

## Studying emergent tone-systems in Nepal: Pitch, phonation and word-tone in Tamang

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This paper focuses on the particular kinds of difficulties which arise in the study of an emergent tone-system, exemplified by Tamang in Nepal, where pitch, phonation and other laryngeal features combine in the definition of a tone. As a consequence, conducting a well-ordered analysis in stages first of phonetic transcription, then variation in context, then interpretation is not possible. Rather we have to discover the contrasting categories first, and study their phonetic realization next, or do both at the same time. This also leads to questioning the validity of the traditional distinction of features into “distinctive” and “redundant” and proposing instead an analysis of an abstract “tone” as a bundle of cues.

We will only sketch the second characteristic of the Tamang tone system, the extension of tone over the phonological word. The contributions of instrumental studies and of a comparative-historical perspective are discussed.

**INTRODUCTION.** In the present paper the reader will be walked through techniques of fieldwork which a researcher discovered as she was faced with a tone system of an unexpected type. This will be presented largely as a narrative, because in the area of discovery procedures no absolute instructions can be given, only examples and warnings. Here we will provide a few practical and theoretical tools to include in the all purpose toolbox that the fieldworker requires. I will narrate what I did when I encountered an emergent tone system in Nepal, unaware that such systems existed.

Two main characteristics of the Tamang<sup>1</sup> language, which will be our topic, posed particular difficulties in description.

(1) tone categories in Tamang are defined by bundles of laryngeal features, including pitch but also voice quality and mode of articulation, in particular the voicing of initial stops, with some trade-offs between realizations of these features, even in repetitions by a single speaker.

(2) the domain of tone is the word, which commonly has more than one syllable, so that many syllables do not carry a tone of their own, but are part of a polysyllabic word that carries a single tone.

For the descriptor, the characteristics mentioned reduce the functional weight of pitch per se in the phonology, so that at first hearing, Tamang may not “sound like” a tone language. More seriously, the trade-offs between elements (pitch, breathiness, and initial voicing) of the feature-bundles mean that we cannot arrive at a consistent phonetic transcription of any one of them from token to token.

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<sup>1</sup> The initial study was based on the dialect of Risiangku in Central Nepal, East of Kathmandu. This is the dialect which is designated here simply as “Tamang”.

Given this situation, I will outline a method for establishing categories where the distinctive traits are not easily accessible to the analyst. This essentially relies on accessing speakers' linguistic capacity to make distinctions associated with meaningful units, rather than building these distinctions on sets of individually distinctive features. Once the categories are established functionally, we can fruitfully return to the question of their phonetic composition, but this does not magically become straightforward.

We will also note that the typologically uncommon characteristics (1) and (2) turn out to have relatively straightforward diachronic explanations.

Finally, we will summarize recent instrumental studies which have confirmed the variety and variability of the components of Tamang tones<sup>2</sup>.

**1. IS THIS LANGUAGE A TONE-LANGUAGE?** The study of tone languages in the field may present interesting problems and difficulties at many levels. One of these is Hyman's (2010) procedural stage III, abstract analysis and interpretation. But problems may arise much earlier, at Hyman's stage I: phonetic transcription of what is suspected to be tone. In that case, as often in linguistic fieldwork, transcription, analysis, and interpretation have to be done all at once.

When I first went to Nepal as a doctoral student in the spring of 1969 to study Tamang, a language belonging to the Sino-Tibetan family<sup>3</sup>, I had some previous experience working on the Chinese dialect of Amoy, a language with seven tones and extensive modification of tone in context, known as tone-sandhi.

In beginning fieldwork on a new language, I expected to have some difficulties identifying and analyzing tones if there were any, but I did not expect to ask myself the question: is this a tone language? But this is what happened. And this uncertainty lasted for the first three months of my work, notwithstanding the fact that I was actively looking for tones<sup>4</sup>. There were melodic movements in sentences, but these did not sound so different from the intonations of my native French<sup>5</sup>. There were none of the abrupt ruptures in pitch, as in Vietnamese or any dialect of Chinese, which make it impossible to ignore that something

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<sup>2</sup> Helpful comments are gratefully acknowledged from participants in the Berkeley Tone Workshop, three reviewers, Boyd Michailovsky and Alexis Michaud. A. Michaud who was responsible for the phonetics part of our 2008 joint paper, also kindly drew all the necessary figures for the present paper.

<sup>3</sup> Tamang has been correctly classified by Robert Shafer (Shafer 1955) in a branch of what he called the Bodish section of the Bodish division of Sino-Tibetan. The Bodish section, which concerns us here, splits into a Bodish branch, comprising Tibetan (Bod means « Tibet ») and its many dialects, and a Tamang (alias Gurung) branch, which I have designated in my publications by the initials of its main members Tamang-Gurung-Thakali-Manangke (TGTM). This branch has been also referred to under the name « Tamangic » in other publications.

<sup>4</sup> R. K. Sprigg had kindly given me access to his fieldnotes from fieldwork he had conducted fifteen years earlier on the verb phrase in Tamang. In that unfinished study he had tentatively noted three tone patterns on verb phrases.

<sup>5</sup> Transcribed samples of spontaneous Tamang speech are available for listening in the Pangloss Collection ([http://lacito.vjf.cnrs.fr/archivage/languages/Tamang\\_en.htm](http://lacito.vjf.cnrs.fr/archivage/languages/Tamang_en.htm)). Readers are invited to compare their auditory impressions of these with their expectations of a tone language.

other than intonation is going on. There were melodic movements on individual words elicited in basic word lists, which I tried to mark as tones, but these were overridden by strong continuation or final intonation patterns. The remaining lexical difference if any was heard as a minor variation on the intonation pattern. Variation between repetitions of the same word was wide.

As I was transcribing words and sentences, and working simultaneously on other aspects of the phonology, vowel timbres, length, final consonants, places of articulation, and the opposition of aspiration on initial voiceless stops all fell into place. But there were other elusive features besides pitch: there was a strange hollow-sounding voice on some words, which I transcribed with an “h” somewhere in the syllable, not always in the same place, and I also had difficulty deciding if some occlusive initial consonants were voiced or not – an unexpected difficulty for a native French speaker. So I concentrated on transcribing these other features as best as I could, and getting those, at least, fixed for each word. I could not do that either. The h’s which I used to transcribe the hollow voice kept moving around, before the vowel, after the vowel, and sometimes disappeared altogether in repetitions of the same word. Some words which I had transcribed with a voiced stop initial had a completely voiceless initial the next time around, while some words, it seemed, never had a voiced initial. The three elements, pitch, phonation, and voicing of initial stops remained elusive.

My approach would be to try to get at speakers’ phonological categories, regardless of their phonetic transcription. Most of my language consultants were unschooled, and did not write. Those who did wrote in the Indo-Aryan national language, Nepali, a toneless language. They had never reflected on distinctivity or homonymy. Discovering minimal pairs was my job, not theirs.

Before explaining how I proceeded to sort out the tones of Tamang, or, as it turned out, the three problematic features that participate in Tamang tones, I want to insist on the fact that this is not a problem of interpreting the relationships between defined, partially interacting features, some of which could be assigned (or not) to tones. This kind of problem has given rise to the multiple tonal analyses proposed for Lhasa Tibetan, a language closely related to Tamang, which I will present briefly as a point of comparison.

**2. WHAT CAN BE IN A TONE?** Minimally, we can suspect the presence of tone in a language if at least some use of pitch differences is made to differentiate words. Some researchers equate tone with pitch. In Asian languages, other features are often considered as part of the characteristics of a tone, for instance the creaky voice of Mandarin Chinese third tone, a final glottalization on two of the tones of Lahu (Matisoff 1973: 21), and on one of the Vietnamese tones (Michaud 2004), breathiness and length<sup>6</sup> on the second or “heavy” tone of Burmese (Gruber 2011:7), sometimes also described as pronounced “with greater emphasis” (Cornyn and Roop 1968), and so on. Such other-than-pitch features are most often described as idiosyncratic characteristics of specific tones.

In some languages, it is a matter of analysis whether these other-than-pitch features are considered as part of the tones’ definitions or as independent orthogonal phonological ele-

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<sup>6</sup> Length is also claimed for the low tone by a number of authors see Gruber 2011 for a comprehensive summary; Watkins 2001 includes recordings.

ments. In Lhasa Tibetan, it is possible to propose various analyses of the tonal system, with from 2 to 6 tones according to Hu Tan's survey of existing analyses (Hu 1982), depending on such decisions. Pitch differences, in Lhasa Tibetan, are easy to hear: the beginning of a word is either High or Low, and the end of a word is either (high) falling or (high) level<sup>7</sup>. On a monosyllable this yields four melodies<sup>8</sup>. Are these four tones? This is a possible analysis, and presently the most commonly accepted one. It can be noted though that on open syllables the falling pitch is associated with a final glottal catch, if not a full glottal stop (often followed by an echo of the vowel). So several authors, Sprigg (1955) for example, have proposed an analysis of Tibetan in terms of two tones, High and Low, with the glottal stop, analyzed as a consonantal phoneme, responsible for a drop in pitch (an effect which the rare final stops also have). Vowel length is also found to differentiate words. This has been analyzed either as a characteristic of some tones, or as a feature of the vowel system. Hu Tan (1982) presents over a dozen analyses of Lhasa Tibetan tones, and retains three classes of analysis, each of which can account accurately for the suprasegmental distinctions in a Tibetan word, given the proper statements of restriction in co-occurrence of some features: six tones, with no independent vowel length or glottal phoneme; four tones either including the glottal in the tone, or including the length in the tone; two tones, with anything else than the High and Low beginning of words pushed back into segmental phonology<sup>9</sup>. All of these choices have been defended by different authors. The "non-uniqueness of phonemic solutions to phonetic problems" (Chao 1966) applies to tones too. Appendix 1 gives a summary of the analyses proposed.

In Tamang, the problem was not simply a matter of interpreting the relationship of different features. Phonetic variation was such (as I will detail below in section 8 with some instrumental evidence) that a reliable phonetic transcription across individual tokens seemed out of reach. So how to proceed?

### 3. WHAT TO DO IF DIFFICULTIES START WITH "STAGE I", BASIC TRANSCRIPTION?

If you cannot reach a reliable phonetic transcription directly, you can still establish phonological categories. I used two methods to help myself and the native speaker discover pertinent differences. The first is classical in all aspects of phonological work, not only tone, and needs little explanation: it consists in finding words of different meanings which differ minimally by the feature (or set of features) which escapes you, that is minimal pairs. The second is the frame and lists method, which I will dwell on a little longer. A third method consisting in asking the consultant for a metalinguistic opinion can be excellent, but is not always possible, as Stephen Morey explains elsewhere in this volume.

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<sup>7</sup> These remarks are based both on the extensive literature (see Hu 1982, or Chang and Shefts 1978-1981, and references therein) and on my own experience. See also (Sun 1997).

<sup>8</sup> On polysyllabic words four melodies are also found since internal syllables of a word are all high level.

<sup>9</sup> An extreme analysis where the tonal system is reduced to zero by positing diachronic derivations as if they were synchronic rules will not be considered here (Kjellin 1975).

**3.1 PRESUMED MINIMAL PAIRS.** Although the use of minimal pairs is standard, it should be emphasized that it is not straightforward. Determining whether two words are homophonous or not is already a sophisticated metalinguistic judgment which a naive speaker cannot necessarily make without error. Nevertheless, in the course of elicitation, I progressively obtained a number of pairs like /<sup>3</sup>maŋ/ ‘ghost’ vs /<sup>4</sup>maŋ/ ‘dream’ (I write the tone by an abstract number), which could be used to test new words against. I choose this example on purpose: when you start working, you might wonder if ‘ghost’ and ‘dream’ are not two meanings of the same word. This kind of hesitation is part of the progressive cleaning up of first impressions. A few triplets and one quadruplet were not found until the analysis was actually completed, when they were actively hunted for in order to demonstrate the oppositions.

This method consists in comparing words which are presumed to be different. The second method consists, on the contrary, in bringing together words that are presumed to share a given feature.

**3.2 FRAME AND LIST METHOD.** The second method was taught to me by Kenneth Pike, who happened to be in Kathmandu at the time I was finishing my first three months of fieldwork. Members of the SIL were at that time engaged in the description of a dozen languages of Nepal, and some were confronted with the same difficulties as I was in the languages they dealt with. Pike, the author of *Tone languages* (Pike 1948) the reference work of the time, was familiar with many types of tones, but not with these. He nevertheless recommended that we use techniques appropriate to revealing tonal contrasts to study these languages. We worked with ears, pencil, papers, a tape-recorder, and many repetitions of data by native speakers<sup>10</sup>. Pitch extraction and other instrumental techniques were unavailable under the circumstances.

The method has two aspects: the frame, and recording in lists.

The first aspect of the method consists in placing each word in a frame, as is commonly done for any type of tones. A single frame is not sufficient, since we know that words of the frame can influence the pronunciation of the word studied, by tone-sandhi. So we need to use a set of frames, where the tones of the words on each side of the item studied represent the full set of existing tones in the language. And since we do not know yet what this set is, this implies a large amount of trial and error to identify frames which bring out as clearly as possible the differences in tone category in the target words. When pitch differences are subtle, the tones of the framing words serve as reference points in listening to the tone of the word studied. This is useful in listening to presumed minimal pairs as well.

For simplicity, I started with monosyllabic morphemes. In many languages of Asia, there would be no choice since most morphemes are monosyllabic. In Tamang half the nouns and all the verb stems are monosyllabic.

Recording in lists, as a method, aims at sorting all of the vocabulary with reference to the feature under study. Let us call it tone or “toneme” even though we suspect that pitch is only one of its phonetic characters. The method consists in establishing a preliminary classification of all the words according to the initial hypothesis. Let us say we start with

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<sup>10</sup> I recall with gratitude the help of Austin Hale, who was then working on Newari, a non-tonal language, and who took time to help me listen to endless lists of words in frames.

the hypothesis of two tones, High and Low. Because we know that the segmental make up of a word can have a strong influence on the pitch, we will sort each of the two lists by subgroups (open vs closed syllables, consonant clusters, nasal vs liquid vs stop initial consonants, aspirate vs non aspirate, vowel timbres etc). Because nouns and verbs can hardly fit in the same slot in a grammatical construction or an intonational curve, they will also be sorted separately.

The language consultant is then asked to pronounce the whole list of words of hypothesized tone H in a given frame. Before computers and their convenience for editing sound, the recording was done without intervening material (without announcing the meanings on the tape<sup>11</sup>). This was done to help the researcher pick out, in a monotonous list of identical melodies, the one which sticks out. The word which sticks out is removed from the list of “H” and inserted in the list of “L”. The list of hypothesized “Low” is re-recorded with the words which have been eliminated from the “H” list. If that placement is unsatisfactory too, more classes of presumed tones may have to be tested. After many rounds of sorting, re-recording, and adjusting the number of classes, homogeneous lists are arrived at. In the case of Tamang, I arrived at four lists, that is four presumed tonemes.

To give a concrete example: one of the early frames used was the following for nouns: /<sup>2</sup>cu \_\_-ri <sup>1</sup>mula/ ‘it is in/on the \_\_’. The lists recorded in that frame would be ordered by initial consonant type and syllable structure: First non-aspirated continuant initials with CV structure:

<sup>2</sup>cu <sup>1</sup>la-ri <sup>1</sup>mula ‘it is in the god’;  
<sup>2</sup>cu <sup>1</sup>me-ri <sup>1</sup>mula ‘...in the fire’;  
<sup>2</sup>cu <sup>1</sup>ra-ri <sup>1</sup>mula ‘...on the goat’ etc,

then CVV : <sup>2</sup>cu <sup>1</sup>mee-ri <sup>1</sup>mula ‘it is in the tail’ etc;

then aspirated initials in CV structures:

<sup>2</sup>cu <sup>1</sup>phi-ri <sup>1</sup>mula ‘it is in the peel’;  
<sup>2</sup>cu <sup>1</sup>pha-ri <sup>1</sup>mula ‘...husband’, etc.

Lists of presumed tone 2 were constituted in the same way:

<sup>2</sup>cu <sup>2</sup>ne-ri <sup>1</sup>mula ‘it is in the pilgrimage place’;  
<sup>2</sup>cu <sup>2</sup>le-ri <sup>1</sup>mula ‘...on the tongue’, etc.

Supposing that the word /ra/ ‘goat’ appeared not to fit in the list of tone 1 words, the sentence <sup>2</sup>cu <sup>2</sup>ra-ri <sup>1</sup>mula, now presumed to include a tone 2 target word, would be re-recorded inserted in the list of presumed tone 2 words, some place in the vicinity of /<sup>2</sup>ne/ ‘pilgrimage place’ and /<sup>2</sup>le/ ‘tongue’. As you go, you notice which segmental characters

<sup>11</sup> A corollary of this constraint was that you needed to keep very good notes on your recordings. There is no reason nowadays to avoid recording the prompt that the researcher gives to the speaker for each sentence.

(aspiration, vowel length etc) seem to influence the homogeneity of a list; and you take this into account in composing new lists.

One interesting aspect of this method is that it seems to stimulate the phonological awareness of the speaker. The speaker is normally asked to repeat each sentence three times<sup>12</sup>. This is done for all the words suspected of having a given tone. If after the twenty-fifth sentence of the same pattern, there arrives a twenty-sixth sentence with a word of a different tone, the speaker is very likely to pronounce it wrongly on the first utterance, giving the word the same tone as the previous words in the list. But that mistake wakes him up from his boredom, and he will give the second repetition with the correct tone, exaggerating it. This is the time when the speaker and the researcher learn together what is distinctive. These field techniques can be considered as a sort of psycholinguistic experiment: none of the results of each technique is definitive, several different techniques need to be used to converge on the question studied. A side remark on this is that material which was elicited and recorded with a certain question in mind should not be used indiscriminately to study a different question. If you have provoked your informant to make a mistake, don't include that token in later statistics.

**3.3 QUALITY OF THE FRAME.** To finish with the frame method, the plain “say X again” frame, which is so familiar in phonetics labs, is very unsatisfactory. For one thing, it is likely to produce a pause in intonation before the quotation, which destroys the benefit of having a frame. Secondly, in many languages, the word in such a frame will be either utterance initial or final. In the best of cases it gives only one position in the intonation curve. The example which we gave in the preceding paragraph was also not perfect. In Tamang, any noun phrase can be deleted if it is determinate; you need not mention what is well-known. As it happens, the demonstrative pronoun ‘this’ and the demonstrative adjective ‘this’ are both expressed by /<sup>2</sup>cu/. So the sentences above can be parsed in two different ways, with a resulting difference in intonation either as:

- (1) [<sup>2</sup>cu]    [<sup>1</sup>me-ri] [<sup>1</sup>mula]  
           this    fire-in is  
           This is in [the] fire

or

- (2) [∅]    [<sup>2</sup>cu    <sup>1</sup>me-ri] [<sup>1</sup>mula]  
           [it]    this    fire-in is  
           [It] is in this fire.

Studying phonology independently of other aspects of an undescribed language is hardly possible. You will probably be collecting at least some grammatical material, and running texts are the best for this. Chance can help you then. For Tamang verbs I discovered, in texts which I was collecting and transcribing while studying the phonology, a

<sup>12</sup> Repeating three times is a way of ensuring against mistakes and of controlling for paragraph intonation inside the list.



frame where the same verb occurred three times, in initial, internal and final position in the sentence.

- (3) Ikra-ma Ikra-ma 3la:nan Ikra-ci  
 cry-ing cry-ing much cry-Past  
 She cried her heart out.

It turned out that most verbs could fit in this construction. This became my pet frame, although not by any means the only one. I could not find such an excellent frame for nouns. And this is how, for Tamang, I am very confident in the tone classification of the verbs, and a little less in that of the nouns, although, like everybody else, I started the elicitations by asking for nouns.

**3.4 CHANGING THE FRAME.** Trying out several frames does not end when you have found the best frame. You may have to run all or most of your material through a set of frames for two reasons: to help you hear better, and to control for possible perturbations due to the frame. Frames are also used of course in order to contrast patterns; if you do not have minimal pairs, words of similar segmental composition can be compared in a frame to ascertain their proper tonal classification and to study the phonetic details.

When the phonetic distance between the tones which you are studying is small, a single frame may not suffice to bring out that difference. Let us take a simple example. Suppose you have a system of four level tones: 1 High, 2 Mid, 3 Lower Mid, and 4 Low (roughly the pitch characteristics of the Tamang tones ignoring contour). Placing a Mid tone between two High tone words will produce a drop in pitch between the frame and the target word, which will help ascertain that the word studied is really Mid rather than High. For instance we can compare

- <sup>2</sup>cu <sup>1</sup>tar <sup>1</sup>ra <sup>1</sup>mula ‘this is a white goat’  
<sup>2</sup>cu <sup>1</sup>tar <sup>2</sup>ta <sup>1</sup>mula ‘this is a white horse’

Placing a Lower Mid target word in the same context will produce a more salient drop. But this same High frame will most likely not be of a great help in distinguishing a Lower Mid from a Low target word; as with

- <sup>2</sup>cu <sup>1</sup>tar <sup>3</sup>mi <sup>1</sup>mula ‘this is a white man’  
<sup>2</sup>cu <sup>1</sup>tar <sup>4</sup>me <sup>1</sup>mula ‘this is a white cow’

To distinguish these two words we will place them in a Lower Mid frame, replacing /<sup>1</sup>mula/ ‘is’ by /<sup>3</sup>papa/ ‘brings’. The syntax of the language does not let you bring into direct contact as many different tones as you would like. In the present example, there is no tone 3 monosyllabic adjective which could replace /<sup>1</sup>tar/.

The second reason for running the material through a set of frames is that the frame



itself may induce modifications<sup>13</sup>. It is necessary to ascertain that the number of classes you have found in a given frame and the membership in those classes remain constant when you change the frame. If not, more classes may be needed, and the rules of change will have to be discovered. Tamang did not offer that type of complexity; some small phonetic modifications were observed from one frame to the next, but the classes — the tonal categories — remained constant.

Note that it is not the case that all tone systems require such methods. A few years later I had the opportunity to study another Tibeto-Burman language, which I collected from a Naxi speaker who was a refugee in Kathmandu. Naxi is spoken in Yunnan, China, and belongs to a different branch of Tibeto-Burman. There, it was very clear after a few sessions of informant work that we had three level tones, High, Mid, and Low, and a Rising tone, with clear pitch differences between them, even in isolation, and no voice quality differences. My informant was prompt to correct me if I missed the tone! That never happened in Tamang.

The reason that such painstaking observation was necessary in Tamang is the interplay of phonetic cues to the identification of a Tamang tone, which leads to a great variability in the realization of each of the phonetic cues taken individually.

**3.5 GETTING SOME METALINGUISTIC HELP FROM YOUR CONSULTANT.** Although my language consultants were very good at finding ways to make me understand subtleties of word meanings<sup>14</sup>, they could not generally be asked for metalinguistic judgments. Concerning tone classification, once the system had been established, I could get some help in placing a new word in the proper tone class by asking my informant to compare it with a pair of words whose tones were already known. This also is rather standard practice. To have a chance of getting a meaningful answer, the target word had to be very close in syllable structure and in segmental composition to the minimal pair of words which I would present as a comparison base. For instance, given a new word like [ḍoŋ] ‘tree’ in which I would have already noted traits characteristic of the low tones, I could ask my consultant which one of the two low tone words /<sup>3</sup>maŋ/ ‘ghost’ and /<sup>4</sup>maŋ/ ‘dream’, she would “put it with”. In doing the comparison she would readily place the word in the different frames which we had arrived at together and repeat to herself the reference words and the candidate in those frames before answering. She could not answer if I suggested comparing a word of a CV structure with the two reference words above. Morey (this volume §3.2.2 about Tangsa) shows that the possibility of making metalinguistic judgments depends not only on personal abilities of consultants, but also on the language.

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<sup>13</sup> As, conversely, the changed target word may induce a modification in the frame. For instance in the examples above, the pitch of /<sup>1</sup>tar/ when preceding the tone 2 of ‘horse’ was higher than when preceding the tone 1 of ‘goat’. An anticipation of the following drop in pitch can be heard already in the increased positive difference in F0 between the first word of the frame /<sup>2</sup>cu/, and the second word of the frame /<sup>1</sup>tar/. Note that such an effect can help identify the tone of the target word.

<sup>14</sup> I worked monolingually in the target language with informants with whom I had no common language since my Nepali, and their Nepali for several of them, was too poor. Their ingenuity at building little stories to illustrate semantics was amazing.

**3.6 THE RESULTING ANALYSIS.** As the lists gained in consistency, the phonological analysis and the phonetic features of each category became clearer. It became clear that pitch alone could not differentiate the tones. There was too much variation in the realizations. Some other characters helped identify the tone. A median separation line in the system between two high and two low tones was recognized, with phonological as well as phonetic correlates, some realized on the vowel and some on the initial consonant.

a) Phonologically, under the two high tones, two series of initial stops are found: voiceless aspirated and voiceless unaspirated. With the lower tones, no aspirated initials are found. The aspiration contrast is neutralized in this context. In terms of our lists, this means that there were only two lists instead of four for morphemes starting with an aspirate.

b) Phonetically, the single series of occlusives occurring under the two lower tones (the archiphonemic series for those who use this concept) is pronounced all the way from fully voiced to fully voiceless (unaspirated), apparently at will. This will be exemplified in the instrumental analysis section (see figure 6 and linked sound).

c) Breathy voice occurs with the two low tones in varying degree.

d) Among the high tones, and among the low tones, the distinction of tones 1 vs 2 and of 3 vs 4 depends on pitch (melodic) differences.

e) Although a phonological contrast exists between long and short vowels, a duration difference can also be listed as a character of tone. Tone 1 is shorter than the other tones, so that a long vowel under tone 1 has about the same length as a short vowel under tone 2. (On the complex relations of tone and quantity, see Remijsen, this volume) Figure 1, illustrating word-tone, shows that the brevity of the tone 1 root is actually manifested on the totality of the root + suffix word.

<i>tones</i>	<i>pitch</i>	<i>phonation of vowel</i>	<i>laryngeal character of C<sub>initial</sub> stop</i>	<i>aspiration contrast on C<sub>initial</sub> stop</i>
1, 2	Higher /1/ [54] /2/ [44]	more modal	voiceless	yes
3, 4	Lower /3/ [23] /4/ [21]	more breathy	can be voiced	no

TABLE 1. Phonetic and phonological correlates of tone in Tamang

**3.7 STUDYING RELATED LANGUAGES AND DIALECTS.** Up to now we have concentrated on the procedures used when no previous work exists on the language, or the language group, or languages of that type. Nepal had timidly opened to foreign visitors less than twenty years before, and nothing had been published on the Tamang group since the 1909 volume of the Linguistic Survey of India, except for 8 pages by Burton-Page on Gurung (Burton-Page 1955). When I turned to studying other languages and dialects of the group, it was not necessary to repeat the whole procedure. I used the tonal categories established on this dialect of Tamang, plus my reconstruction of the group (see below section 7) to produce the equivalent of Gedney's tone boxes for the Tai languages (Morey, this volume).

A set of common words whose tonal category was well established in Tamang was chosen, and cognates were elicited in the newly studied languages to fill in tables like table 1 above for each language. A sufficient number of words (about 500) were verified to ensure that the number of categories did not change. The categories turned out to be stable, although the phonetic realizations varied.

Later researchers coming in the field would not need to reestablish the categories from scratch, but could start from the already established etymological categories, just as students of Tai do.

**4. WHAT IS REVEALED, AND WHAT DO WE HEAR?** It is certainly true that physically you hear pitch, not tone, and that at the beginning of a study you should be careful not to jump too quickly to a transcription which would ignore what you may wrongly deem "non essential" variation. But as we have just seen you may also arrive at categories directly, through functional oppositions, rather than by progressive lumping of detailed phonetic transcriptions. In the case of Tamang, what our classification method arrived at was indeed something abstract. As I was sorting the Tamang vocabulary into the above-mentioned lists, I was looking for pitch differences. The resulting lists were tonal categories which revealed the imbrication of the three elements: pitch, phonation of the vowel, and voicing of the consonant, all elements related to the state of the glottis. Later instrumental analyses confirmed the extreme variability, to the point of overlap, of all three of these determining features of a Tamang tone category, if considered individually (Mazaudon and Michaud 2008).

So what does the speaker, if not the researcher, "hear"?

Apparently, in Tamang the speaker and the hearer make use of a bundle of cues<sup>15</sup> to identify the phonological tone of the word, or rather they make use, at will, of one or more of a set of cues, which singly or together define a tone. I discussed this point at some length in Mazaudon (2012).

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<sup>15</sup> The theoretical status of the notion of "bundle of cues" is developed in Mielke (see below §6). Whether the end analysis of a given tone system retains a « bundle of cues » theory or not, the important role played by non-pitch cues in the identification of a tone, both for speakers and researcher, is pointed out in other language groups as well. Among contributions in this volume, Rice mentions the role of a final glottal stop in identifying the high tone in Fort Good Hope Dene (§ 4), Alec Coupe mentions the extra length of only one tone of a set of five tones in Khiamnungan (end of § 4), Morey notes duration and phonation as features of Tai Phake tone (§ 2.2), duration and stress are mentioned by Remijsen (passim).

Here a point of method. As long as I was working with the hypothesis that one feature was “distinctive” and the others redundant, I was thinking in terms of automatic conditioning, as in co-articulation. In that framework, I was expecting to find that if the pitch was lower, there would be more breathiness, and more voicing of the initial. Accepting the theoretical idea that cues could compensate each other rather than reinforce each other opened the way to the observation that in fact the degree of breathiness, voicing, and low F0 did not vary together. Please note that I did not need instruments for this: I needed a theory to help me accept what my ears were telling me.

As for Tamang, my training in comparative-historical linguistics unexpectedly came in handy. We will dwell on this point in section 7. For now let us only consider the following point: if some feature can replace another historically, why could they not be in a trading relationship in synchronic variation?

**5. WORD-TONE.** Part of the difficulty encountered in discovering the phonemic tones of Tamang comes from the fact that the domain of tone is not the syllable but the word, so that it is rare that direct contact occurs between two syllables each carrying, compacted on one syllable, all the characters of a given tone. As a result, abrupt changes in the F0 curve of the sentence are rare. The pitch curve defined by the lexical morpheme which starts the word expands over the whole word, making for a smooth transition to the next tone. Figure 1 shows how the pitch curve of the suffix of a verbal form is determined by the lexical tone of the verb root.

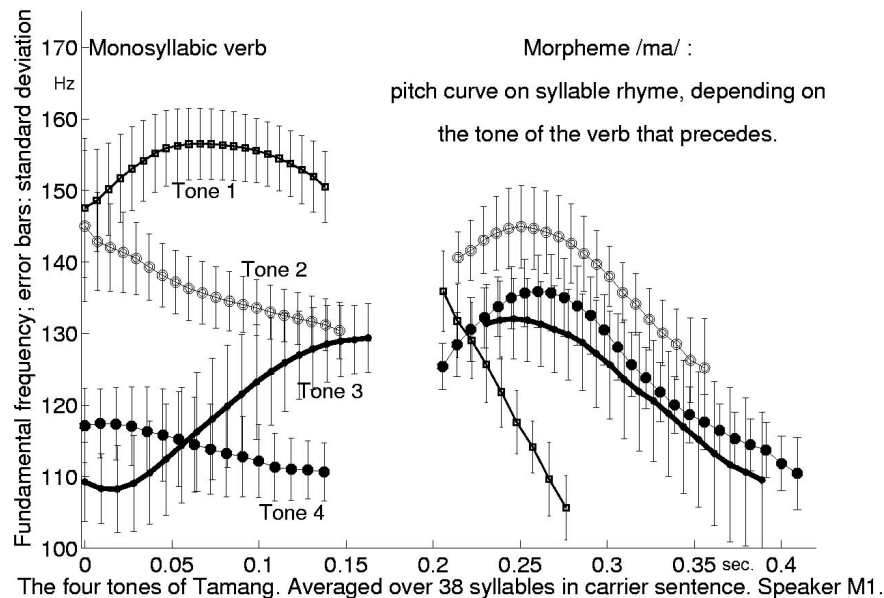


FIGURE 1. The four tones of Risiangku Tamang on Verb-root + suffix disyllabic words (error bars reduced by half for readability)

The method for discovering this structure was very much the same as for the rest: commutation of suffixes, and studying the result in frames. The theory in the late 1960's, before autosegmental phonology, was set by Pike's definition of tone: "A tone language may be defined as a language having lexically significant, contrastive but relative pitch on each syllable." (Pike 1948:3). So, like everyone else, I tried to mark pitch on each syllable. But I soon discovered that changing the suffix on a verb root or on a noun did not change the melody of the word. Grammatical morphemes did not have a tonal specification of their own. Nor were they pronounced with a fixed F0 pattern, as a neutral tone might be, or with less intensity. So an interpretation of the system as a combination of an initial stress with four tones, which would all be neutralized in suffixes, although considered for a moment, was rejected (Mazaudon 1973b:61-91).

The grammatical structure of Tamang requires that lexemes in most sentences be followed by an affix, a case marking suffix for nouns, or a Tense-Aspect-Mood suffix for verbs. This contributes to the smoothness of melodic curves which I mentioned at the start, and which differentiates the overall auditory impression of Tamang from that of more typical tone languages. The potential for a direct contact between different tones on adjacent syllables is restricted to the rare grammatical constructions where a nominal or verbal bare root is allowed. For verbs, a root followed by a modal is the only case where such close contact occurs, as in /<sup>1</sup>ni <sup>4</sup>tooci/ 'We must go' (go-must). With nouns, as we saw in the examples earlier, one monosyllabic adjective, /<sup>1</sup>tar/ 'white', and a few demonstratives can occur before nouns without an intervening suffix. The other adjectives are disyllabic deverbal formations. Numerals can follow the noun without intervening affixes /<sup>3</sup>mi <sup>4</sup>nii/ 'two persons'. As it happens the numerals have only two of the four tones, so their usefulness for frame construction is limited.

I expected that polysyllabic nouns would offer sequences of different tones. But when disyllabic morphemes were sorted into lists they also fell into four categories, as did the rare morphemes of more than two syllables. Phonetically, the disyllabic monomorphemic nouns (polysyllabic verb roots do not exist) showed the same patterns as words formed of a monosyllabic lexeme (noun or verb) + suffix.

After all word structures have been examined, we find only the same four melodies fitted onto lexemes of any length, from monosyllables with a short vowel to trisyllables, as well as onto words formed of a lexeme and a string of suffixes<sup>16</sup>. The spreading of the melody on words could be roughly represented as in Table 2.

	<i>on 1 syllable</i>	<i>on 2 syllables</i>	<i>on 3 syllables</i>
tone 1	[55 1] or [54 1]	[55 44 1 1] or [54 43 1 1]	[55 44 33] 1 1 1
tone 2	[44 1]	[44 44 1 1] or [44 55 1 1]	[44 55 44] 1 1 1
tone 3	[23 1]	[23 33 1 1]	[23 33 33] 1 1 1
tone 4	[21 1]	[21 32 1 1]	[11 33 22] 1 1 1

TABLE 2. The spreading of the melodic curve on words of various length. Pitch values represented in Chao's system (once in tone numbers once in tone letters) (Chao 1930).

<sup>16</sup> To be complete on the characteristics of Tamang word-tone let us mention that breathiness can spread if not stopped by an intervening obstruent, and that the voicing of syllable initial stops word-internally is determined by the preceding segment, and is wholly independent of tone.

Here again a prevailing theory needed some amendment to fit the descriptive reality without artifice. Pike yielded to the evidence and revised his general theory, proposing the foot as the domain of tone in this group of languages (Pike 1970).

**6. SOME BRIEF TYPOLOGICAL CONSIDERATIONS.** Both counts on which Tamang was found to be peculiar, the definition of a tone as a bundle of features rather than as pitch only, and the word as the domain of tone are also characteristic of the other languages of the Tamang branch of Bodish, as described in a series of works summarized in (Hale and Pike 1970) and (Hale and Watters 1973), as well as in recent studies like (Hildebrandt 2003, 2005). This is not surprising given the historical origin of the system in the ancestor of the group, as we will see.

Outside this narrow group, a similar tendency to have only one melody over the whole word was already pointed out for standard Tibetan by Chao Yuan-ren (in Yu 1930), and this is observed again in many of the tonal dialects of Tibetan presented in (Sun 1997). But Lhasa Tibetan, for one, could be claimed to have word-tone only with a two-tone analysis. If the currently favored four-tone analysis was chosen, it should be noted that monosyllabic words with a short vowel have only two tones, not four as in Tamang<sup>17</sup>.

In the Tibeto-Burman family, outside of the Bodish section (the Tibetan-Tamang group, to be simple), in spite of the traditional view of Asian languages as basically monosyllabic, a tendency to a less-than-one-tone-per-syllable structure is noted in languages with a weak syllable, like Burmese, and in some Chin dialects (Mazaudon 1977:76-90). These are also different from the Tamang type, where all syllables are evenly stressed. Further afield, Kukuya, in Africa, is mentioned as a potential word-tone language by Hyman (2006: 230-231). As is often the case, the very small number of languages reported with this type of tone does not encourage the recognition of the structure in newly studied languages, neither did the fact that this type was not recognized at all in reference works like (Hyman 2001). A more detailed elaboration of the typology of this type of prosodic structure is yet to come.

Tamang exemplifies a special case of the co-presence of pitch and phonation in a language, one where the two are inextricably linked. This is not always the case. In the African language, Dinka (Remijsen and Ladd 2008, Remijsen, this volume), or in the Oto-mangean languages in America (Silverman 1997:133sq), tone, defined by pitch, co-exists with an independent phonation contrast. Burmese, Vietnamese and Hmong, on the other hand, seem rather to belong, like Tamang, to the category of what Silverman calls “laryngeally simplex” languages, languages which do not allow phonologically independent use of pitch and phonation.

The analysis of the Tamang tones as bundles of features, which are in a compensating relation – another way to say that pitch and phonation do not “cross-classify” – was also not readily accepted as long as theories did not have a place for this type. Maddieson (1984), in his survey of suprasegmental patterns, re-interpreted the Tamang system as the crossing of two distinctive tones and two distinctive phonations. This misrepresentation of

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<sup>17</sup> Note that the four tones of Lhasa are not in regular correspondence with the four tones of the TGTM languages, and the recent Lhasa melodic feature has a different historical origin from the two tones of Proto-Tamang.

the synchronic phonology led Silverman to classify Tamang in his group of “laryngeally complex” languages — the group which includes Dinka and Otomangean<sup>18</sup>.

Reports of previously unrecognized types challenge theoretical frameworks into which they cannot fit comfortably. I have discussed elsewhere the fact that neither traditional structuralist phonology, nor generative phonology accommodates the idea of a bundle of features, as opposed to the selection of one pertinent/distinctive feature, accompanied by any number of redundant features. Recent theories of emergence in phonology (Blevins 2004; Bybee and Hopper 2001; Mielke 2008), while referring to something different from the historical emergence of tone that we consider here, may afford a better framework, in which “features may be more or less important in defining [a] category, but no feature is redundant and thus dispensible” (Bybee and Hopper 2001:33).

On the other hand do we want to define as a synchronic type every transient organization of a system?

On the synchronic level, the same question arises with the idea of a word-tone. In first grappling with this notion, I had met with Firthian “prosodic phonology”, through the work of Sprigg. But there, all phonological elements are spread across long “pieces”, not just tones. Although this approach was helpful, it could not be used in the structuralist framework I was working in. The functioning of word-tone was not distinguished from the rest. Only when Pike, working in the phonemic structuralist framework, recognized the existence of a word-tone structure as a particular linguistic structure, not as a new general theory of phonology, could we see the specificity of Tamang tones. The same question arises with autosegmental phonology: should everything be either autosegmental or not?

For descriptive work, the take-home message on this might be:

(1) it is alright to shoehorn data into a theoretical framework or a typological classification... to a certain point. But if, after trying everything, the resistance of the data is too great, a relatively superficial description may be the best, or a modification of the framework may be warranted.

(2) synchronic typology and an evolutionary perspective (as will be developed in section 7) should both be brought to bear on cases where an ongoing evolution is suspected. It may not be warranted to propose a special type for every phase of an evolution, but conversely it should be accepted that some (?most) languages are evolving and that consequently in one or the other aspect of their phonology they may not fit neatly any place in a typology. And this should not inhibit a precise, non conforming description of the data.

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<sup>18</sup> When classified in that group, Tamang constituted an exception to the hypothesis that when breathiness and pitch are independent phonological elements, they are “phased” (i.e. some non-breathy space is left on the syllable where pitch distinctions can be heard more clearly), which is not the case in Tamang since breathiness spreads. On the other hand, if counted as a laryngeally simplex language, Tamang contradicts another generalization of Silverman’s: that only one tone should have an idiosyncratic phonation character; both of Tamang’s low tones have some measure of breathiness, apparently contradicting this hypothesis. For details see (Mazaudon 2012:165-166).



**7. THE ORIGIN OF THE SYSTEM: AN HISTORICAL EXPLANATION OF SYNCHRONIC STRUCTURE AND TYPE.** We have noted two, not necessarily related, odd characteristics of the Tamang tone system. Understanding how this situation came about may not be of concern to some descriptive linguists. For some reason, historical linguistics and field descriptions, which had been so closely associated in the beginnings of scientific linguistics in the late nineteenth century — see for instance the analysis of Brugmann's work, among others, by Morpurgo (Morpurgo Davies 1998:237sq) — became estranged in the twentieth century. This is unfortunate since the two approaches shed much light on each other's findings.

In the case of Tamang, can we discover in earlier states of the language an explanation of why the three features of pitch, phonation and laryngeal features on adjacent consonants are so imbricated that they appear as facets of a single (multi-faceted) coin? Why, also, do we find restrictions on the co-occurrence of some segments with some tones: the absence of aspirated initials on low tones? This is not a synchronic universal — witness the presence of low tones after aspirated initials in Bangkok Thai, Cantonese, Lhasa Tibetan or Pho Karen (Jones 1961) to name but a few of the better known languages of the Asian linguistic area.

Turning to comparison<sup>19</sup> with the closely related languages which were studied at the same time by members of the SIL under the guidance of Kenneth Pike and Austin Hale (Hale and Pike 1970), and some other data from my own fieldnotes (on Manang<sup>20</sup>, Marpha and Syang), and using internal reconstruction, I was able to show that the origin of the modern tonal system of Tamang (and related languages) was to be sought in laryngeal features previously borne by consonants (Mazaudon 1973a, 1978).

To make a long story short, Proto-Tamang had only two tones (of unknown origin), and it had three series of initial consonants: a series of voiceless aspirated stops (\*ph, \*th...), a series consisting of voiceless obstruents and voiceless continuants (\*p, \*t..., \*s, \*hm, \*hn...), and a series consisting of voiced obstruents and voiced continuants (\*b, \*d..., \*z, \*m, \*n...). As the voiced stops started devoicing, and the voiceless continuants started becoming voiced, the loss of the distinction between the two series \*VOICED and \*VOICELESS was gradually replaced by the increasing importance of features of phonation, and of pitch, previously redundantly associated with each of the two series. These eventually were phonologized into a four tone system by the complete merger of a part of the \*voiced and \*voiceless series: the voiced/voiceless continuants and the voiced/voiceless sibilant. [Voice] was slow to disappear on stops, and drags along as an occasional feature of the newly phonologized low tones.

The evolution of Proto-Tamang is a special case of a type of evolution which has swept across Asia in the last two millenia, by which the merger of two (rarely three) series of initial consonants has led to the multiplication of tones. Haudricourt (1961, 1972) offers a portfolio of dozens of examples.

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<sup>19</sup> Keren Rice (this volume, section 7) also points out how studying other varieties or closely related languages can boost the fieldworker's confidence that he/she « has not missed things » in their work on the first variety.

<sup>20</sup> Later work on this language by Hildebrandt confirmed the earlier findings, and provided some welcome instrumental analysis (Hildebrandt 2005).

The interesting point about Tamang is that the evolution is still in progress, so that old features, intermediate features and new features coexist, yielding the particular type of tones that we have described, in which the best definition of each tone is as a bundle of features, sometimes concomitant and sometimes replacing each other. For more details about the historical evolution in the Tamang group as a whole see (Mazaudon 2005, 2012).

What does history have to say about our second question: why are there no aspirates on low tones? Since the proto \*ASPIRATES remained voiceless aspirated and nothing came to merge with them, there was no multiplication of tones in that context, whence the non occurrence of aspirated stops with low tones. This is the result of a historical development, not of any universal, or phonetic necessity.

The historical explanation of word-tone is more tentative. It can be observed that there is no contrast of voicing in word internal position in any dialect of Tamang or the other languages of the Tamang group: occlusives are fully voiced intervocally, and they are fully devoiced when preceded by a stop, whatever the tone of the word: /<sup>1</sup>pit-pa/ ‘to send’ [p<sup>1</sup>itpa], /<sup>1</sup>la:pa/ ‘wind’ [l<sup>1</sup>a:ba]. In Old Tibetan, as reflected in the spelling, we see that the distribution of voiced and voiceless spelling of suffix initials is contextually determined in a similar pattern. The spelling of recent, semantically transparent compounds respects the etymology and does not reflect this distribution, but we can observe that modern Lhasa Tibetan has not developed a High/Low contrast on non-initial syllables: they are all phonetically high, whatever the spelling of the second element of the compound. We can presume that the contrast between voiced and voiceless consonants — the material from which the High/Low contrast was phonologized — did not exist elsewhere than in word-initial position. This may have been the general situation in the phonology of Bodish languages at the time when the initial consonant shift occurred. For more details on word-tone in other Tibeto-Burman languages see (Mazaudon 1977:76-90).

**8. INSTRUMENTAL ANALYSIS.** Nowadays the linguist can rely much more heavily on the help of instrumental phonetics. Electricity is still not present everywhere, nor are roads to carry heavy equipment — see Hildebrandt’s (2007) account of her Nepal experience in the present decade — but, if practical, there is no reason not to avail oneself of instrumental help while still in the field. It should be remembered though that instruments, like statistics, are meaningfully used to check a hypothesis rather than to make one.

Except for a few pitch extraction tracings which I was able to make at the SOAS just after I finished the fieldwork in 1970, my study in the early seventies remained by ear. Thirty years later, I was able to reopen the question thanks to the collaboration of Alexis Michaud. The aim of the study was to check if the variation was indeed as large as first thought, and to find if there was some direct correlation between the different features.

An acoustic analysis was done on the old and new audio recordings. An electroglottographic<sup>21</sup> (EGG) study, with simultaneous audio recording, was conducted in order to

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<sup>21</sup> By electroglottography it is possible to measure the Open quotient (Oq) which is the percentage of each cycle during which the glottis is open. This gives an indirect estimation of the airflow. See (Mazaudon and Michaud 2008:233) for a quick overview, and references therein. I collected the EGG data along with the audio, as this does not require any special training. The analyses were done by A. Michaud.

demonstrate the presence of a phonation difference between the tones, and evaluate its extent and variability. The same EGG recordings gave information on the extent of the use of a difference in voicing of the initial consonant in correlation with the tone.

**8.1 PITCH VARIABILITY.** Pitch variability was evident in the acoustic analysis of the old audio recordings as well as in the new ones. The amplitude of variation, as shown by the error bars on the representation of average curves of the four tones with a single speaker in figure 2, is extremely large, as compared to other tone languages. A comparison with Naxi and Vietnamese, which Michaud had analyzed in his dissertation (Michaud 2005), brought out the differences in strategy between these languages (Michaud and Mazaudon 2006). Figures 2 and 3 compare Tamang and Naxi tonal space for two male speakers. Although the pitch range is roughly equivalent in the Tamang and the Naxi speakers, the extent of overlap is striking in the Tamang speaker, whereas the four tones of Naxi remain well separated.

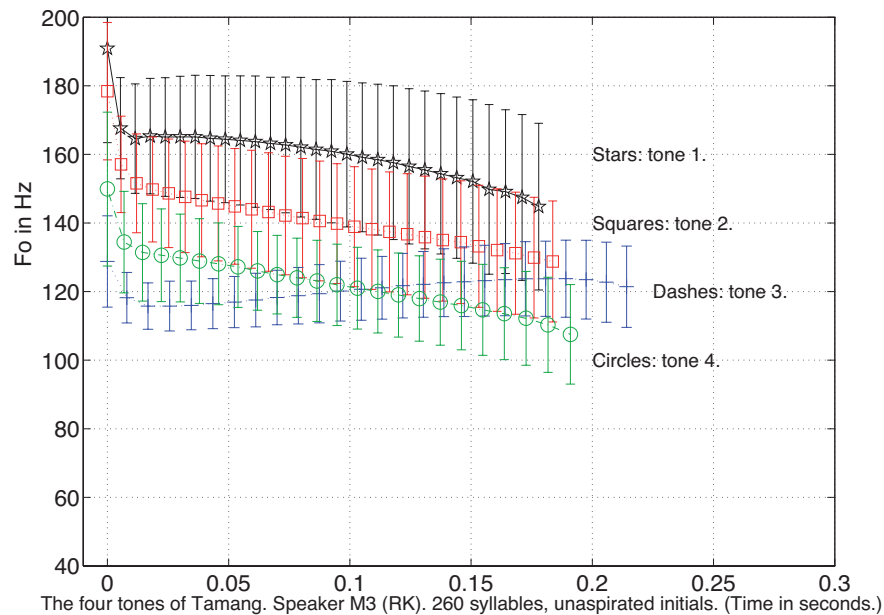


FIGURE 2. Average pitch curves for the four tones of Risiangku Tamang

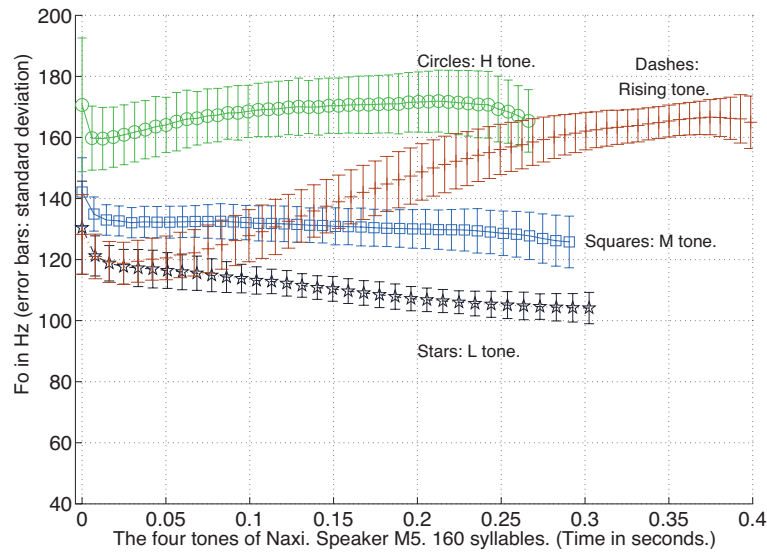


FIGURE 3. Average pitch curves for the four tones of Naxi.

The variation between speakers is also important. Figure 4 below shows the average pitch curve for the four tones of 5 male speakers in their thirties belonging to the same family.

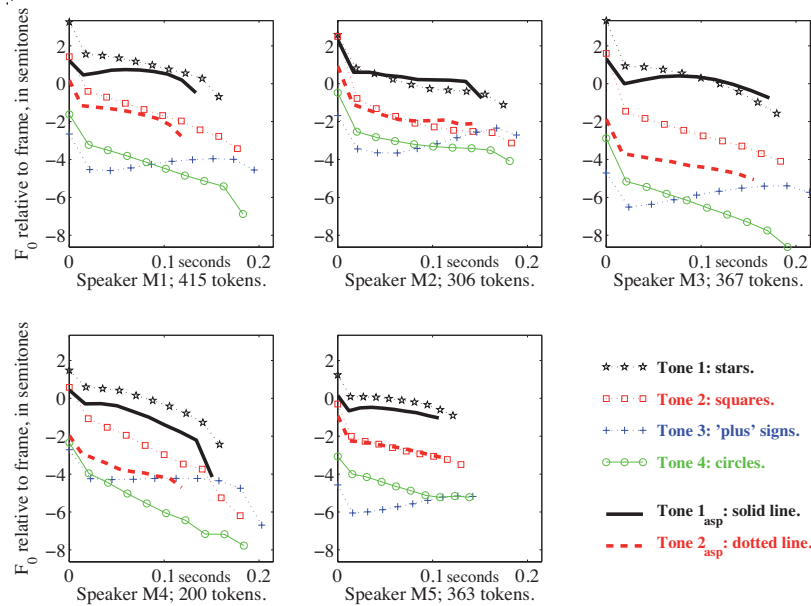


FIGURE 4. Average pitch curve for the four lexical tones of Risiangku Tamang, averaged for each of five speakers (expressed in semitones relative to the frame.) (Words with an aspirate initial, Tone1<sub>asp</sub> / Tone2<sub>asp</sub>, are represented separately because of a slight phonetic effect with some speakers.)

**8.2 PHONATION.** The phonation which accompanies the two low tones, which I can best describe as “breathiness” from its auditory character, was also studied with the non-invasive technique of the EGG. A precise articulatory description would need more invasive techniques, which the speakers might not be eager to accept. With EGG we get a measure of the time during which the glottis is open in each cycle, the open quotient (Oq), whence an indirect indication of the amount of airflow. We should mention that the difference between the most breathy (largest Oq) and the least breathy (smallest Oq) tones is small as compared to other languages which make phonological use of phonation contrasts, as Vietnamese for example.

Figure 5 shows averaged curves of open quotient, providing an indication on the degree of breathiness, for the four tones as realized by each of the same five speakers. The glottal open quotient is represented as a percentage deviation (positive or negative) from a reference value calculated for the speaker (the average Oq of all samples recorded for the speaker). So the value zero corresponds to normal phonation (modal phonation), and higher values to breathier phonation<sup>22</sup>. Here again, we observe differences from one speaker to the next. Without going into details, which can be consulted in (Mazaudon and Michaud 2008), we can compare the figures for pitch in figure 4 and for phonation in figure 5 for the second speaker, M2, and observe that M2 has the smallest pitch range and the largest phonation range of the five speakers, suggesting a compensatory use of the features. Note in particular – in figure 5 – how his tone 3 (blue ‘+’ signs) is much breathier (higher up in the figure) than his tone 4 (green circles), while their pitch difference – in figure 4 – is narrow.

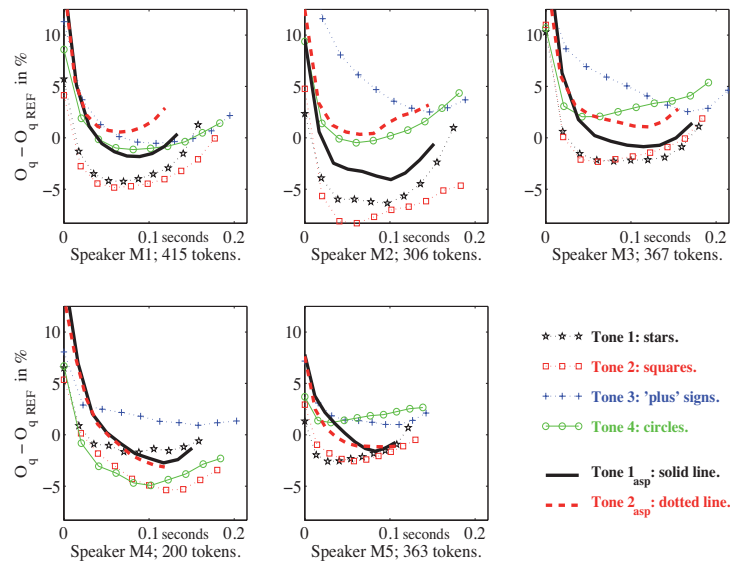


FIGURE 5. Averaged curves of Open quotient (giving an indirect cue to degree of breathiness) for each of five speakers of Risiangku Tamang.

<sup>22</sup> Error bars are not plotted but standard deviation is high.

**8.3 VOICING OF THE INITIAL STOPS ON LOW TONES.** The third component, voicing of the initial on the low tones, is also found to vary. Using spectrographic analysis and EGG, we believed we could set up three degrees, or types, of voicing: fully voiceless, fully voiced, and half-voiced (for details see (Mazaudon and Michaud 2008)). From that study it was revealed that voicing of any degree (full or half) occurred less than 25 per cent of the time when a Low tone word was uttered (against zero per cent with a High tone word).

We also found some clear examples of variation in the voicing of a single word uttered by a single speaker. Figure 6 and the accompanying sound recordings demonstrate the use of all three degrees of voicing by a single speaker in three repetitions of the same sentence.

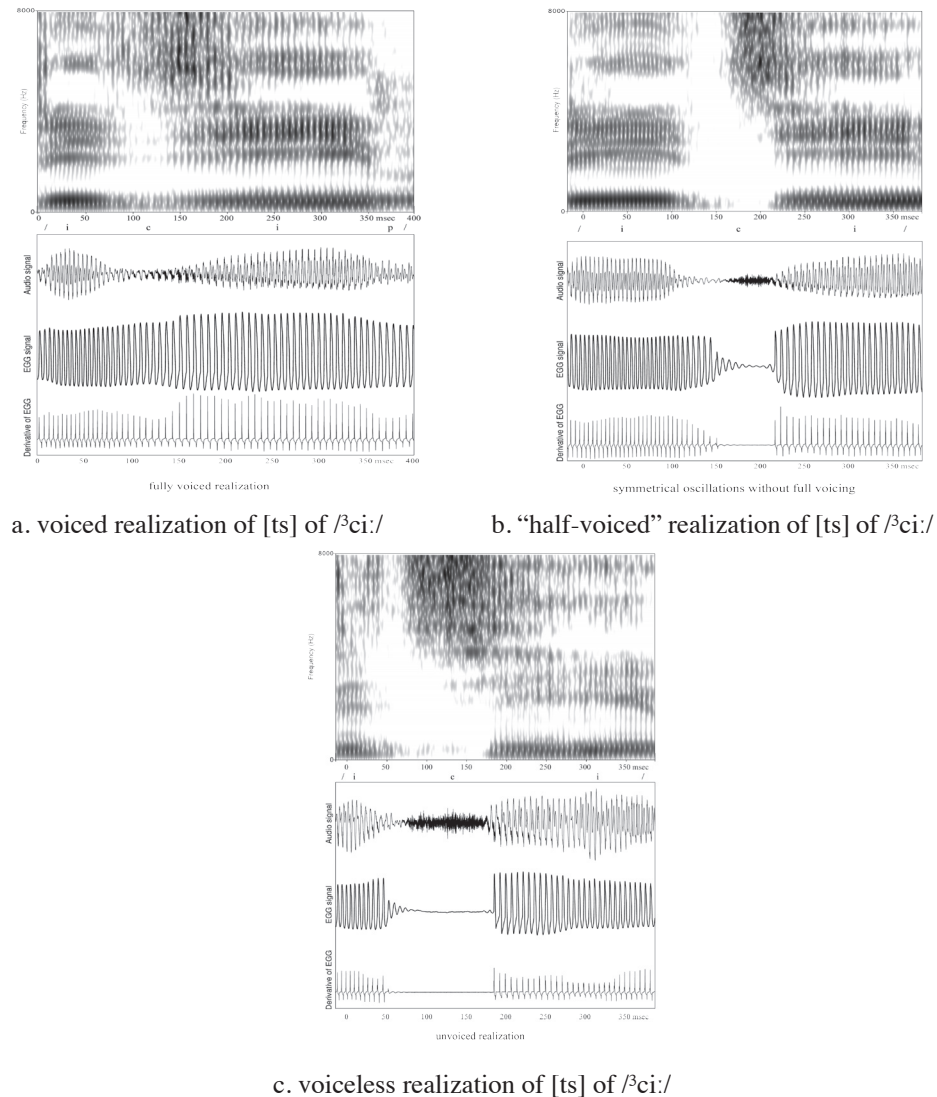


FIGURE 6. Evidence for the instability of the voicing of initial occlusives on low tones in three repetition of the same sentence /<sup>2</sup>cu-ri <sup>3</sup>ci:-ci/ ‘Here it pinched’ by the same speaker: a. voiced, b. “half-voiced”, c. voiceless.

Clearly none of the three cues is stable enough to be retained as the sole phonologically significant element, with the other two being redundant.

**8.4 PROSPECTS.** Almost no psycholinguistic experimental work has been done on the whole of the Bodish group. Certainly, since we are trying to understand how different cues relate in the speaker's mind and usage, synthesis and listening tests would be useful. This methodology is slowly getting out of the lab and being applied in the field. A first step in that direction in Nepal is the thesis by Cathy Bartram on a Bodish language, Walunge (Bartram 2011).

**CONCLUSION.** We have explained a method used to study a complex prosodic system where the difficulties started with the basic transcription of the data. The specific problem posed by Tamang arises from its typological character as a language using several phonetic cues in a compensating relation in order to realize its phonological tones, the main cues being pitch and phonation. The method we used aimed at discovering tonal categories before ascertaining the full details of their phonetic realization.

Help can be found nowadays in instrumental analyses. We showed how such analyses, acoustic and physiological, confirmed the extent of variation of the phonetic cues to a given tone in Tamang. Using instrumental help earlier in a study would help to train the ear, and could comfort the researcher in the accuracy of his observations. But instruments would not do the phonological analysis. No perceptual tests were conducted. If the study was conducted nowadays, we would certainly include some synthesis and discrimination tests as an indication of what the speakers/hearers rely principally on to distinguish their tones.

The trading relation which we observed between different features of a phonological entity contradicts the principle of one feature being distinctive and any others only redundant. We suggested that this deserved to be considered in general phonological theory.

Another rare typological character of Tamang is word-tone. There does not seem to be any necessary link between these two characters, which together result in a lower saliency of pitch, and a lower functional load of tone, as compared to prototypical one-tone-per-mora or one-tone-per-syllable pitch-only languages.

Finally, fieldwork immediately puts the researcher into contact with variation, between speakers, between hamlets, between dialects, even between tokens pronounced by a single speaker. We showed how a comparative-historical perspective helps to bring some order to an otherwise perplexing situation.



**APPENDIX: LHASA TIBETAN TONES (AFTER HU TAN 1982)**

a. Lhasa Tibetan prosodies: six combinations of melody/ length/ phonation. Examples in Written Tibetan spelling and modern pronunciation

	short smooth ending CV	long smooth ending CVV/CVN	medium length glottalized or stopped CVʔ/CVNʔ/CVp
	Level pitch	Level pitch	Falling pitch
High register (pitch starts high)	‘order’ <i>bka</i> ka 54 ʅ	‘pillar’ <i>ka.wa</i> ka: 55 ʅ	‘prevent’ <i>bkag</i> kaʔ 52 ʅ
Low register (pitch starts low)	‘saddle’ <i>sga</i> ka 12 ʅ	‘lay out’ <i>bsgar</i> ka: 113 ʅ	‘plug’ <i>ʼgag</i> kaʔ 132 ʅ

b. Four of the many possible phonological analyses of Lhasa Tibetan tones

	6 tones	2 tones + V length + ʔ phoneme (final ʔ cancels length contrast)	4 tones + V length (Falling tone cancels length contrast)	4 tones + V length (short V cancels level/falling contrast. Medium length is interpreted as ‘long’)
‘order’ <i>bka</i> ka 54 ʅ	<sup>1</sup> ka	kă H	kă Hlevel	kă H
‘saddle’ <i>sga</i> ka 12 ʅ	<sup>2</sup> ka	kă L	kă Llevel	kă L
‘pillar’ <i>ka.wa</i> ka: 55 ʅ	<sup>3</sup> ka	kā H	kā Hlevel	kā Hlevel
‘lay out’ <i>bsgar</i> ka: 113 ʅ	<sup>4</sup> ka	kā L	kā Llevel	kā Llevel
‘prevent’ <i>bkag</i> kaʔ 52 ʅ	<sup>5</sup> ka	kaʔ H	ka HFalling	kā HFalling
‘plug’ <i>ʼgag</i> kaʔ 132 ʅ	<sup>6</sup> ka	kaʔL	ka LFalling	kā LFalling

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