorific 'back' [ku. dʒɑp] (van Driem 1998: 424-425). Here we find no evidence of a coda [n] or of vowel fronting. Thus, in the case of honorific 'presence', the honorific prefix [ku] has a coda [n] due to resyllabification of a nasal prefix in the second morpheme. This coda [n], in turn, causes the [u] in [ku] to front to [ʏ].

Tableau 5.16.

input: ‘kitten’ L/bdʒi/+L/li/+ H/ptʃu/+L/gu/	*COMP	MAX	SYLLD
a. → dʒi. lip. tʃu. gu		*	*
b. bdʒi. li. ptʃu. gu	*!*W	L	L
c. dʒi. li. tʃu. gu		**!W	L

candidate violates SYLLDEPENDENCE in order to avoid violations of the higher ranking constraints, MAX and *COMP. Failure to resyllabify the complex onset results in suboptimal candidates, Cands (b) and (c). Furthermore, as seen in Tableau 5.15 (p. 99), word-initial complex onsets are simplified through deletion. Thus, the optimal candidate is one which deletes the initial segment of a complex onset in word-initial position, but resyllabifies the initial segment of a complex onset in word-medial position.

Tableau 5.17 gives a similar example where the underlying form also has a word-medial complex onset. However, in this example the preceding syllable has a coda which meets the CODASTIPULATION. Thus, simplification of the complex onset occurs through deletion of the /p-/ prefix instead of resyllabification.

Tableau 5.17.

input: ‘summer’ H/nɑm/ + L/ptʃɑː/	*COMP	MAX
a. → nɑm. dʒɑː		*
b. nɑm. bdʒɑː	*!W	L

This section has shown how my analysis of the Dzongkha morphological decimals is also generalizable to non-numeric phonological words. Thus, as addressed above, my analysis accounts for word-medial complex onset simplification through resyllabification of the first segment in the cluster. Moreover, my analysis accounts for invariant parsing of underlying word-medial coda [k]; however, this differs from the morphological decimals which show variable parsing and deletion of this coda. This discrepancy will be addressed in Section 5.3.2, where the organization of the data will be reevaluated, providing a simpler organization of the data. In addition to the examples provided above, my analysis assumes that, in cases where a phonological word has both an underlying coda [k] and a complex onset in the following syllable, coda [k] will always surface and the complex onset will be simplified through deletion. This is attested in numeric examples such as: ‘sixty’ [ɖuk. tʃu] (/ɖuk + ptʃu/), ‘one hundred’ [tʃik. dʒɑ] (/ktʃik + ptʃɑ/), and ‘two thousand’ [ɲik. toŋ] (/ɲik + ptoŋ/). Thus, without evidence to the contrary, this is assumed to be true of non-numeric phonological words.

5.2.5 The Intermediate Tens, Ordinals, and Collectives Affixes

Under the cophonologies approach “every morphological construction- each compounding, affixation… and so on- is associated with a cophonology, which may potentially differ from the cophonologies of other constructions” (Inkelas & Zoll 2005: 71). Importantly, however, differences between cophonologies are restricted to those constraints which have been left unranked by the master ranking of the language (Inkelas 2008: 15).

There are two cophonologies within Dzongkha: the Compounding/Affixation Cophonology and the Phonological Word Cophonology. All affixes (i.e. the collectives, ordinals, and intermediate tens markers) and compounds (i.e. words presented in Chapter 4) are indexed to the Compounding/Affixation Cophonology. Meanwhile, all phonological words, including the morphological decimals, are indexed to the Phonological Word Cophonology.

Under the cophonologies approach, the hierarchical structure of word formation allows for the interaction of cophonologies within the same word (Inkelas 2008: 14). In terms of the Dzongkha data, this means that the morphological decimals (and all other phonological words) are run through the Phonological Word Cophonology first. After, affixation and compounding may take place. Then, at the point of compounding/affixation, the form is run through the Compounding/Affixation Cophonology. Importantly, the scope of a given cophonology is the level in the word formation process with which the cophonology is associated as well as everything that precedes it. It is important to note here that the Phonological Word Cophonology pertains to the overall ranking for the morphological decimals established at the end of Section 5.2.2:[118]

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[118] Elaboration of how variation in the morphological decimals is accounted for within the Phonological

(1) *COMP, *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX

(2) *C^{unsyll}, DEP, CODASTIPULATION$_{word}$ » MAX$_{CV\sigma}$

In regard to the Compounding/Affixation Cophonology, as of yet, we have not looked at examples which illustrate the ranking of this cophonology. Thus, its ranking will be established below (see Figures 5.6, p. 105, and 5.9, p. 107, as well as Tableaux 5.18, p. 105, and 5.20, p. 109).[119]

Starting with 'thirty-one', an example of an intermediate ten, Figure 5.1 illustrates the word formation process. First ^{H}/ktʃik/, 'one', is run through the phonological system pertaining to phonological words/morphological decimals (the Phonological Word Cophonology). The output of this phonological system is [tʃi] (see Tableau 5.4, p. 88). Then, affixation with the intermediate 'thirty' morpheme, ^{H}/so/, takes place. At this point the phonology pertaining to morphological constructions (anything made by putting phonological words or affixes together) is applied. The output of this phonological system (the Compounding/Affixation Cophonology) is [so. tʃi]. Notably, while the scope of the Phonological Word Cophonology is only ^{H}/ktʃik/, the scope of the Compounding/Affixation Cophonology is ^{H}/so/ + [tʃi]. While the constraints active in the Compounding/Affixation Cophonology are not yet obvious, I assume that the constraints involved in allophonic obstruent voicing are active in all cophonologies.

The ordinals are formed in the same way. In the example of ^{L}/ʈuk/ + ^{L}/pɑ/, 'sixth', the Phonological Word Cophonology first applies to ^{L}/ʈuk/, producing the output [ɖu], 'six'. Figure 5.2 shows word-final coda [k] deletion (as well as obstruent onset voicing in the low tone) in 'six' [ɖu]. Then, the ordinal marker, ^{L}/pɑ/, is affixed onto this output, producing [ɖu] + ^{L}/pɑ/ 'sixth', which is the input to the Compounding/Affixation Cophonology. Again, I assume that the constraints involved in allophonic obstruent voicing are active in

Word Cophonology (i.e. the ranking presented in Section 5.2.1 versus the ranking presented in Section 5.2.2) is reserved for Section 5.3.1.

[119] While the ranking established in Chapter 4 is presented as pertaining to compounds, as we will see, the individual morphemes of the compound are separately run through the Phonological Word Cophonology, simplifying all complex onsets via deletion, and, after, they are compounded in the morphology (at which point the Compounding/Affixation Cophonology applies; see Section 5.3.1, specifically Figure 5.11, p. 114).

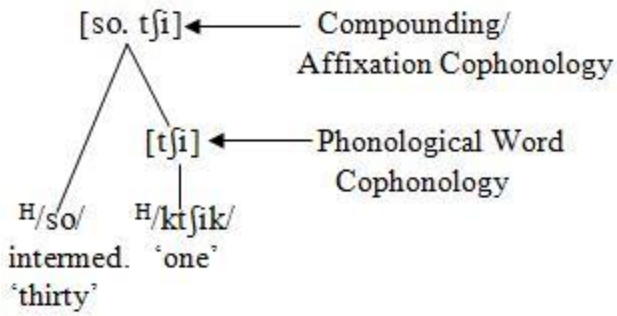

Figure 5.1. 'thirty-one'.

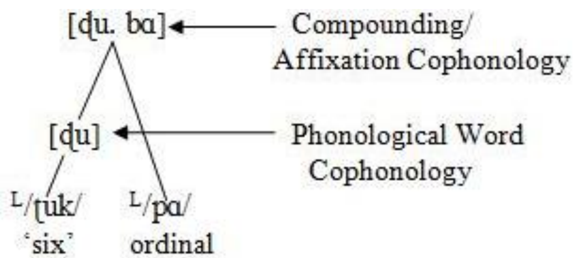

Figure 5.2. 'sixth'.

both cophonologies; thus, the output of the Compounding/Affixation Cophonology yields a voiced obstruent onset in the ordinal affix, with the final output being 'sixth', [ɖu. bɑ].

One issue that is important to note is that, under this model, it is impossible to account for the other possible form, [ɖuk. bɑ], since parsing of coda [k] in 'six' leads to a fatal violation of CODASTIPULATION$_{word}$.[120] This is quite interesting since coda [k] is possible numeral-finally in 'sixth', [ɖuk. bɑ], but not in 'eleventh', ^{H}/ptʃu/ + ^{H}/ktʃik/ + ^{L}/pɑ/, *[tʃu. tʃik. bɑ] and *[tʃuk. tʃik. bɑ]. Figure 5.3 illustrates the morphological structures of 'sixth' and 'eleventh'.

The construction of the variable forms of 'eleventh' is shown in Figures 5.4 and 5.5. Refer to Tableau 5.5 (p. 89) for the constraint ranking pertaining to [tʃu. tʃi] and Tableau 5.7 (p. 91) for [tʃuk. tʃi].[121] The construction is the same as that of Figure 5.2 and, thus, requires no further explanation.

[120] Recall from Chapter 2 that my consultant originally gave [ɖu. bɑ] as the only form for 'sixth'. Later, after asking if coda [k] is possible in 'sixth', she gave [ɖuk. bɑ] as another possible form. It is my suspicion, however, that [ɖuk. bɑ] is actually a literary pronunciation and is not used in conversational speech.

[121] Recall that variability in the teens is due to SYLLDEPENDENCE and MAX being unranked in relation to one another. An in-depth explanation of how variation in the morphological decimals is accounted for within

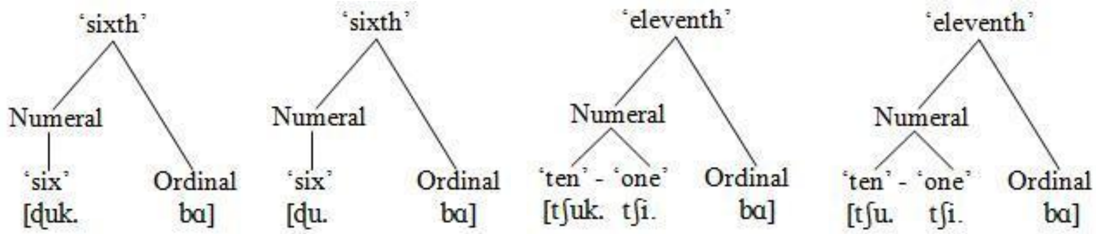

Figure 5.3. The morphological structures of 'sixth' and 'eleventh'.

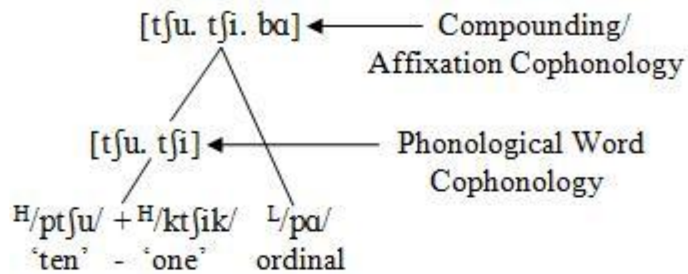

Figure 5.4. 'eleventh'.

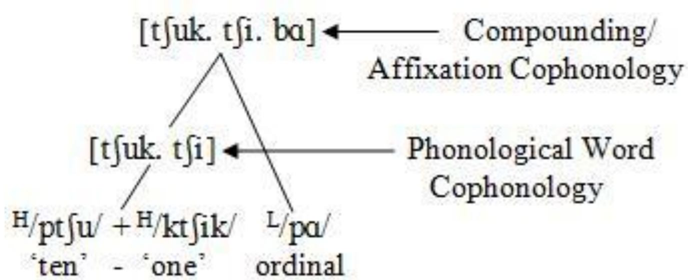

Figure 5.5. 'eleventh'.

The final ordinal example (Figure 5.6) is slightly more complex as it provides additional information about the constraints in force in the Compounding/Affixation Cophonology. First, 'seven' is run through the Phonological Word Cophonology (see Tableau 5.1, p. 87). Next, the ordinal marker is affixed to the output, [dʏn]. However, the output of the Compounding/Affixation Cophonology is [dʏm. bɑ], not *[dʏn. bɑ]. Thus, in order to account for nasal place assimilation of coda [n] in [dʏn], three new constraints are needed:

Faithfulness Constraints

- **Ident-IO(labial)**: The feature [+labial] must not change from input to output.

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the Phonological Word Cophonology is given in Section 5.3.1.

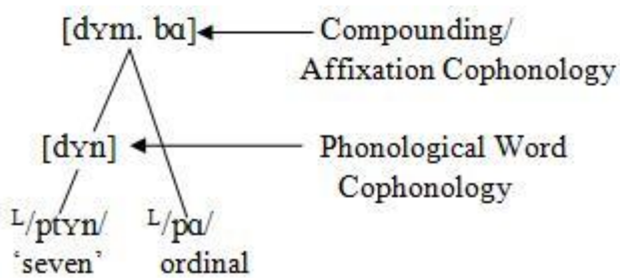

Figure 5.6. 'seventh'.

- **IDENT-IO(Place, nasal)**: All place features of nasals must be the same from input to output.

  Markedness Constraints

- **$*N_{[-lab]}C_{[+lab]}$**: Assign one violation mark for all nasal + consonant sequences where the nasal is [-labial] and the following consonant is [+labial].[122]

Tableau 5.18 illustrates the ranking of these three constraints. This ranking pertains to the Compounding/Affixation Cophonology in order to account for nasal place assimilation. The tableau provides evidence for two ranking relations: $*N_{[-lab]}C_{[+lab]}$ dominates IDENT-IO(Place, nasal) (Cand (b)) and IDENT-IO(labial) dominates IDENT-IO(Place, nasal) (Cand (c)). As such, nasal place assimilation of coda [n] occurs in order to avoid violation of the higher ranking constraints $*N_{[-lab]}C_{[+lab]}$ and IDENT-IO(labial).

Tableau 5.18.

input: 'seventh' dʏn + L/pɑ/	$*N_{[-lab]}C_{[+lab]}$	IDENT-IO (labial)	IDENT-IO (Place, nasal)
a. → dʏm. bɑ			*
b. dʏn. bɑ	*!W		L
c. dʏn. dɑ		*!W	L

Figure 5.7 shows the construction of the collective 'the four'. As with all phonological words, the word-initial complex onset is simplified via deletion. After, the output, [ʒi], and the collective morpheme are affixed and run through the

122 A better, more general constraint for categorizing nasal place assimilation is CODA-COND (Kager 1999:130-132); however, given that I have very little data on nasal place assimilation in Dzongkha and the fact that it is a side issue from this present study, an analysis using this constraint is reserved for later work.

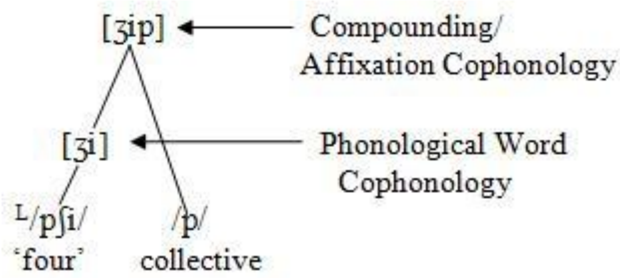

Figure 5.7. 'the four'.

Compounding/Affixation Cophonology; the output, [ʒip], provides no additional information about the constraints or ranking at this level.

The collective 'the three' (Figure 5.8) is constructed in the same way as above; however it provides additional ranking evidence for the Compounding/Affixation Cophonology.

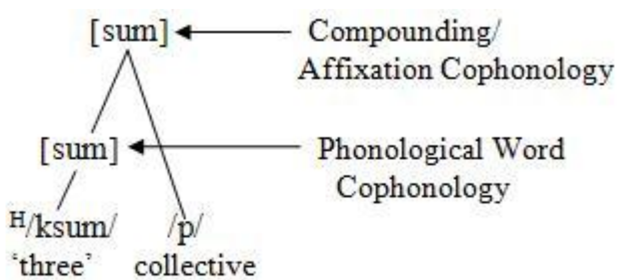

Figure 5.8. 'the three'.

As with 'four' above, the word-initial complex onset in 'three' is simplified via deletion in the Phonological Word Cophonology. After, the collective morpheme is affixed to the cardinal number; however, constraints in force in the Compounding/Affixation Cophonology simplify the complex coda that is made from this morphological construction, as *[sump] is not a possible output.

Tableau 5.19 illustrates this process where [sum] is the optimal output. Here we see a familiar ranking whereby *COMP dominates MAX. Recall that this same ranking is necessary for the accurate prediction of the compound decimals and the morphological decimals. Thus, in order to avoid violation of *COMP and $\text{MAX}_{\text{CV}\sigma}$, it appears that the optimal output must

Tableau 5.19.

input: ‘the three’ sum + /p/	*Comp	Max	Max$_{CV\sigma}$
a. → sum		*	
b. sump	*!W	L	
c. sup		*	*!W

entirely delete the ‘collective’ morpheme /p/ (compare with Cands (b) and (c)).[123] Notably, as we will see in Tableau 5.20 (p. 109), this is not actually the case.

Finally, ‘the seven’ provides further information on the constraints and rankings active in the accurate prediction of [dʏm]. Figure 5.9 shows the construction of the affixed number. Refer to Tableau 5.1 (p. 87) for the constraints and rankings active in predicting [dʏn] as the optimal output of the Phonological Word Cophonology.

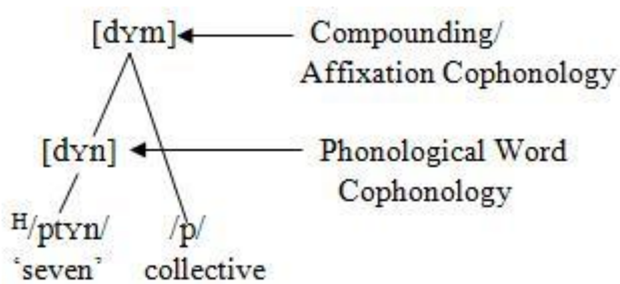

Figure 5.9. ‘the seven’.

Once the collective marker is affixed to [dʏn], the resulting form is run through the Compounding/Affixation Cophonology. In order to account for the data, one new constraint is required:

Faithfulness Constraint

- **Max$_{morph}$**: Do not delete all of the features of a morpheme.

Recall from Chapter 2, Section 2.2.2 that the Dzongkha reflex of some Classical Tibetan disyllables has been to reduce them to monosyllables. Notably, however, reduction is not a matter of simply deleting the second morpheme, a suffix which coincides with the second syllable. Instead, disyllabic words which have been reduced to monosyllables retain part of

[123] Cand (e) is harmonically bounded by winner but has been left in for illustrative purposes.

the suffix in some form. Thus, the preservation of some part of the second morpheme in a reduced syllable, whether only minimally (e.g. through place assimilation of a preceding nasal coda as in 'long' [riːm]—cf. written Tibetan *ring-po*), or in a larger form (e.g. through retention of the first segment of the suffix as in 'yellow' [seːp]—cf. written Tibetan *ser-po*), provides evidence for the presence of an inviolable constraint against deletion of all features of a morpheme (MAX$_{morph}$).[124, 125]

This is the same process occurring with the collectives. Thus, it is the interaction between the markedness constraint against complex onsets and codas (*COMP), the faithfulness constraint against deletion of all features of a morpheme (MAX$_{morph}$), the faithfulness constraint against changing the place feature of nasals (IDENT-IO(Place, nasal)), and the faithfulness constraint against deletion of segments that are adjacent to tautosyllabic vowels that leads to place assimilation of the nasal in ^{L}/ptʏn/ + /p/ (Tableau 5.20).[126] In other words, it is worse to delete all features of a morpheme, to have a complex coda, or to delete a segment that is next to a vowel than to change the place feature of a nasal in order to retain some feature of the second morpheme. Importantly, this is also the case for 'the three', [sum] (Tableau 5.19, p. 107); however, because the coda [m] already shares the same place feature as the collective morpheme, /p/, the place of the second morpheme is retained without any obvious change from input to output (see Appendix C).

[124] Written Tibetan transcriptions come from Mazaudon and Michailovsky (1989/2006).

[125] Notably, words which have been historically reduced from disyllables to monosyllables do not keep this form in compounds. Instead, the root alone is found in compounds (when it is the first element of the compound) and the suffix is dropped. Compare, for example, 'milk' [oːm], transliterated by Mazaudon and Michailovsky (1989/2006: 135) as *o-ma* (literally 'milk-suffix') and 'milk powder' [op. tʃi] transliterated by me as *o-phye* (based on my consultant's written form in the Ucen script). Additionally, compare 'guest' [gøm], transliterated by van Driem (1998: 69) as *mgyon-ma*, (literally 'guest-suffix') and 'guest house' [[gøn] + [tʃʰim]], transliterated by van Driem (1998: 69) as *mgyon-khyim* (based on my transcription of van Driem's consultant).

[126] This is not the only possible analysis. It is also possible to analyze [dʏm] as a sequence of nasal place assimilation followed by complex coda deletion, leading to an opaque environment (see Chapter 6). However, as the cophonologies of a language must adhere to the master ranking, handling opacity by way of an intermediate output [dʏmp] is not possible due to *COMP ranking above MAX. Thus, a different analysis is used here which requires two additional constraints.

An alternate analysis, which also avoids the issue of opacity, is to analyze [dʏm] in terms of coalescence whereby the resulting coda [m] is a fusion of /n/ and /p/.

Tableau 5.20.

input: 'the seven' dʏn + /p/	*COMP	*$N_{[-lab]}C_{[+lab]}$	IDENT-IO (labial)	MAX morph	MAX	MAX CVσ	IDENT-IO (Place, nasal)
a. → dʏm					*		*
b. dʏnp	*!W	*!W			L		L
c. dʏmp	*!W				L		*
d. dʏnd	*!W		*!W		L		L
e. dʏn				*!W	*		L
f. dʏp					*	*!W	L

The ranking ascertained from Tableau 5.20 is such that *COMP must rank above MAX (Cands (c)), $\text{MAX}_{\text{morph}}$ crucially dominates IDENT-IO(Place, nasal) (Cand (e)), and $\text{MAX}_{\text{CV}\sigma}$ outranks IDENT-IO(Place, nasal) (Cand (f)). There is no direct ranking evidence for $\text{MAX}_{\text{morph}}$, MAX, and $\text{MAX}_{\text{CV}\sigma}$ as these constraints are in a stringency relation. Additionally, $\text{*C}^{\text{unsyll}}$ and DEP must dominate MAX in order to eliminate [dʏm. p] and [dʏm. pɑ] respectively; however, these candidates and constraints have been omitted in order to simplify the tableau.

Based on the analysis presented here, new rankings have been established for the Compounding/Affixation Cophonology. These rankings are:

(1) *COMP, DEP, $\text{*C}^{\text{unsyll}}$ » Max

(2) $\text{MAX}_{\text{morph}}$, $\text{MAX}_{\text{CV}\sigma}$, $\text{*N}_{[-\text{lab}]}\text{C}_{[+\text{lab}]}$, IDENT-IO(labial) » IDENT-IO(Place, nasal)

The next section discusses how the rankings of the two cophonologies fit together in a grammar lattice.

5.3 THE GRAMMAR LATTICE

This section uses a grammar lattice (Anttila 2002, Inkelas & Zoll 2007) to model Dzongkha phonology. Recall that the cophonologies approach states that a language consists of a single grammar that is made up of partially ordered pairs of constraints. Furthermore, the constraints in each cophonology may or may not be completely ranked. In the case that they are not fully ranked, subordinate cophonologies are present and, moreover, multiple outputs are possible (Anttila 2002, 2007, Inkelas 2008, Inkelas & Zoll 2007). It is important to note here, as discussed in Chapter 2, that in addressing free variation, partially ordered grammars are commonly used to determine the probability of a variant's occurrence;

however, such an analysis is not possible with a small data size. Thus, a probabilistic analysis of free variation in the Dzongkha morphological numerals is left for a future study.

This section is organized as follows: Section 5.3.1 provides an initial version of the Dzongkha grammar lattice; Section 5.3.2 reevaluates the data, providing a simpler organization of the data; and Section 5.3.3 gives a revised grammar lattice.

5.3.1 The Initial Grammar Lattice

Figure 5.10 presents the Dzongkha grammar lattice which illustrates the relationship between cophonologies. The grammar lattice reads from top to bottom, becoming gradually more ranked as you move to the bottom of the lattice. The numbers seen throughout the lattice are used only as a guide to help the reader follow the discussion. They have been arbitrarily named.

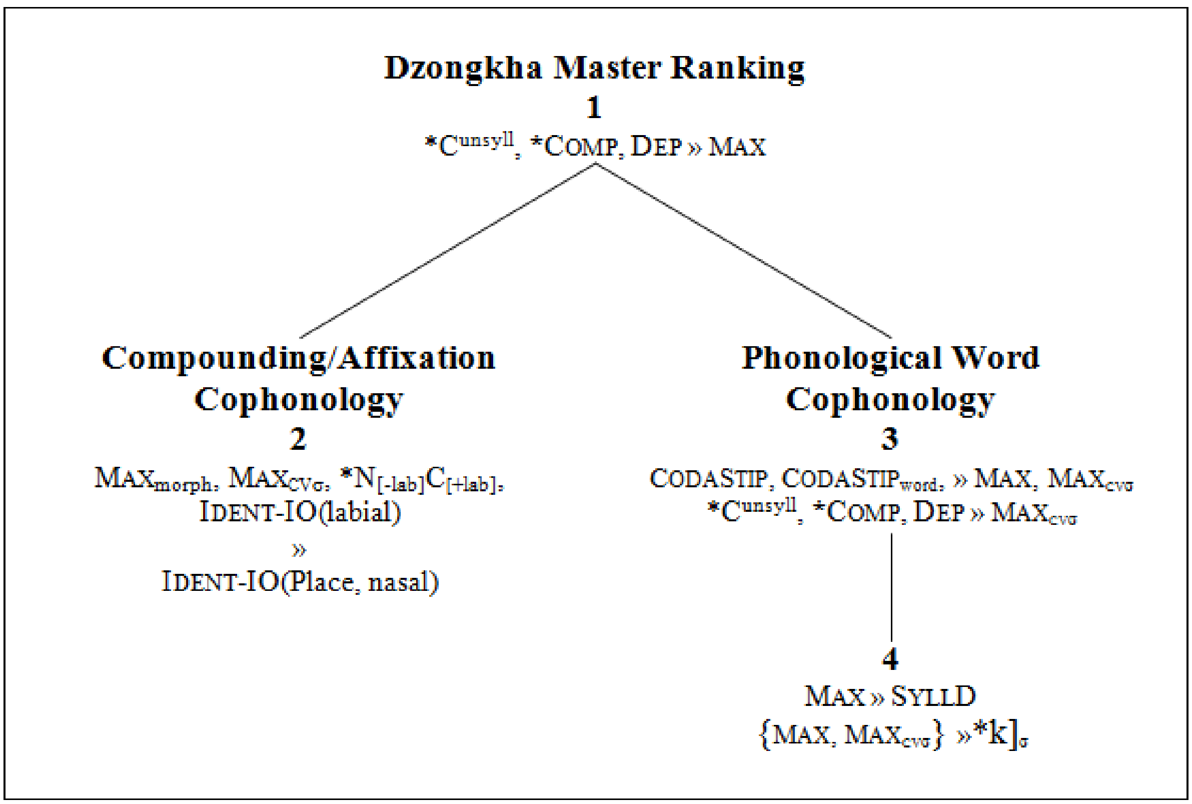

Figure 5.10. The Dzongkha grammar lattice.

The rankings presented in the grammar lattice are those established in Chapter 4 and Section 5.2 of this chapter along with all other crucial rankings (see Appendix D).[127] At the very top of the lattice is the master ranking, which is always true of the general phonology of Dzongkha. In other words, these rankings must always be obeyed. Moreover, each daughter node retains the rankings of its mother node. The Dzongkha Master Ranking establishes that *COMP, DEP, and *C^{unsyll} dominate MAX.[128]

In addition to the master rankings, the ranking of the Compounding/Affixation Cophonology (Node 2) is such that MAX_{morph}, $\text{MAX}_{CV\sigma}$, $*N_{[-lab]}C_{[+lab]}$, and IDENT-IO(labial) dominate IDENT-IO(Place, nasal). These are the necessary rankings in order to account for phenomena such as nasal place assimilation found specifically in affixed constructions (see Section 5.2.5).

The Phonological Word Cophonology (Node 3), which includes the master rankings, is such that *COMP, DEP, *C^{unsyll}, CODASTIPULATION and $\text{CODASTIPULATION}_{word}$ all dominate MAX and $\text{MAX}_{CV\sigma}$.[129] Embedded within the Phonological Word Cophonology there is a subordinate node (Node 4) which establishes that MAX dominates SYLLDEPENDENCE and $*k]_\sigma$ ranks below MAX and/or $\text{MAX}_{CV\sigma}$.[130, 131] The morphological decimals and the nodes they are indexed to are addressed in the next few paragraphs.

The morphological units, teens (with the exception of 'eighteen'), ten thousands, and hundred thousands are associated with the root node of the Phonological Word Cophonology (Node 3). The units are accurately accounted for when indexed to Node 3 as word-initial complex onsets are invariably simplified through deletion due to the ranking of *COMP above

[127] For reasons of simplification, constraints and rankings which are an aside from the main topic at hand (i.e. constraints related to obstruent voicing and tone) are not included here.

[128] Although rankings in a grammar lattice are typically listed in pairs, they have been combined in order to simplify the lattice.

[129] Recall that MAX and $\text{MAX}_{CV\sigma}$ are in a stringency relation and, thus, cannot be ranked in relation to one another. Moreover, CODASTIPULATION, $\text{CODASTIPULATION}_{word}$, *$C^{unsyll}$, *****COMP, DEP are all undominated and, therefore, cannot be ranked in relation to one another.

[130] There are other rankings present in Node 4, but they have been omitted for redundancy's sake. For example, *COMP, $\text{CODASTIPULATION}_{word}$, CODASTIPULATION, DEP, and *C^{unsyll} must also dominate SYLLDEPENDENCE; however, as these constraints dominate MAX, it is redundant to make such a distinction (due to MAX also dominating SYLLDEPENDENCE).

[131] Since it is undeterminable whether only one of the constraints MAX and $\text{MAX}_{CV\sigma}$ or if both must rank above $*k]_\sigma$, they are indicated in Node 4 using brackets.

MAX. This occurs regardless of the ranking between SYLLDEPENDENCE and MAX. Moreover, the variation exhibited in the teens (see Sections 5.2.1 and 5.2.2) as well as the ten thousands and hundred thousands (see Section 5.2.3) is accurately accounted for when indexed to Node 3; all possible ranking combinations between SYLLDEPENDENCE and MAX as well as MAX, $\text{MAX}_{CV\sigma}$, and $*k]_\sigma$ will all lead to accurate prediction of all variants of these numbers without predicting any ungrammatical forms.

Table 5.4 gives a breakdown of the variable outputs given the different possible ranking combinations at Node 3. The columns have been arbitrarily lettered to aid the reader in following the discussion.

Table 5.4. Possible Outputs According to Node 3

Column	**A**	**B**	**C**	**D**
Ranking	SYLLD » MAX $*k]_\sigma$ » MAX, $\text{MAX}_{CV\sigma}$	SYLLD » MAX {MAX, $\text{MAX}_{CV\sigma}$} » $*k]_\sigma$	MAX » SYLLD {MAX, $\text{MAX}_{CV\sigma}$} » $*k]_\sigma$	MAX » SYLLD $*k]_\sigma$ » MAX, $\text{MAX}_{CV\sigma}$
Description of Optimal Output	Deletion of all prefixes in a complex onset as well as deletion of underlying medial coda [k] in output forms	Deletion of all prefixes in complex onsets but parsing of underlying medial coda [k] in output forms	Resyllabification of all prefixes in complex onsets and parsing of underlying medial coda [k] in output forms	Resyllabification of [p] prefixes in a complex onset, deletion of [k] prefixes in a complex onset, and deletion of underlying medial coda [k] in output forms
Sample Outputs	‘thirteen’ ^{H}/ptʃu/+^{H}/ksum/ [tʃu. sum]	‘thirteen’ ^{H}/ptʃu/+^{H}/ksum/ [tʃu. sum]	‘thirteen’ ^{H}/ptʃu/+^{H}/ksum/ [tʃuk. sum]	‘thirteen’ ^{H}/ptʃu/+^{H}/ksum/ [tʃu. sum]
	‘fourteen’ ^{H}/ptʃu/+ ^{L}/pʃi/ [tʃu. ʒi]	‘fourteen’ ^{H}/ptʃu/+ ^{L}/pʃi/ [tʃu. ʒi]	‘fourteen’ ^{H}/ptʃu/+ ^{L}/pʃi/ [tʃup. ʒi]	‘fourteen’ ^{H}/ptʃu/+ ^{L}/pʃi/ [tʃup. ʒi]
	‘ten thousand’ ^{H}/ktʃik/+ ^{H}/ʈʰi/ [tʃi. ʈʰi]	‘ten thousand’ ^{H}/ktʃik/+ ^{H}/ʈʰi/ [tʃik. ʈʰi]	‘ten thousand’ ^{H}/ktʃik/+ ^{H}/ʈʰi/ [tʃik. ʈʰi]	‘ten thousand’ ^{H}/ktʃik/+ ^{H}/ʈʰi/ [tʃi. ʈʰi]

The ranking in Columns A and B deletes all prefixes in a complex onset due to SYLLDEPENDENCE dominating MAX. On the other hand, the ranking in Columns C and D allows prefixes to resyllabify due to MAX dominating SYLLDEPENDENCE; however, while resyllabification of all prefixes is possible under the ranking of Column C, coda [k] prefixes may not resyllabify under the ranking of Column D. This is due to $*k]_\sigma$ dominating MAX and $\text{MAX}_{CV\sigma}$ whereby all candidates with a coda [k] are eliminated from the competition. Of course, resyllabification under the rankings of Columns C and D may only happen given the proper environment (i.e. the preceding morpheme is coda-less). In regard to underlying word-medial coda [k], the ranking of $*k]_\sigma$ above MAX and $\text{MAX}_{CV\sigma}$ in Columns A and D leads to deletion while the ranking of $*k]_\sigma$ below MAX and/or $\text{MAX}_{CV\sigma}$ in Columns B and C leads to optimal output forms where medial coda [k] is parsed. Thus, by associating the teens, ten thousands, and hundred thousands with Node 3, the variation exhibited in these forms is accounted for.

The morphological tens, hundreds, thousands, and ‘eighteen’ are indexed to Node 4. Recall from Section 5.2.2 that these forms invariably simplify word-medial complex onsets through resyllabification of the first segment in the cluster where the preceding morpheme does not have a coda. Additionally, in cases where the preceding syllable has an underlying coda [k], these forms will invariantly parse coda [k] and the complex onset will simplify through prefix deletion. Thus, in order to accurately account for these forms MAX must rank above SYLLDEPENDENCE and $*k]_\sigma$ must rank below $\text{MAX}/\text{MAX}_{CV\sigma}$.[132] This is precisely the ranking of Node 4.

Non-numeric phonological words in Dzongkha are also indexed to Node 4. Recall from Section 5.2.3 that phonological words with underlying coda [k] invariantly parse this coda in word-medial position. In addition, non-numeric phonological words with word-medial complex onsets invariably simplify through resyllabification in the case that the preceding morpheme is coda-less. Thus, these non-numeric phonological words follow the same pattern as the tens, hundreds, and thousands and are, therefore, indexed to Node 4.

[132] As Node 4 is a subordinate cophonology of Node 3, it is unsurprising that the ranking of Node 4 is the same as that found in Column C in Table 5.4 (p. 112).

At this point in the analysis it is important to note that the construction and phonology of compounds is not as previously presented. In Chapter 4, my analysis was such that the underlying form of the morphemes that make up a compound were the input of a phonology which deleted all complex onsets, both word-initially and word-medially. Notably, this phonology was identical to that of the Phonological Word Cophonology, with the exception that SYLLDEPENDENCE crucially dominated MAX. This ranking was crucial to deletion of initial segments of complex onsets at the juncture of the members of a compound.

Under the cophonologies approach, however, this ranking is not necessary to the accurate prediction of compounds. Instead, the individual members of a compound are run through the Phonological Word Cophonology first and, afterwards, they are compounded. Then, they are then run through the Compounding/Affixation Cophonology; the output of this cophonology, however, does not produce any observable phonological change in compounds. Figure 5.11 presents the construction of the compound 'seven hundred' (cf. Tableau 4.3, p. 80).

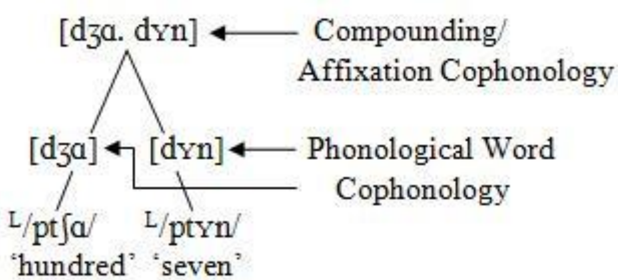

Figure 5.11. 'seven hundred'.

In this section I have set up a grammar lattice which uses partially ranked constraints. Furthermore, by indexing constructions to particular nodes, I have shown how partially ranked constraints fit together under one grammar and account for variation within the language. However, the grammar can be further simplified. This is addressed in the next sections.

5.3.2 Reorganization of the Data

Throughout my analysis I have made the distinction between phonological words and compounds. Recall that the compound decimals and other non-numeric compounds exhibit complex onset simplification by means of deletion of the first segment and, furthermore, always delete coda [k] due to its word-final position. In contrast, numbers belonging to the phonological word category (i.e. the morphological decimals) show variable means of complex onset simplification and variable treatment of word-medial coda [k]. Interestingly, it is only the morphological decimals, and not the non-numeric phonological words, which show this variation. Recall from Section 5.2.4 that non-numeric phonological words always resyllabify word-medial complex onsets (provided that the preceding syllable is coda-less) and always parse underlying word-medial coda [k]. Perhaps, then, the variation seen in the morphological decimals is not variation within phonological words, but is due to a single number being associated with two different constructions: either being made up of a single word or being made up of more than one word and constituting a compound (see Appendix E for the new organization of the data).

Take, for example, the variable complex onset simplification seen in the teens. If we understand [tʃuk. tʃi], 'eleven', to be a single phonological word, but [tʃu. tʃi] to be a compound, the analysis can be simplified. Furthermore, in regard to underlying coda [k], if we understand [ɖuk. ʈʰi], 'sixty thousand', to be a single phonological word, but [ɖu. ʈʰi] to be a compound, again the analysis can be simplified. In analyzing the data this way, we no longer require two separate nodes within the Phonological Word Cophonology (see Figure 5.10, p. 110). Instead, the ranking of MAX above SYLLDEPENDENCE is established at Node 3. Moreover, $*k]_\sigma$ is no longer necessary to explain variable coda [k] parsing/deletion as coda [k] is always parsed word-medially in phonological words and is always deleted in compounds (due to violation of CODASTIPULATION$_{word}$).

5.3.3 The Revised Grammar Lattice

By asserting that resyllabification of complex onsets and parsing of coda [k] must occur within phonological words and that deletion of complex onsets and coda [k] must occur at the word-margins, the Dzongkha grammar lattice is simplified.

Figure 5.12 gives the new grammar lattice. The Dzongkha Master Ranking and Node 2 rankings are identical to that of Figure 5.10 (p. 110).

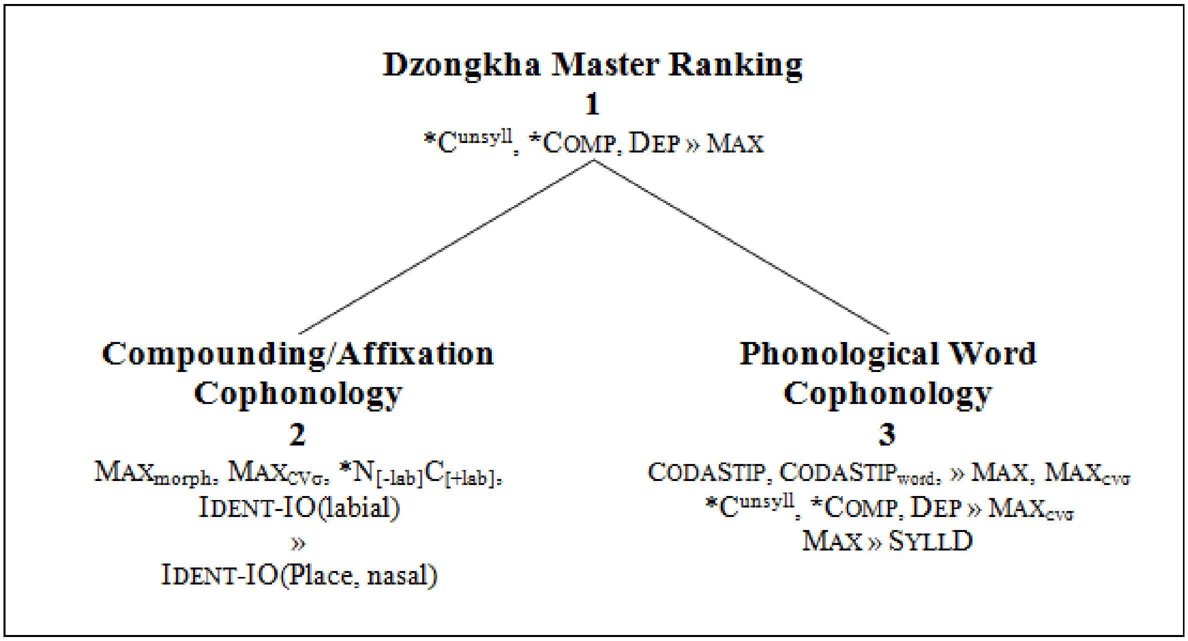

Figure 5.12. The new grammar lattice.

To summarize, the new organization of the data simplifies the analysis by no longer requiring the constraint $*k]_\sigma$ in order to explain variation. This is because, under the cophonologies approach, variation is now understood to arise out of one word having two different constructions, being constructed as either a single phonological word or as a compound made up separate phonological words.[133]

5.4 Summary

In this chapter I have provided an Optimality Theoretic analysis of the Dzongkha morphological decimal system which functions as a single phonological word. I have done this by using a restricted version of the cophonologies approach. Furthermore, I have shown how this analysis is extendible to other (non-numeric) phonological words within the language. Finally, I have established a single, partially ranked grammar within Dzongkha in order to account for phonological words, compounds, and their affixed forms.

[133] While this new organization of the grammar allows for one less constraint in the grammar (i.e. $*k]_\sigma$), it is, perhaps, not much of an improvement from the original organization of the grammar. For example, in providing a lexical account under the new organization of the grammar, it is now impossible to determine the probability of a speaker producing a phonological word or a compound. In contrast, the structural account of the original organization of the grammar allows for a probabilistic analysis (although I did not provide one).

The initial architecture of the Dzongkha grammar lattice (Figure 5.10, p. 110) accounted for free variation in some of the numbers (i.e. the teens, ten thousands, and hundred thousands) and a lack thereof in others (i.e. the tens, hundreds, and thousands). Under this architecture, free variation within the decimal system was analyzed as the result of SYLLDEPENDENCE and MAX as well as MAX, $\text{MAX}_{CV\sigma}$ and $*k]_{\sigma}$ being unranked in relation to one another at Node 3 (i.e. the Phonological Word Cophonology). However, after taking a second look at the data and reorganizing it, I have refined the grammar lattice. Under the current analysis, free variation is understood as arising out of one meaning having two different constructions. Drawing on the two forms of 'fourteen' [tʃup. ʒi] and [tʃu. ʒi], when the underlying form is constructed as a single phonological word, ^{H}/ptʃu/ + ^{L}/pʃi/, it is indexed to the Phonological Word Cophonology whereby resyllabification is optimal to deletion; thus, the optimal output is [tʃup. ʒi]. On the other hand, where the word is constructed as a compound, the individual phonological words which make up the compound (i.e. ^{H}/ptʃu/ and ^{L}/pʃi/) are run separately through the Phonological Word Cophonology yielding the outputs [tʃu] and [ʒi]. Afterwards, these outputs are compounded and run through the Compounding/Affixation Cophonology, whereby the output is [tʃu. ʒi]. Therefore, variation is accounted for through the interaction of the phonology and morphology (see Appendix F for the morphological trees of the affixed forms of 'fourteen').

This analysis, however, is not without its issues.[134] My analysis is problematic in that it cannot account for one of the variants of 'sixth', [ɖuk. bɑ], as the cardinal number 'six', ^{L}/ʈuk/, must meet the requirements of the Phonological Word Cophonology. Thus, the output of this phonology, [ɖu], deletes coda [k] in order to avoid violation of the constraint on word-final codas. As a result, the only available input to the Compounding/Affixation Cophonology is [ɖu], meaning that [ɖu. bɑ] is the only output predicted by my analysis.

[134] Another issue (albeit a side issue from the study at hand) is that, while my analysis can accurately predict 'the seven', [dʏm], it cannot account for the opaque phonological interactions in arriving at the output form. While the cophonologies approach does lend itself to intermediate outputs, thus giving rise to the ability to account for opaque environments in other analyses, it does not work for this analysis as all intermediate outputs must obey the general ranking of the language. In Dzongkha, the ranking of *COMP above MAX is part of the general phonology of the language. As such, the intermediate form *[dʏmp] is not possible in Dzongkha and, therefore, the environment leading to opacity cannot be derived. In order to side-step this issue, the cophonologies analysis instead requires an additional constraint, MAX_{morph}.

In addition, while the cophonologies approach was initially used in order to account for variation, under the new organization of the data a traditional analysis is possible (although it is not without its own issues) (see Appendix G).[135] This is achieved by adding a constraint against resyllabification across word boundaries. In the next Chapter I will analyze the data using Stratal OT.

[135] A completely parallel analysis still cannot account for opacity in 'the seven' [dʏm] and, thus, MAX$_{morph}$ is still needed to side-step the issue.

CHAPTER 6

A STRATIFIED APPROACH TO DZONGKHA OT

This chapter addresses a stratified analysis, specifically Stratal OT. Recall from Chapter 2 that Stratal OT draws on the principal insights of both traditional OT and Lexical Morphology and Phonology. Accordingly, this approach designates different phonologies in the form of ranked constraints at different levels. While the idea of different phonologies or "phonological subsystems" is reminiscent of the cophonologies approach of Chapter 5, Stratal OT differs from the cophonology approach in that it is not constrained by a master ranking; however, it is more restrictive in some respects as there are only three layers available in the grammar: stem, word, and phrase.[136]

The organization of the chapter is as follows: Section 6.1 discusses the data in terms of compound types; Section 6.2 reviews the necessary ranking for the Stratal OT analysis; Section 6.3 explains the analysis; and Section 6.4 summarizes the findings of this chapter, specifically addressing problems in the analysis, and compares Stratal OT with the cophonologies approach.

6.1 LEXICALIZED AND NON-LEXICALIZED COMPOUNDS

Throughout this study I have distinguished between compounds and phonological words. This distinction was made following Vogel's (2010: 147) assertion that "in many languages… syllabification processes observed within the individual PWs [phonological words] of a compound are not observed across the juncture of these items." Thus, I analyzed the numbers which simplify complex onsets via deletion as compounds. Meanwhile, I analyzed numbers which resyllabify the first segment of a complex onset into the coda of the preceding morpheme as phonological words. Importantly, however, non-numeric phonological words presented in Chapter 5, where prefix simplification occurs via

[136] In fact, Inkelas (2008: 5) states that Stratal OT "can be characterized as a very restrictive version of cophonology theory."

resyllabification, were clearly compounds (e.g. *o-phye* [op. tʃi] 'milk powder', literally 'milk-flour' (data from my consultant); *lcags-gzer* [tʃɑːn. dze] 'metal nail', literally 'iron-nail' (van Driem 1998: 79); and *ser-sbyangma* [sip. dʒɑːm] 'bees', literally 'yellow-flying insects' (van Driem 1998: 87)). Therefore, it seems that both classes of numbers (and their non-numeric counterparts) are actually compounds.

The difference is this: non-lexicalized compounds tend not to interact across their juncture; meanwhile, lexicalized compounds "tend to exhibit certain phonological phenomena that are not observed in more productive types of compounds. In fact, they often exhibit phonological properties that are more typical of non-compound words, an indicator that they have indeed undergone lexicalization" (Vogel 2010: 149). Thus, compounds which exhibit prefix resyllabification function as a single phonological word because they have been lexicalized within Dzongkha. Given this distinction, compounds which exhibit prefix deletion at their junction will be referred to as non-lexicalized compounds, while those that exhibit prefix resyllabification at their juncture are noted as lexicalized compounds or phonological words.

6.2 The Ranking

Following the organization of the data established in Chapter 5 (see Appendix E), there is only one (partially ordered) ranking necessary in order to account for variable complex onset simplification and parsing/deletion of underlying coda [k]. This ranking applies only to phonological words and lexicalized compounds, which invariably resyllabify the first segment of word-medial complex onsets (given that the preceding morpheme is coda-less) and parse underlying coda [k] in word-medial position.

The ranking is the same as that established for phonological words in Chapter 5: CodaStipulation$_{word}$, CodaStipulation, *C^{unsyll}, *Comp, and Dep rank above Max and Max$_{CV\sigma}$; and Max ranks above SyllDependence.[137] To illustrate this ranking, Figure 6.1 provides a Hasse diagram. Additionally, Figure 6.2 provides a more familiar, linear portrayal

[137] *Comp, CodaStipulation$_{word}$, CodaStipulation, Dep, and *C^{unsyll} also dominate SyllDependence; however, as these constraints dominate Max, it is redundant to make such a distinction (due to Max also dominating SyllDependence).

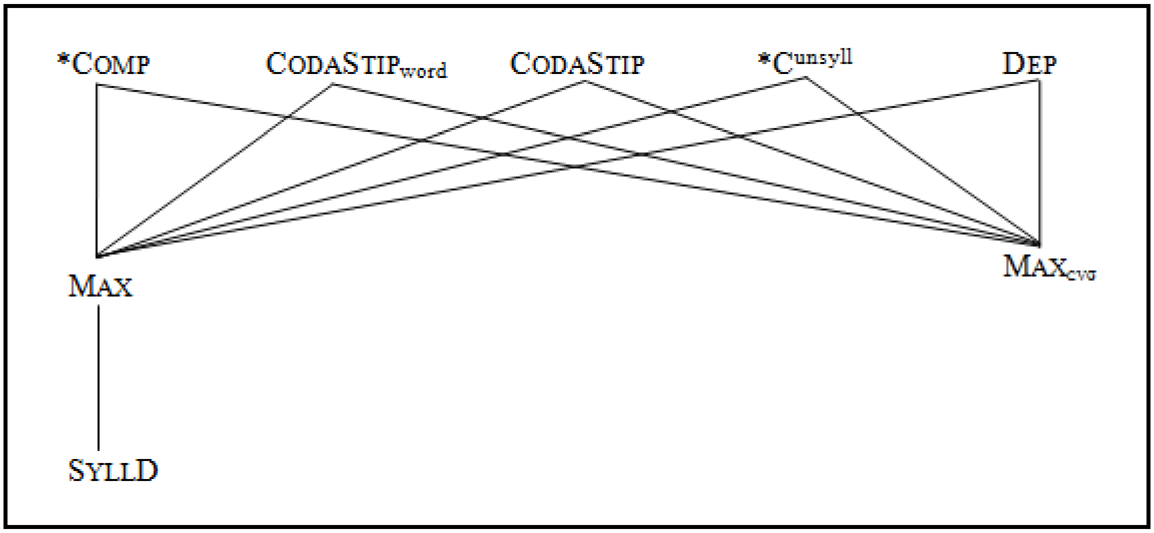

Figure 6.1. A Hasse diagram of the stem-level constraint ranking.

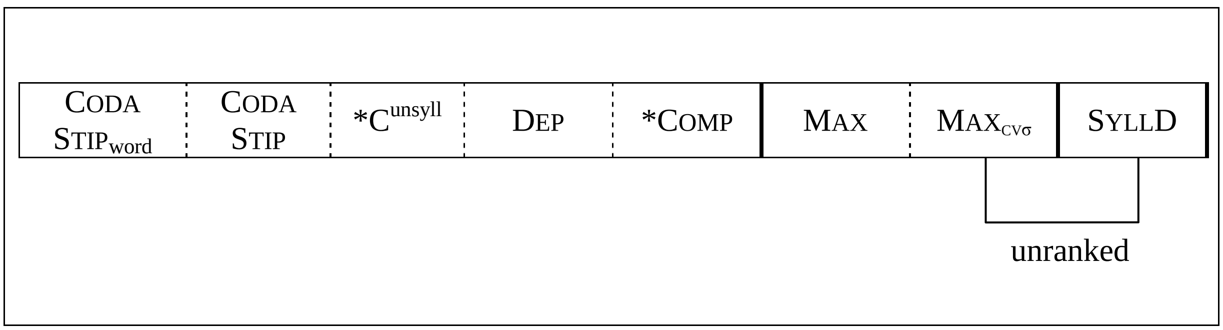

Figure 6.2. A linear diagram of the stem-level constraint ranking.

of the constraint rankings. In this figure, as in regular tableaux, the undominated constraints are listed to the left, a dotted line denotes that the constraints are not ranked in relation to one another, and a solid line denotes that constraints are ranked in relation to one another. In addition, constraints which are unranked in relation to each other, but where this fact cannot be accurately indicated in a linear diagram, have been noted.

With this ranking all phonological words or lexicalized compounds are accurately predicted. The next section will draw on an example where there is free variation between two forms in order to illustrate how the grammar arrives at each optimal output.

6.3 The Stratal OT Analysis

Similar to the cophonologies approach, Stratal OT associates different morphological constructions with different constraint rankings; however, in Stratal OT the morphological constructions are associated with one of three different levels in the grammar (stem, word, and phrase). As such, phonological constraints are applied in a serial manner whereby the phonology is applied to stems first and, afterwards, to words. Furthermore, because the output of each level is the input to the next level, the grammar has access to intermediate outputs. Like the cophonology approach, the benefit is an analysis that can account for derivational effects.[138] Figure 6.3 illustrates the stratified process (based on Kiparsky 2010 and Bermúdez-Otero 2007).

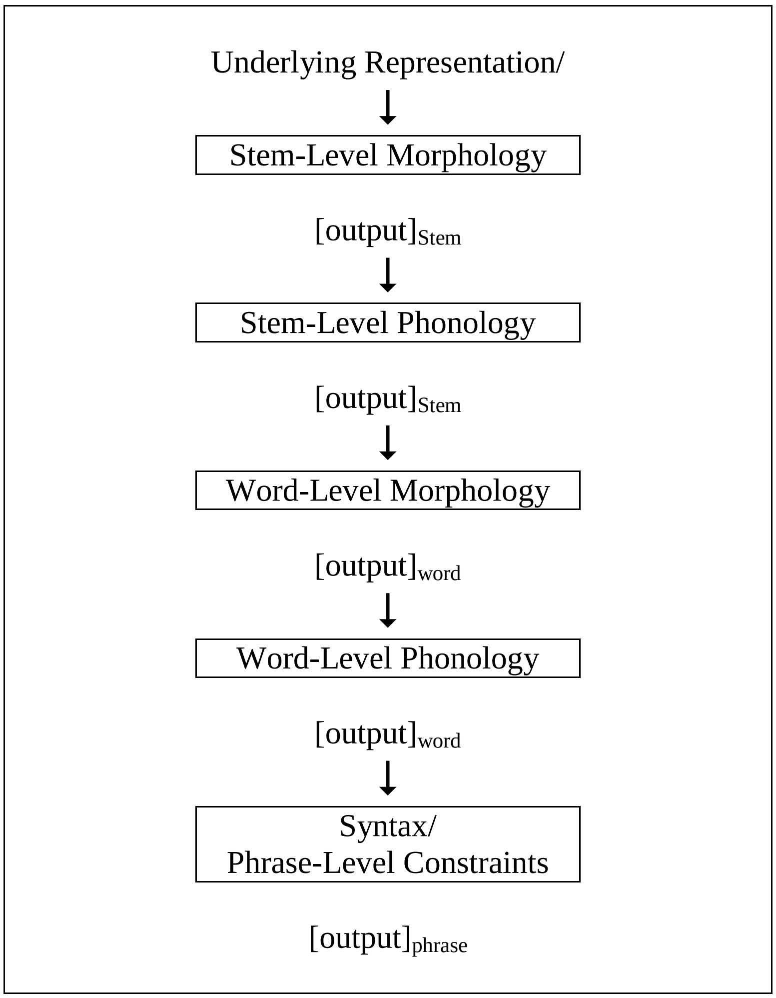

Figure 6.3. The strata.

[138] While the cophonologies approach has access to intermediate outputs, it is constrained by the master ranking. On the other hand, Stratal OT is not constrained by a master ranking (each level may have a ranking that is independent of the others), but there are only three levels available in the grammar.

The underlying representation is input to the stem-level morphology. The output is a stem which comprises a phonological word (PW) or lexicalized compound which is then subjected to the stem-level constraint ranking. Next, the optimal output of the stem-level phonology passes through the word-level morphology. At this level affixed words and non-lexicalized compounds are formed. The word-level affixes, which are bound morphemes, are affixed to the phonological words or lexicalized compounds in the input. Examples of these affixes include the truncated tens morpheme in the intermediate tens (e.g. ‘forty’ [ʒe]), the ordinal morpheme [bɑ], and the collective morpheme [p]. Afterwards, these affixed phonological words can then be input to the word-level phonology or continue cycling through the morphology to form compounds such as ‘forty-four’ [ʒip. tʃu. ʒe. ʒi] ^{L}/pʃi/ + ^{H}/ptʃu/ + ^{L}/ʃe/ + ^{L}/pʃi/ (see Appendix H for a morphological tree of the full form).

Phonological words with word-level affixes include: ‘forty-four’ [ʒe. ʒi], ‘eleventh’ [tʃuk. tʃi. bɑ], and ‘the four’ [ʒip]. Figures 6.4 illustrates the stratal process for deriving ‘forty-four’ [ʒe. ʒi].

^{L}/pʃi/

↓

Stem-Level Morphology

^{L}[pʃi]$_{PW}$

↓

Stem-Level Phonology

^{L}[ʃi]$_{PW}$

↓

Word-Level Morphology

[^{L}[ʃe]$_{affix}$ + ^{L}[ʃi]$_{PW}$]$_{word}$

↓

Word-Level Phonology

[ʒe. ʒi]$_{word}$

Figure 6.4. ‘forty-four’.

Figure 6.5 illustrates the stratal process for deriving ‘eleventh’ [tʃuk. tʃi. bɑ].

^{H}/ptʃu/ ^{H}/ktʃik/

↓

Stem-Level Morphology

[^{H}ptʃu + ^{H}ktʃik]$_{\text{Lexical. Compound}}$

↓

Stem-Level Phonology

[^{H}tʃuk. ^{H}tʃi]$_{\text{Lexical. Compound}}$

↓

Word-Level Morphology

[[^{H}tʃuk. ^{H}tʃi]$_{\text{Lexical. Compound}}$ + [^{L}pɑ]$_{\text{affix}}$]$_{\text{word}}$

↓

Word-Level Phonology

[tʃuk. tʃi. bɑ]$_{\text{word}}$

Figure 6.5. ‘eleventh’.

In addition to phonological words, non-lexicalized compounds are constructed in the word-level morphology and may receive affixes. This occurs through cyclicity whereby the compound is created first and continues to cycle through the word-level morphology until it is complete (e.g. ‘eleventh’ [tʃu. tʃi. bɑ]).

Once through the word-level morphology, the output becomes the input of the word-level phonology. This process continues sequentially through the syntax and phrase-level phonology, with the final output being a phrase. In terms of traditional Lexical Morphology and Phonology, the phrase-level constraints are known as post-lexical.

Drawing on the variable forms of ‘eleventh’, the discussion will now illustrate how each variable form is derived through a stratified analysis. First, the underlying forms are run through the stem-level morphology. At this level the morphemes ^{H}/ptʃu/, ‘ten’, and ^{H}/ktʃik/, ‘one’, are compounded through cyclicity forming the compound stem (what I call a lexicalized compound), [^{H}ptʃu. ^{H}ktʃik]. The outputs of the stem-level morphology are [^{H}ptʃu], 'ten', [^{H}ktʃik], 'one', and [^{H}ptʃu. ^{H}ktʃik], 'eleven'.

The output of the stem-level morphology is then submitted to the stem-level constraints. Tableau 6.1 illustrates the process of the stem-level phonology selecting the optimal output based on the input [^{H}ptʃu. ^{H}ktʃik].[139] As a result of the first morpheme being coda-less, resyllabification is possible word-internally. Thus, [tʃuk. tʃi], is the optimal output.

Tableau 6.1.

input: 'eleven' [^{H}ptʃu. ^{H}ktʃik]	CODA STIP$_{word}$	*COMP	MAX	MAX$_{CV\sigma}$	SYLLD
a. → tʃuk. tʃi			**	*	*
b. ptʃu. ktʃik	*!W	**W	L	L	L
c. tʃu. tʃi			***!W	*	L
d. ptʃuk. tʃi		*!W	*L	*	*
e. tʃu. tʃik	*!W		**	L	L
f. ptʃu. ktʃi		*!*W	*L	*	L

In contrast, Tableaux 6.2 and 6.3 illustrate the optimal outputs of the phonological words, [^{H}ptʃu] and [^{H}ktʃik], respectively, which are made up of only one morpheme. In these tableaux, the proper environment in which resyllabification occurs is not present. Thus, deletion of the first segment of the complex onset occurs. Like Tableau 6.1, however, Tableau 6.3 deletes coda [k] word-finally in the morpheme 'one' [^{H}ktʃik].

Tableau 6.2.

input: 'ten' [^{H}ptʃu]	*COMP	*C^{unsyll}	DEP	MAX
a. → tʃu				*
b. ptʃu	*!W			L
c. p. tʃu		*!W		L
d. pɑ. tʃu			*!W	L

[139] This is the same tableau presented in Chapter 5 (Tableau 5.7, p. 91). The essential constraint rankings are described in detail there.

Tableau 6.3.

input: 'one' [^{H}ktʃik]	*COMP	CODA STIP$_{word}$	MAX	MAX$_{CV\sigma}$
a. → tʃi			**	*
b. ktʃik	*!W	*W	L	L
c. tʃik		*!W	*L	L
d. ktʃi	*!W		*L	*

Once the phonological words have gone through the constraint ranking, the optimal outputs are then the input of the word-level morphology. Thus, in order to form 'eleventh' there are two possibilities. One option is to combine the optimal output from Tableau 6.1 (p. 125), [tʃuk. tʃi], with the ordinal affix, ^{L}/pɑ/, forming one of the variants, [tʃuk. tʃi. bɑ]. The other option is to compound the optimal outputs of Tableaux 6.2 (p. 125) and 6.3, [tʃu], 'ten', and [tʃi], 'one', and affix the ordinal marker, thus forming the other variant, [tʃu. tʃi. bɑ] (see Appendix I for the morphological trees of these forms). Again, the variation in these forms arises out of either: (1) the cardinal number forming a lexicalized compound, and, thus, allowing for word-medial resyllabification of the first segment in the complex onset; or (2) the cardinal number forming a non-lexicalized compound (where the cardinal number is made up of two separate phonological words), and, thus, deleting the first segment of all complex onsets.

After going through the word-level morphology, the output becomes the input of the word-level phonology; however, the phonology of this level does not affect the output. Notably, the stem-level constraint ranking discussed above is all that is needed in order to handle the variable means of complex onset simplification and variable parsing/deletion of coda [k] within phonological words, lexicalized compounds, and non-lexicalized compounds.

One example of word-level phonology is allophonic obstruent voicing based on tone (see Chapter 3). This phonological process must occur after the stem-level phonology as allophonic obstruent voicing is found in word-level affixes (e.g. the ordinal affix [bɑ]). Thus, I assume that it occurs at the word-level. It is also possible, however, that it occurs in the phrase-level phonology or that these constraints are active at all levels of the grammar.

Finally, another example of word-level phonology is nasal place assimilation.[140] This is seen, for example, in 'seventh' ^{L}/ptʏn/ + ^{L}/pɑ/, where the nasal consonant assimilates to the place of the following labial segment (cf. the output form [dʏm. bɑ]). Notably, this phonological process must follow word-level morphology where ^{L}/pɑ/ is affixed to the cardinal number.

Tableau 6.4 illustrates this process (see Chapter 5, Section 5.2.5 for a definition of the constraints). As established in Chapter 5 (see Tableau 5.18, p. 105), nasal place assimilation occurs in order to avoid violation of the undominated constraints $*N_{[-lab]}C_{[+lab]}$ and IDENT-IO(labial).

Tableau 6.4.

input: 'seventh'[141] [^{L}tʏn] + [^{L}pɑ]	$*N_{[-lab]}C_{[+lab]}$	IDENT-IO(labial)	IDENT-IO (Place, nasal)
a. → dʏm. bɑ			*
b. dʏn. bɑ	*!W		L
c. dʏn. dɑ		*!W	L

[140] Recall from Chapter 5 (see Tableau 5.20, p. 109) that the collective 'the seven', ^{L}/ptʏn/ + /p/, also undergoes nasal place assimilation. Under a Stratal OT analysis, which proponents claim has the advantage of accounting for opacity, [dʏm] cannot be easily accounted for:

First, the collective morpheme /p/ is affixed to 'seven' ^{L}[tʏn] in the word word-level morphology. (The complex onset in 'seven' has already been simplified in the stem-level phonology; I assume that allophonic obstruent voicing occurs in the word-level phonology.) After, the word-level phonology leads to nasal place assimilation, following the same process as seen above in Tableau 6.4. The output of the word-level phonology is [dʏmp], which leads to a complex coda. Importantly, *COMP must rank below MAX at this level in order to allow for nasal place assimilation to take place, otherwise the output would be incorrectly predicted as *[dʏn]. The complex coda must then be simplified in the phrase-level phonology, the only remaining stratum, in order to account for the opaque form, [dʏm]. Notably, however, the fact that [dʏm] is a word and not a phrase leads to a problem in the analysis. Such issues are not new to Stratal OT as it "simply… does not provide *enough* layers" to account for different phonological phenomena (Inkelas 2008: 15). While one of the purported advantages of Stratal OT is its ability to account for phonological phenomena such as opacity, clearly its stipulation of only three strata within the grammar appears to be overly restrictive.

[141] While I assume that allophonic obstruent voicing occurs at this level, the constraints related to this phonological process have been omitted and candidates are shown with voiced obstruents in order to simplify the tableau.

6.4 SUMMARY

In this chapter I have provided a Stratal OT analysis of the Dzongkha data. Specifically, I have shown that Stratal OT can accurately account for most of the Dzongkha data.[142] One issue, not addressed above, is that the analysis is unable to account for [ɖʉk. bɑ], one of the variable forms of 'sixth'. The issue is that that the optimal output of the cardinal number, 'six', ^{L}/ʈʉk/, deletes its underlying coda [k] at the stem-level in order to avoid violation of CODASTIPULATION$_{word}$. When affixation occurs (at the word-level), the only possible input to the word-level morphology is [ɖʉ]; thus, Stratal OT can only account for [ɖʉ. bɑ].[143]

Stratal OT allows each level of the grammar to have a ranking that is independent of the other levels; however there are only three levels available in the grammar. On the other hand, under the cophonologies approach the grammar has access to a finite, but not overly restrictive, number of possible cophonologies which are confined by the unranked constraints in the master ranking. Regardless of these theoretical differences, when comparing the cophonologies approach and the approach of this current chapter (Stratal OT), it is apparent that they offer very similar analyses.[144]

[142] For example, Stratal OT cannot easily account for phonologically opaque forms such as 'the seven', [dʏm], even with access to intermediate outputs, as there are not enough available layers in the grammar.

[143] Recall that affixation of the ordinal suffix ^{L}/pɑ/ must occur at the word-level in order to account for word-final [k] deletion in [tʃuk. tʃi] and [tʃi]. Without this ordering through the strata *[tʃuk. tʃik. bɑ] and *[tʃu. tʃik. bɑ] would be inaccurately predicted as optimal outputs.

[144] In fact, the only real difference between the two analyses lies in how they account for the phonologically opaque word [dʏm], 'the seven'. While the cophonologies approach requires an extra constraint, MAX$_{morph}$, in order to side-step the opacity issue, Stratal OT relies on phrase-level phonology to account for the output (but does not require an extra constraint). Thus, both analyses have their own issues in regard to this output.

CHAPTER 7

CONCLUSION

This study has provided an Optimality Theoretic analysis of some aspects of Dzongkha phonology. To start, I examined the relationship between onsets and tone. In Chapter 3 I stated that tone is lexical as it is contrastive after sonorant initials and I posited that voiced obstruent/breathy vocalic onsets are the allophonic variants of their less marked counterparts, occurring only in the low tone. In order to account for this allophonic variation in OT, my analysis is such that faithfulness to input tone (i.e. IDENT-IO(tone)) and avoidance of the context-specific markedness constraint on voiceless obstruent/plain vowel onsets occurring in syllables with low tone (i.e. $*^{L}\text{-VOI}]_{\sigma}$ and $*^{L}V_{onset}]_{\sigma}$) take priority over avoidance of the general markedness constraint on voiced obstruents and breathy vowels (i.e. VOP and *V̤). Importantly, all of these constraints dominate faithfulness to input onset voicing and vowel quality (i.e. IDENT-IO(voice) and IDENT-IO(Vqual)).

The remainder of the thesis addressed the variable means of complex onset simplification and the variable treatment of coda [k] present in my consultant's dialect. In this portion of the study I focused mostly on the Dzongkha decimal system as it provided ample evidence of these phenomena; however, I also applied my analysis to non-numeric data where available. Two separate analyses of the data were provided using different approaches within OT: the cophonology approach and Stratal OT.

Initially, I organized the data such that decimals of the structure 'units' + 'power of ten' were analyzed as phonological words (referred to as the "morphological decimals") and that decimals of the structure 'power of ten' + units were analyzed as compounds (referred to as the "compound decimals"). Under this organization, the morphological decimals exhibit variable complex onset simplification through resyllabification or deletion of the first segment and variable parsing of coda [k]. In contrast, the compound decimals exhibit simplification of complex onsets through deletion of the first segment, and coda [k] is never parsed. Notably, while the teens are of the structure 'ten' + units (i.e. that of the compound decimals), I chose to categorize them as phonological words as they exhibit prefix resyllabification (although occurring variably with prefix deletion), which does not occur in the compound decimals.

Under this original organization of the data, I proposed a cophonology approach made up of two separate phonological subsystems within Dzongkha: one applying to phonological words, called the Phonological Word Cophonology and another applying to affixed constructions, called the Compound/Affixation Cophonology. In order to account for the variable treatment of complex onsets in the teens and variable treatment of coda [k] in the ten thousands and hundred thousands, I developed an analysis in which variation was the result of these numbers being indexed to a node within the Phonological Word Cophonology where MAX, $\text{MAX}_{CV\sigma}$, SYLLDEPENDENCE, and $*k]_\sigma$ were not ranked in relation to one another.

Upon reexamination of the data, however, I was able to simplify the analysis. This was accomplished by organizing the numbers according to treatment of coda [k] and complex onsets instead of organizing them according to structure, as was done before. Thus, where the teens, ten thousands, and hundred thousands parse coda [k] or exhibit simplification of complex onsets through resyllabification, the form is understood as functioning as a single phonological word and, thus, is indexed to the Phonological Word Cophonology. In contrast, where the teens, ten thousands, and hundred thousands delete a coda [k] or delete the first segment of a complex onset when the preceding morpheme is coda-less, the form is functioning as a compound made up of separate phonological words and is associated with the Compounding/Affixation Cophonology. Thus, under this analysis variation is now understood to arise not out of unranked constraints, but out of one meaning being associated with two different constructions. Moreover, the analysis is simplified: there is no longer any evidence of the necessity of $*k]_\sigma$.

The other approach used in this thesis is Stratal OT. Following the same ranking established for phonological words under the cophonologies approach, this analysis is also able to account for variable means of complex onset simplification and the variable treatment of coda [k]. Thus, the optimal output of the stem-level phonology will always parse word-medial coda [k] and resyllabify the first segment of a word-medial complex onset. This is seen specifically in bimorphemic/disyllabic lexicalized compounds (e.g. ‘ten thousand’

^{H}/ktʃik/ + ^{H}/ʈ^{h}i/, [tʃik. ʈ^{h}i], and ‘fourteen’ ^{H}/ptʃu/ + ^{L}/pʃi/, [tʃup. ʒi]). However, where a coda [k] or complex onset occurs at the word margins, deletion of the coda [k] and/or of the first segment of the complex onset will occur. This is seen in monomorphemic/monosyllabic phonological words (e.g. ‘one’ ^{H}/ktʃik/, [tʃi] and ‘four’ ^{L}/pʃi/, [ʒi]).

In order to form the non-lexicalized compound decimals, the output of the stem-level phonology is run through the word-level morphology, forming constructions such as ‘ten thousand’, (^{H}/tʃi/ # ^{H}/ʈ^{h}i/) [tʃi. ʈ^{h}i], and ‘fourteen’, (^{H}/tʃu/ # ^{L}/ʃi/) [tʃu. ʒi]. Notably, prefix resyllabification and coda [k] are not attested in these forms as they have been eliminated by the stem-level phonology. Thus, variation in Stratal OT arises out of one word being constructed at two different strata of the grammar, as demonstrated here.

The cophonologies approach and Stratal OT offer very similar analyses. In fact, proponents of the cophonology approach state that it is not incompatible with Stratal OT (Anttila 2002) and, moreover, that Stratal OT “can be characterized as a very restrictive version of cophonology theory” (Inkelas 2008: 5). There is, however, a subtle difference in these approaches. Under the cophonologies approach, the number of possible cophonologies within a language is confined by the constraints which are unranked in the master ranking; therefore, there is a finite, but not overly restrictive, number of possible cophonologies within a language. In contrast, Stratal OT is much more restrictive, only allowing for three different phonologies within the grammar; however, the individual levels in Stratal OT are not confined by a master ranking. As such, the ranking between strata can vary radically.[145]

[145] In regard to the specific analyses that each approach offers, they vary only in how they handle phonological opacity in [dʏm], ‘the seven’. While the cophonologies approach lends itself to intermediate outputs, these outputs must obey the general ranking of the language. Since the ranking of *COMP above MAX is part of the general phonology of Dzongkha, the intermediate form *[dʏmp] is not possible; therefore, the environment leading to opacity cannot be derived. This does not mean that the cophonologies approach cannot account for [dʏm], however. Instead, the analysis requires an additional constraint: MAX$_{morph}$.

On the other hand, Stratal OT accounts for this form through intermediate outputs which are not constrained by the general phonology of the language; thus, *[dʏmp] is a possible output under this approach. Importantly, however, as affixation leading to this form occurs at the word-level, the form must be simplified in the phrase-level phonology. Clearly this is an issue for Stratal OT as [dʏm] is a word and not a phrase. Thus, the restrictiveness of this analysis (i.e. only allowing three layers in the grammar) is problematic; at least in Dzongkha, there are not enough layers in the grammar to accurately handle opacity, one of the purported advantages of the approach.

While this study has examined two different Optimality Theoretic approaches to variation in Dzongkha, there are certainly other approaches that can be applied to the data. For example, Stochastic OT is also commonly used in cases of variation. In this approach "constraints are ranked on a numerical scale" (McCarthy 2008: 263). At the time of evaluation "a random positive or negative value ('noise') is temporarily added to the ranking value of each constraint" (Anttila 2007: 532). This noise may change the ranking, leading to a different output. The benefit of such an approach is that it has proven to be quite accurate at predicting probable outcomes of variants (Anttila 2007: 532, McCarthy 2008: 263). However, as discussed in Chapters 2 and 5, probabilistic analyses require the availability of corpus data in order to affirm the accuracy of such an analysis. Thus, future research on Dzongkha using Stochastic OT is likely far off in the distance.

In addition to further research within the realm of variation in Dzongkha, there are also many other phonological phenomena which have yet to be analyzed. For example, a diachronic analysis of the process of disyllables simplifying to monosyllables (as discussed in Chapter 2) could be addressed. Or, sticking with historical linguistics, future research could examine the diachronic processes leading to vowel fronting before dentals (also discussed in Chapter 2). In addition, although I did not come across many examples, I did see some evidence of stop fricativization in fast speech. This could be yet another path of future research. The possibilities are nearly limitless as there has been relatively little analytical work done on the language.

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APPENDIX A

A COMPARISON OF THE DZONGKHA AND TIBETAN INTERMEDIATE TENS

Table A.1. Intermediate Tens: The Twenties

	Dzongkha	Tibetan[146,147]		
	Consultant Output Forms[148]	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
21	tsɑ. tʃi	tsa. tɕi	tsak. tʃik	tsʌq. tʃiː
22	tsɑ. ɲi	--	tsag. ɲiː	tsʌŋ. ɲiː
23	tsɑ. sum	--	tsak. sum	tsʌq. sum ~tsaq. som
24	tsɑ. ʒi	--	tsap. ʃi	tsʌp. ʃi
25	tsɑ. ŋɑ	--	tsa. ŋa	tsɛː. ŋa
26	tsɑ. ɖu	--	tsa. ʈuk	tsʌ. ʈuː
27	tsɑ. dʏn	--	tsab. dỹː	tsʌp. tỹː
28	tsɑ. gɛ	--	tsab. gʲɛ	tsap. kɛː
29	tsɑ. gu	tsa. ku	tsa. gu	tsʌr. qu ~tsʌː. qu

[146] There is some disagreement in the transcription of Tibetan numbers, so three sources are used.

[147] Keeping with the transcription used throughout this paper, I indicate allophonic obstruent voicing instead of tone in the Tibetan transcriptions (which I have also translated into IPA). The exception to this is Roerich and Lhalungpa (1972) which do not indicate tone, but do transcribe using obstruent voicing. It is important to note that Tournadre and Dorje (2003: 432) state that "one of the phonological features of Standard Tibetan is the absence of a clear opposition between voiced and voiceless consonants. *In a high tone*, all consonants are voiceless, whereas in a low tone we find slightly aspirated voiced consonants as well as partial or complete voicing." While Tournadre and Dorje indicate where an obstruent is clearly voiced in the low tone, they make no such assertion for the phonemes [ɕ] and [ʈʰ]. Thus, voicing is assumed on these consonants in the low tone, which are allophonically [ʑ] and [ɖʰ], respectively; however, their voicing is likely not as clear as with other obstruents.

[148] These forms come from my consultant.

Table A.2. Intermediate Tens: The Thirties

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
31	so. tʃi	so. tɕi	so. tʃik	sʊː. tʃiː
32	so. ɲi	--	so. ɲiː	sʊː. ɲiː
33	so . sum	--	so. sum	soː. som ~ sɔː. som
34	so. ʒi	--	so. ʃi	sʊp. ʃi
35	so. ŋɑ	--	so. ŋa	sɔː. ŋa
36	so. ɖu	--	so. ʈuk	sʊ. ʈuː
37	so. dʏn	--	sob. dỹː	sʊp. tỹː
38	so. gɛ	--	sob. gʲɛ	sɔp. kɛː
39	so. gu	so. ku	so. gu	sʊr. qu ~ sʊː. qu

Table A.3. Intermediate Tens: The Forties

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
41	ʒe. tʃi	ʒe. tɕi	ʃe. tʃik	ʒiː. tʃiː
42	ʒe. ɲi	--	ʃe. ɲiː	ʒiː. ɲiː
43	ʒe. sum	--	ʃe. sum	ʒeː. som
44	ʒe. ʒi	--	ʃep. ʃi	ʒip. ʃi
45	ʒe. ŋɑ	--	ʃe. ŋa	ʒeː. ŋa
46	ʒe. ɖu	--	ʃe. ʈuk	ʒi. ʈuː
47	ʒe. dʏn	--	ʃeb. dỹː	ʒip. tỹː
48	ʒe. gɛ	--	ʃeb. gʲɛ	ʒep. kɛː
49	ʒe. gu	ʒe. ku	ʃer. gu	ʒir. qu ~ ʒiː. qu

Table A.4. Intermediate Tens: The Fifties

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
51	ŋɑː. tʃi	ŋa. tɕi	ŋa. tʃik	ŋʌː. tʃiː
52	ŋɑː. ɲi	--	ŋa. ɲiː	ŋʌː. ɲiː
53	ŋɑː. sum	--	ŋa. sum	ŋaː. som
54	ŋɑː. ʒi	--	ŋa. ʃi	ŋʌp. ʃi
55	ŋɑː. ŋɑ	--	ŋa. ŋa	ŋɛː. ŋa
56	ŋɑː. ɖu	--	ŋa. ʈuk	ŋʌ. ʈuː
57	ŋɑː. dʏn	--	ŋab. dỹː	ŋʌp. tỹː
58	ŋɑː. gɛ	--	ŋab. gʲɛ	ŋap.kɛː
59	ŋɑː. gu	ŋa. ku	ŋa. gu	ŋʌr. qu ~ ŋʌː. qu

Table A.5. Intermediate Tens: The Sixties

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
61	r̠e. tʃi	re. tɕi	re. tʃik	riː. tʃiː
62	r̠e. ɲi	--	re. ɲiː	riː. ɲiː
63	r̠e. sum	--	re. sum	reː. som
64	r̠e. ʒi	--	re. ʃi	rip. ʃi
65	r̠e. ŋɑ	--	re. ŋa	reː. ŋa
66	r̠e. ɖu	--	re. ʈuk	ri. ʈuː
67	r̠e. dʏn	--	reb. dỹː	rip. tỹː
68	r̠e. gɛ	--	reb. gʲɛ	rep.kɛː
69	r̠e. gu	re. ku	re. gu	riː. qu

Table A.6. Intermediate Tens: The Seventies

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
71	døn. tʃi	d^{h}øn. tɕi	tø̃ː. tʃik	d^{h}ỹː. tʃiː
72	døn. ɲi	--	tø̃ː. ɲiː	d^{h}ỹː. ɲiː
73	døn. sum	--	tø̃ː. sum	d^{h}ø̃ː. som
74	døn. ʒi	--	tø̃ː. ʃi	d^{h}yː. ʃi
75	døn. ŋɑ	--	tø̃ː. ŋa	d^{h}ø̃ː. ŋa
76	døn. ɖu	--	tø̃ː. ʈuk	d^{h}ỹ. ʈuː
77	døn. dʏn	--	tø̃ː. dỹː	d^{h}ỹ. tỹː
78	døn. gɛ	--	tø̃ː. g^{j}ɛ	d^{h}ø̃.kɛː
79	døn. gu	d^{h}øn. ku	tø̃ː. gu	d^{h}ỹː. qu

Table A.7. Intermediate Tens: The Eighties

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
81	dʒɑ. tʃi	ɟ^{h}a. tɕi	dʒ^{j}a. tʃik	g^{h}ʌː. tʃiː
82	dʒɑ. ɲi	--	dʒ^{j}a. ɲiː	g^{h}ʌː. ɲiː
83	dʒɑ. sum	--	dʒ^{j}a. sum	g^{h}aː. som
84	dʒɑ. ʒi	--	dʒ^{j}ap. ʃi	g^{h}ʌp. ʃi
85	dʒɑ. ŋɑ	--	dʒ^{j}a. ŋa	g^{h}ɛː. ŋa
86	dʒɑ. ɖu	--	dʒ^{j}a. ʈuk	g^{h}ʌ. ʈuː
87	dʒɑ. dʏn	--	dʒ^{j}ab. dỹː	g^{h}ʌp. tỹː
88	dʒɑ. gɛ	--	dʒ^{j}ab. g^{j}ɛ	g^{h}ap.kɛː
89	dʒɑ. gu	ɟ^{h}a. ku	dʒ^{j}ar. gu	g^{h}ʌr. qu ~ g^{h}ʌː. qu

Table A.8. Intermediate Tens: The Nineties

	Dzongkha	Tibetan		
	Consultant Output Forms	Tournadre and Dorje (2003)	Roerich and Lhalungpa (1972)	Chang and Shefts (1964)
91	go. tʃi	g^{h}o. tɕi	go. tʃik	ɢ^{h}ʊː. tʃiː
92	go. ɲi	--	go. ɲiː	ɢ^{h}ʊː. ɲiː
93	go. sum	--	go. sum	ɢ^{h}oː. som ~ɢ^{h}ɔː. som
94	go. ʒi	--	gop. ʃi	ɢ^{h}ʊp. ʃi
95	go. ŋɑ	--	go. ŋa	ɢ^{h}ɔː. ŋa
96	go. ɖu	--	go. ʈuk	ɢ^{h}ʊ. ʈuː
97	go. dʏn	--	gob. dỹː	ɢ^{h}ʊp. tỹː
98	go. gɛ	--	gob. g^{j}ɛ	ɢ^{h}ɔp.kɛː
99	go. gu	g^{h}o. ku	go. gu	ɢ^{h}or. qu ~ ɢʊː. qu

APPENDIX B

CONTRASTIVE TONE AFTER SONORANT INITIALS

In Dzongkha, tone is contrastive after sonorant initials. Compare two examples of contrastive tone after [l] (van Driem 1998: 91). Tableau B.1 presents an example with underlying high tone.

Tableau B.1.

input: ‘cough’ ^{H} /lo/	IDENT-IO(tone)
a. → ^{H} lo	
b. ^{L} lo	*!W

In contrast, the input seen in Tableau B.2 has an underlying low tone.

Tableau B.2.

input: ‘year’/‘age’ ^{L} /lo/	IDENT-IO(tone)
a. → ^{L} lo	
b. ^{H} lo	*!W

APPENDIX C

SHARED LABIAL PLACE FEATURE BETWEEN CODA [M] AND THE COLLECTIVE MORPHEME

The coda [m] in 'three', ^{H}/ksum/, and the collective morpheme, /p/, share the same place feature; thus, the collective morpheme is not entirely deleted as the [+labial] feature remains (see Figure C.1).

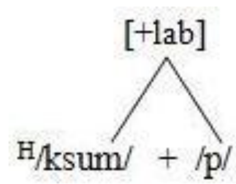

Figure C.1. Shared labial place feature.

APPENDIX D

ADDITIONAL RANKING EVIDENCE

The sample tableaux presented here provide further evidence for rankings not directly established in Chapter 5. The established rankings for the Phonological Word Cophonology are:

(1) *COMP » MAX

(2) *COMP, MAX, CODASTIPULATION$_{word}$ » SYLLDEPENDENCE

(3) CODASTIPULATION$_{word}$, DEP, *C^{unsyll} » MAX, MAX$_{CV\sigma}$.

Thus, it is necessary to show that CODASTIPULATION dominates MAX and MAX$_{CV\sigma}$ and that *COMP ranks above MAX$_{CV\sigma}$.

The examples presented here are somewhat hypothetical; the underlying forms are based on the written form of the word. My reasoning for doing this is to contrive an environment which violates the CODASTIPULATION, as there is no direct evidence of this in the data. Furthermore, in using the spelling forms, I am able to show that *COMP must rank above MAX$_{CV\sigma}$.

Tableau D.1 gives the word *tshod-bsre* [ts^{h}ø. se] 'vegetable' (van Driem 1998: 178). This tableau shows that CODASTIPULATION crucially dominates both MAX and MAX$_{CV\sigma}$ (Cand (b)). In other words, deletion of a coda, even if it is adjacent to a vowel within the same syllable, is preferable to violation of CODASTIPULATION. Thus, the fully faithful candidate, which parses coda [t], is knocked out of the competition.

Tableau D.1.

input: 'vegetable' ^{H}/ts^{h}øt/ + ^{H}/se/	CODASTIP	MAX	MAX$_{CV\sigma}$
a. → ts^{h}ø. se		**	*
b. ts^{h}øt. se	*W!	L	L

Tableau D.2 illustrates the accurate prediction of another hypothetical underlying form, ^{H}/pkɛln/, transliterated as *bkaln* (van Driem 1998: 67). While it has already been established that CODASTIPULATION$_{word}$ ranks above MAX$_{CV\sigma}$ (Cand (e)) and that *COMP ranks above MAX, the important ranking here is that of *COMP above MAX$_{CV\sigma}$ (Cands (b) and (c)). Thus, deletion of a segment which does not meet the constraint on word-final codas and is adjacent to a tautosyllabic vowel is preferable to a complex coda.

Tableau D.2.

input: 'if… send' ^{H}/pkɛln/	CODASTIP$_{word}$	*COMP	MAX	MAX$_{CV\sigma}$
a. → kɛn			**	*
b. pkɛln		*!*W	L	L
c. kɛln		*!W	*L	L
d. pkɛn		*!W	*L	*
e. kɛl	*!W		**	L

Based on the tableaux presented here, the ranking of *COMP above MAX$_{CV\sigma}$ and of CODASTIPULATION above MAX and MAX$_{CV\sigma}$ has been validated (see Chapter 5, Figure 5.10, p. 110).

APPENDIX E

PHONOLOGICAL WORDS AND COMPOUNDS IN THE DECIMAL SYSTEM

Table E.1. Phonological Words vs. Compounds

The Morphological Decimal System			The Compound Decimal System		
Units	1	tʃi	Units	1	--
	2	ɲi		2	--
	3	sum		3	--
	4	ʒi		4	--
	5	ŋɑ		5	--
	6	ɖu		6	--
	7	dʏn		7	--
	8	gɛ		8	--
	9	gu		9	--
Teens	11	tʃuk. tʃi	Teens	11	tʃu. tʃi
	12	tʃuk. ɲi		12	tʃu. ɲi
	13	tʃuk. sum		13	tʃu. sum
	14	tʃup. ʒi		14	tʃu. ʒi
	15	tʃɛ. ŋɑ		15	tʃɛ. ŋɑ
	16	tʃu. ɖu		16	tʃu. ɖu
	17	tʃup. dʏn		17	tʃu. dʏn
	18	tʃop. gɛ		18	--
	19	tʃʏ. gu		19	tʃʏ. gu
Tens	10	tʃu. t^{h}ɑːm	Tens	10	--
	20	ɲi. ʃo		20	--
	30	sum. tʃu		30	--
	40	ʒip. tʃu		40	--
	50	ŋɑp. tʃu		50	--
	60	ɖuk. tʃu		60	--
	70	dʏn. tʃu		70	--
	80	gɛp. tʃu		80	--
	90	gup. tʃu		90	--
Hundreds	100	tʃik. dʒɑ	Hundreds	100	dʒɑ. tʃi
	200	ɲi. dʒɑ		200	dʒɑ. ɲi
	300	sum. dʒɑ		300	dʒɑ. sum
	400	ʒip. dʒɑ		400	dʒɑ. ʒi
	500	ŋɑp. dʒɑ		500	dʒɑ. ŋɑ
	600	ɖuk. dʒɑ		600	dʒɑ. ɖu
	700	dʏn. dʒɑ		700	dʒɑ. dʏn
	800	gɛp. dʒɑ		800	dʒɑ. gɛ
	900	gup. dʒɑ		900	dʒɑ. gu

(Table continues)

Table E.1. (continued)

The Morphological Decimal System			The Compound Decimal System			
Thousands	1,000	tʃik. toŋ	Thousands	1,000	toŋ. ʈʰɑ. tʃi	
	2,000	ɲik. toŋ		2,000	toŋ. ʈʰɑ. ɲi	
	3,000	sum. toŋ		3,000	toŋ. ʈʰɑ. sum	
	4,000	ʒip. toŋ		4,000	toŋ. ʈʰɑ. ʒi	
	5,000	ŋɑp. toŋ		5,000	toŋ. ʈʰɑ. ŋɑ	
	6,000	ɖuk. toŋ		6,000	toŋ. ʈʰɑ. ɖu	
	7,000	dʏn. toŋ		7,000	toŋ. ʈʰɑ. dʏn	
	8,000	gɛp. toŋ		8,000	toŋ. ʈʰɑ. gɛ	
	9,000	gup. toŋ		9,000	toŋ. ʈʰɑ. gu	
Ten Thousands	10,000	tʃik. ʈʰi	Ten Thousands	10,000	ʈʰi. tʃi	tʃi. ʈʰi
	20,000	ɲi. ʈʰi		20,000	ʈʰi. ɲi	ɲi. ʈʰi
	30,000	sum. ʈʰi		30,000	ʈʰi. sum	sum. ʈʰi
	40,000	ʒi. ʈʰi		40,000	ʈʰi. ʒi	ʒi. ʈʰi
	50,000	ŋɑ. ʈʰi		50,000	ʈʰi. ŋɑ	ŋɑ. ʈʰi
	60,000	ɖuk. ʈʰi		60,000	ʈʰi. ɖu	ɖu. ʈʰi
	70,000	dʏn. ʈʰi		70,000	ʈʰi. dʏn	dʏn. ʈʰi
	80,000	gɛ. ʈʰi		80,000	ʈʰi. gɛ	gɛ. ʈʰi
	90,000	gu. ʈʰi		90,000	ʈʰi. gu	gu. ʈʰi
Hundred Thousands	100,000	tʃik. bum	Hundred Thousands	100,000	bum. tʃi	tʃi. bum
	200,000	ɲi. bum		200,000	bum. ɲi	ɲi. bum
	300,000	sum. bum		300,000	bum. sum	sum. bum
	400,000	ʒi. bum		400,000	bum. ʒi	ʒi. bum
	500,000	ŋɑ. bum		500,000	bum. ŋɑ	ŋɑ. bum
	600,000	ɖuk. bum		600,000	bum. ɖu	ɖu. bum
	700,000	dʏn. bum		700,000	bum. dʏn	dʏn. bum
	800,000	gɛ. bum		800,000	bum. gɛ	gɛ. bum
	900,000	gu. bum		900,000	bum. gu	gu. bum
Millions	1,000,000	--	Millions	1,000,000	sɑ. jɑ. tʃi	
	2,000,000	--		2,000,000	sɑ. jɑ. ɲi	
	3,000,000	--		3,000,000	sɑ. jɑ. sum	
	4,000,000	--		4,000,000	sɑ. jɑ. ʒi	
	5,000,000	--		5,000,000	sɑ. jɑ. ŋɑ	
	6,000,000	--		6,000,000	sɑ. jɑ. ɖu	
	7,000,000	--		7,000,000	sɑ. jɑ. dʏn	
	8,000,000	--		8,000,000	sɑ. jɑ. gɛ	
	9,000,000	--		9,000,000	sɑ. jɑ. gu	

(Table continues)

Table E.1. (continued)

The Morphological Decimal System			The Compound Decimal System		
Ten Millions	10 million	--	Ten Millions	10 million	dʒi. wɑ. tʃi
	20 million	--		20 million	dʒi. wɑ. ɲi
	30 million	--		30 million	dʒi. wɑ. sum
	40 million	--		40 million	dʒi. wɑ. ʒi
	50 million	--		50 million	dʒi. wɑ. ŋɑ
	60 million	--		60 million	dʒi. wɑ. ɖu
	70 million	--		70 million	dʒi. wɑ. dʏn
	80 million	--		80 million	dʒi. wɑ. gɛ
	90 million	--		90 million	dʒi. wɑ. gu
Hundred Millions	100 million	--	Hundred Millions	100 million	duŋ. dʒu. tʃi
	200 million	--		200 million	duŋ. dʒu. ɲi
	300 million	--		300 million	duŋ. dʒu. sum
	400 million	--		400 million	duŋ. dʒu. ʒi
	500 million	--		500 million	duŋ. dʒu. ŋɑ
	600 million	--		600 million	duŋ. dʒu. ɖu
	700 million	--		700 million	duŋ. dʒu. dʏn
	800 million	--		800 million	duŋ. dʒu. gɛ
	900 million	--		900 million	duŋ. dʒu. gu

Table E.2. Affixed Phonological Words vs. Affixed Compounds

The Morphological Decimal System			The Compound Decimal System		
Ordinals	1st	daŋ. bɑ	Ordinals	1st	--
	2nd	ɲi. bɑ		2nd	--
	3rd	sum. bɑ		3rd	--
	4th	ʒi. bɑ		4th	--
	5th	ŋɑ. bɑ		5th	--
	6th	ɖuk. bɑ ~ ɖu. bɑ		6th	--
	7th	dɤm. bɑ		7th	--
	8th	gɛ. bɑ		8th	--
	9th	gu. bɑ		9th	--
	10th	tʃu. bɑ		10th	--
	11th	tʃuk. tʃi. bɑ		11th	tʃu. tʃi. bɑ
	12th	tʃuk. ɲi. bɑ		12th	tʃu. ɲi. bɑ
Collectives	the 1	tʃip	Collectives	the 1	--
	the 2	ɲip		the 2	--
	the 3	sum		the 3	--
	the 4	ʒip		the 4	--
	the 5	ŋɑp		the 5	--
	the 6	ɖup		the 6	--
	the 7	dɤm		the 7	--
	the 8	gɛp		the 8	--
	the 9	gup		the 9	--
	the 10	tʃup		the 10	--
	the 11	tʃuk. tʃip		the 11	tʃu. tʃip
	the 14	tʃup. ʒip		the 14	tʃu. ʒip
	the 17	tʃup. dɤm		the 17	tʃu. dɤm
Intermediate Tens	21	tsɑ. tʃi	Intermediate Tens	21	--
	22	ɲer̥. ɲi		22	--
	33	so. sum		33	--
	44	ʒe. ʒi		44	--
	55	ŋɑː. ŋɑ		55	--
	66	r̥e. ɖu		66	--
	66	ɖo. ɖu		66	--
	77	døn. dɤn		77	--
	88	dʒɑ. gɛ		88	--
	99	go. gu		99	--

APPENDIX F

MORPHOLOGICAL TREES OF THE VARIABLE AFFIXED FORMS OF ‘FOURTEEN’

To create affixed forms such as ‘the fourteen’ (which has variable outputs), /p/ may be affixed to the single phonological word [tʃup. ʒi] (as seen Figure F.1) and then run through the Compounding/Affixation Cophonology.

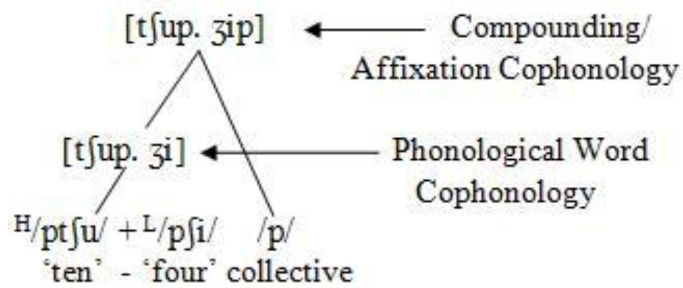

Figure F.1. ‘the fourteen’ as an affixed, single phonological word.

Alternatively, /p/ may be affixed to the compound form (made up of two phonological words), [tʃu. ʒi], and then run through the Compounding/Affixation Cophonology. As seen in Figure F.2, the affixed compound form must run through the Compounding/Affixation Cophonology twice: once to create the compound and a second time for affixation.

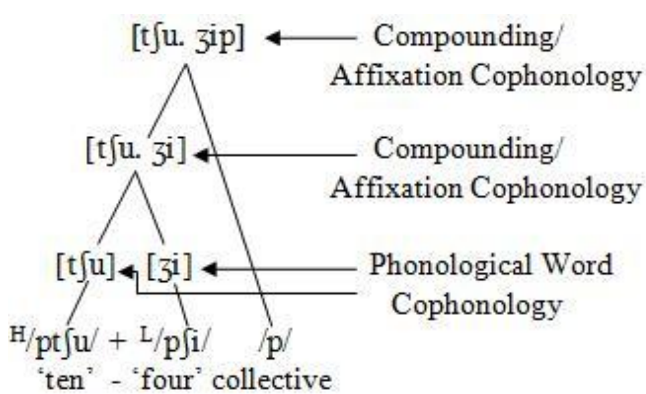

Figure F.2. ‘the fourteen’ as an affixed compound.

APPENDIX G

AN ALTERNATE SOLUTION USING TRADITIONAL OT

Under the current organization of the data (see Appendix E), it is actually possible to avoid the cophonologies approach altogether by using the ranking established for the Phonological Word Cophonology (i.e. MAX ranks above SYLLDEPENDENCE) and adding a constraint against resyllabification across word boundaries. The new constraint is as follows:

Faithfulness Constraint

- **SYLLDEPENDENCE$_{\textbf{word}}$**: Assign one violation mark for every input segment in some syllable that has an output correspondent in a different word.

In doing so, the Dzongkha data can be completely accounted for using a more traditional OT framework. The following tableaux illustrate this.

Tableau G.1 gives the already established ranking for phonological words which leads to word-medial prefix resyllabification. Thus, *COMP ranks above MAX and SYLLD (Cands (b), (d), (e), and (f)) and MAX ranks above SYLLD (Cand (c)). In this example SYLLDEPENDENCE$_{word}$ is not violated as the input is a single phonological word.

Tableau G.1.

input: ‘fourteen’ ^{H} /ptʃu/ + ^{L} /pʃi/	*COMP	SYLLD$_{word}$	MAX	SYLLD
a. → tʃup. ʒi			*	*
b. ptʃu. bʒi	*!*W		L	L
c. tʃu. ʒi			**!W	L
d. ptʃup. ʒi	*!W		L	*
e. ptʃu. ʒi	*!W		*	L
f. tʃu. bʒi	*!W		*	L

Next, Tableau G.2 gives the same input as Tableau G.1; however, the input is constructed of two separate phonological words. Using the same ranking, the optimal output is one that simplifies complex onsets by means of prefix deletion (Cand (a)). This is because resyllabification across a word boundary leads to a fatal violation of the undominated constraint SYLLDEPENDENCE$_{word}$ (Cand (c)). While the ranking of *COMP above MAX and of MAX above SYLLDEPENDENCE has already been established, this tableau provides new ranking evidence of SYLLDEPENDENCE$_{word}$ above MAX (Cand (c)). Thus, although SYLLDEPENDENCE$_{word}$ and SYLLDEPENDENCE are in a stringency relation (i.e. every violation

Tableau G.2.

input: ‘fourteen’ ^H /ptʃu/ # ^L /pʃi/	*COMP	SYLLD$_{word}$	MAX	SYLLD
a. → tʃu. ʒi			**	
b. ptʃu. bʒi	*!*W		L	
c. tʃup. ʒi		*!W	*L	*W
d. ptʃup. ʒi	*!W	*!W	L	*W
e. ptʃu. ʒi	*!W		*L	
f. tʃu. bʒi	*!W		*L	

of SYLLDEPENDENCE$_{word}$ is also a violation of SYLLDEPENDENCE), through transitivity it can be established that SYLLDEPENDENCE$_{word}$ must rank above SYLLDEPENDENCE.

The input of Tableau G.3 is the phonological word ‘eleven’. Just as in Tableau G.1 (p. 158), prefix resyllabification is preferable over prefix deletion as SYLLDEPENDENCE ranks below MAX. Moreover, resyllabification does not lead to a fatal violation of SYLLDEPENDENCE$_{word}$ under this construction. The rankings presented in this tableau are the same as those established in Tableau 5.7 (p. 91): *COMP dominates MAX and SYLLDEPENDENCE (Cands (d) and (f)); MAX ranks above SYLLDEPENDENCE (Cand (c)); and CODASTIPULATION$_{word}$ crucially dominates MAX, MAX$_{CV\sigma}$, and SYLLDEPENDENCE (Cand (e) and (g)).

Tableau G.3.

input: ‘eleven’ ^H /ptʃu/ + ^H /ktʃik/	CODA STIP$_{word}$	SYLLD word	*COMP	MAX	MAX$_{CV\sigma}$	SYLLD
a. → tʃuk. tʃi				**	*	*
b. ptʃu. ktʃik	*!W		**W	L	L	L
c. tʃu. tʃi				***!W	*	L
d. ptʃuk. tʃi			*!W	*L	*	*
e. tʃu. tʃik	*!W			**	L	L
f. ptʃu. ktʃi			*!*W	*L	*	L
g. tʃuk. tʃik	*!W			*L	L	*

The input of Tableau G.4 is also ‘eleven’; however, the construction is such that it is a compound made up of two separate phonological words. Thus, under this construction

Tableau G.4.

input: 'eleven' H /ptʃu/ # H /ktʃik/	*COMP	SYLLD word	CODA STIP$_{word}$	MAX	MAX$_{CV\sigma}$	SYLLD
a. → tʃu. tʃi				***	*	
b. ptʃu. ktʃik	*!*W		*W	L	L	
c. tʃuk. tʃi		*!W	*!W	**L	*	*!W
d. ptʃuk. tʃi	*!W	*!W	*!W	*L	*	*W
e. tʃu. tʃik			*!W	**L	L	
f. ptʃu. ktʃi	*!*W			*L	*	

complex onsets cannot simplify via resyllabification. In fact, Cand (c), which resyllabifies prefix [k], is harmonically bounded under the compound construction by Cand (e).[149]

Moving on to the morphological construction of 'eleventh' (Tableau G.5), we see that the optimal candidate is correctly predicted when MAX ranks above SYLLDEPENDENCE. This ranking is necessary in order for resyllabification to occur. It is important to note here, however, that the ordinal morpheme ^{L}/pɑ/ is understood here as a separate phonological word instead of an affix. Without this distinction, *[tʃuk. tʃik. bɑ] (Cand (e)) would be incorrectly predicted as optimal, as coda [k] in ^{H}/ktʃik/ does not lead to a violation of CODASTIPULATION$_{word}$ (and, moreover, Cand (a) would be harmonically bounded by Cands (d) and (e)). Importantly, however, the ordinal morpheme does not occur in isolation and, thus, should be analyzed as an affix and not a word. Clearly, making such an exception in order to account for the data poses a problem for a completely parallel analysis.

The input of Tableau G.6 is the compound 'eleventh'. The input is different from Tableau G.5, however, as the compound is made up of three separate words. (The input of Tableau G.5 is made up of only two separate words.) Under the established ranking, [tʃu. tʃi. bɑ] is correctly predicted as the optimal output. Interestingly, SYLLDEPENDENCE$_{word}$ does not play a crucial role in prediction of the optimal candidate. This is due to CODASTIPULATION$_{word}$ assigning fatal violation marks to all candidates with a coda [k], whether underlying or resyllabified, as they all occur in word-final position. As with Tableau

[149] The harmonically bounded candidate, Cand (c), has been left in for illustrative purposes.

Tableau G.5.

input: 'eleventh' H/ptʃu/ + H/ktʃik/ # L/pɑ/	*COMP	SYLLD word	CODA STIP$_{word}$	MAX	MAX$_{CV\sigma}$	SYLLD
a. → tʃuk. tʃi. bɑ				**	*	*
b. ptʃu. ktʃik. bɑ	*!*W		*!W	L	L	L
c. tʃu. tʃi. bɑ				***!W	*	L
d. tʃu. tʃik. bɑ			*!W	**	L	L
e. tʃuk. tʃik. bɑ			*!W	*L	L	*
f. ptʃu. ktʃi. bɑ	*!*W			*L	*	L
g. ptʃuk. tʃik. bɑ	*!W		*!W	L	L	*
h. ptʃu. tʃik. bɑ	*!W		*!W	*L	L	L
i. ptʃu. tʃi. bɑ	*!W			**	*	L
j. tʃu. ktʃik. bɑ	*!W		*!W	*L	L	L
k. tʃu. ktʃi. bɑ	*!W			**	*	L

Tableau G.6.

input: 'eleventh' H/ptʃu/ # H/ktʃik/ # L/pɑ/	*COMP	SYLLD word	CODA STIP$_{word}$	MAX	MAX$_{CV\sigma}$	SYLLD
a. → tʃu. tʃi. bɑ				***!	*!	
b. ptʃu. ktʃik. bɑ	*!*W		*!W	L	L	
c. tʃuk. tʃi. bɑ		*!W	*!W	**L	*	*W
d. tʃu. tʃik. bɑ			*!W	**L	L	
e. tʃuk. tʃik. bɑ		*!W	*!*W	*L	L	*W
f. ptʃu. ktʃi. bɑ	*!*W			*L	*	
g. ptʃuk. tʃik. bɑ	*!W	*!W	*!*W	L	L	*W
h. ptʃu. tʃik. bɑ	*!W		*!W	*L	L	
i. ptʃu. tʃi. bɑ	*!W			**L	*	
j. tʃu. ktʃik. bɑ	*!W		*!W	*L	L	
k. tʃu. ktʃi. bɑ	*!W			**L	*	

G.5, the distinction of the ordinal marker L/pɑ/ as a separate phonological word is crucial to accurate prediction of [tʃu. tʃi. bɑ]. Without this distinction *[tʃu. tʃik. bɑ] (Cand (d)) would be incorrectly predicted as optimal. Again, analyzing an affix as a phonological word in order to account for the data raises a strong argument against a completely parallel analysis.

As illustrated here, I have shown how the Dzongkha data can accurately be accounted for using a more traditional OT framework. While not all constraints are ranked in relation to one another (e.g. there is no ranking evidence between SYLLDEPENDENCE and $\text{MAX}_{CV\sigma}$), the addition of $\text{SYLLDEPENDENCE}_{word}$ has simplified the analysis so that there is only one, parallel constraint ranking necessary to account for all of the data. While a parallel analysis was not possible under the original organization of the data, the new organization allows for an alternative to the cophonologies approach. Importantly, however, a fully parallel analysis is not without its own issues in accounting for the variable forms of 'eleventh'.

APPENDIX H

MORPHOLOGICAL TREE OF THE FULL FORM OF ‘FORTY-FOUR’

Recall from Chapter 2 that the full forms of the intermediate tens are used for prices that are not rounded to the nearest ten. This is done through combining the shortened forms of the intermediate tens (i.e. [ʒe. ʒi]) with the rounded tens (i.e. [ʒip. tʃu]). Below is the morphological structure of 'forty-four', ^{L}/pʃi/ + ^{H}/ptʃu/ + ^{L}/ʃe/ + ^{L}/pʃi/ (Figure H.1):

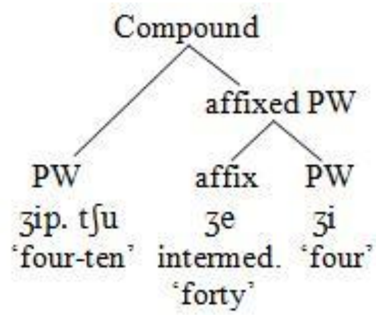

Figure H.1. The full form of 'forty-four'.

APPENDIX I

MORPHOLOGICAL TREES OF THE VARIABLE FORMS OF 'ELEVENTH’

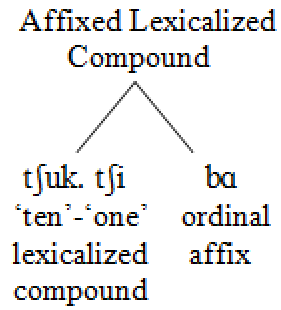

Figure I.1. 'eleventh' as a lexicalized compound.

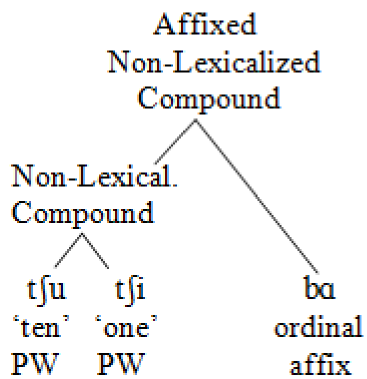

Figure I.2. 'eleventh' as a non-lexicalized compound.