Intonational Phrase Boundaries in Southern Bobo Madaré

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Abstract

Southern Bobo Madaré (Bobo) is a Mande language spoken in southwestern Burkina Faso. This paper presents the first step towards a systematic prosodic analysis of this language. It outlines the phonetic correlates of intonational phrase boundaries in Bobo, focusing on fundamental frequency, final lengthening, and non-modal vowel phonation. It is argued that Bobo has both L and H boundary tones, but that these are optional and needed to describe only a small minority of cases. The phrase-final prosody of questions is also described. The analysis is conducted within the theoretical framework of the Autosegmental-Metrical model [1] [2] [3] [4]. Connections between these findings and those for other tone languages and other languages of West Africa are discussed.

Index Terms: prosodic boundaries, prosodic typology, boundary tone, documentation, Southern Bobo Madaré, Mande

1. Introduction

Southern Bobo Madaré (Bobo) belongs to the Northwestern branch of the Mande language family [5]. It has approximately 160,000 native speakers, most of whom are ethnic Bobo living in the Houet province of Burkina Faso [6]. The purpose of this project is to investigate the phonetic correlates of intonational phrase boundaries in Bobo, which is part of a larger project to document its phrase-level prosody as a whole. To date, there is no detailed description of the phrase-level prosody of any Mande language, and West African languages in general are underrepresented in the prosody literature.

Bobo is an understudied language, and there is no systematic description of its phrase-level prosody yet. Morse briefly describes some phonetic correlates of utterance types (declarative, interrogative, negative, and exclamatory) in her 1976 dissertation [7]. However, it is difficult to square her description with modern prosodic work because of the brevity and fundamental difference in approach—her description does not make a distinction between linguistic and non-linguistic effects on intonation. The only other work on the phonetics or phonology of Bobo is a grammatical sketch and short lexicon published in 1981 [8].

While it is not possible at this stage to present a full Autosegmental-Metrical (AM) model of the prosodic phonology of Bobo, the fundamental tenets of an AM model are assumed. Surface prosodic phenomena of an utterance are analyzed as the realization of an underlying, categorical prosodic structure and distinctive tones. Phrase-level pitch movements are understood to be the result of a sequence of underlying level tones. Relevant for this project is also the assumption that phrase-final pitch movement may be due to a phrase-level tone associated with the phrase boundary itself, i.e. a boundary tone.

Prior work on the phrase-level prosody of West African languages is limited, but contains interesting findings with implications for prosodic typology. Rialland and Robert describe Wolof, a Senegambian language of Senegal, as having a "minimal intonational system" [9, p. 934] due to its limited use of phrase-level tone—including use of morphological, rather than prosodic, focus. Schwarz describes a similar phenomenon in Buli, a Gur language of Ghana [10]. Rialland also proposes that there is an areal question prosody in West Africa that lacks a high boundary tone element [11]. Additionally, work on lexical tone languages outside of West Africa has found that boundary tone is not always an obligatory phonological component of the prosodic system. For example, in Hong Kong Cantonese [12] and Mandarin [13], boundary tones exist but are optional. One question that has been raised in the literature is whether the additional functional load tone places on pitch reduces (or changes) the use of phrase-level tone [4] [3]. However, the current evidence is limited because the majority of research on phrase-level has focused on non-lexical tone languages.

1.1. Tone in Southern Bobo Madaré

Bobo is a lexical tone language with a complex tone system. There are three lexical tone levels: high (H), mid (M), and low (L). Bobo also has contour tones. Morse [7] claims LM, LH, and ML contour tones, which she analyzes as a sequence of level tones sharing the same domain (the syllable). Le Bris and Prost [8] claim that the contour tones are LH, MH, HL, and ML. Because the number and identity of the contour tones is uncertain, phrases in which contour tones were in positions critical to the analysis were excluded in analysis of F_0 this study.

In addition to lexical tone, Bobo has grammatical tone. This has some implications for the data used in this project. According to Le Bris and Prost [8], the perfect of transitive verbs is marked with grammatical low tone. My data indicates that this is also true of the majority of intransitive and transitive verbs in both the perfect and the simple present. In other words, the majority of verbs have a low tone. Because Bobo is an SOVX language (where 'X' is an indirect object), this means that there is a strong bias toward a lexical L tone in phrase-final position in spontaneous speech. Additionally, since the stimuli for elicitation sentences were designed assuming that the description of the conjugation in Le Bris and Prost [8] was correct, lexical L tone in phrase-final position is over-represented in the non-spontaneous speech data as well.[1]

2. Methods

The analysis presented here is based on data that was collected in Bobo-Dioulasso, Burkina Faso, during the summers of 2013 and 2014. Three young adult native speakers of Bobo participated in the project. Two are female, and one is male. All

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[1]It is possible that the discrepancy is due to language change, as their description is over thirty years old.

three are bilingual in Dioula (a regional lingua franca), and two are also proficient in French. Audio recordings were made in a quiet room using two Shure SM10A head-mounted microphones and a Focusrite Scarlett 2i2 audio interface. The were recorded into Praat or Audacity at 44,000Hz.

2.1. Data

The recordings analyzed here consist of one monologue, two conversations between participants, one set of 38 elicited statements, and one set of 30 question-and-answer pairs. The monologues and conversations were recorded in order to provide examples of continuous speech, with the conversations intended to be the most natural and spontaneous speech possible in a recording context. The elicited statements and question-and-answer pairs were recorded in order to provide examples of speech in which lexical tone and syntactic structure were controlled. Controlling lexical tone makes it easier to analyze pitch movement associated with phrase-level tone [14], while controlling syntactic structure avoids unknown grammatical tone alternations. The elicited statements were transitives of the form $NP_{subject}$ NP_{object} VP (ADV). All words had lexical M tone if possible. Example (1) is typical.

(1) nō̄ nē nyāmā-bɛ̀ tēlēlē
child 1SG.ACC exhaust-CAUSATIVE/PF really
'The child really exhausted me.'

The elicited question-and-answer sentences were created specifically in order to collect examples of prominence and question prosody. The structure of the answers was similar to that of the elicited statements: simple transitive or intransitive statements controlled for lexical and grammatical tone. Participants were asked to read each set as though they were having a conversation—that is, the first speaker asked the question, and the second speaker responded.

The elicited statements and question-and-answer pairs were presented in random order on a computer screen in both Bobo and French. Two repetitions from each speaker were collected at least two days apart for the statements; for the question-and-answer pairs, the speakers switched roles for the second repetition. For the monologue, the speakers were asked to tell a story from memory, which was recorded in a single, uninterrupted session. (Multiple monologues were recorded, but only one is analyzed at this time.) They asked to practice their stories the night before recording, so the monologue is best considered an example of "semi-rehearsed" speech. They did not practice the conversations, but discussed what they would say beforehand.

2.2. Analysis

The recorded conversations, narratives, elicited statements, and elicited question-and-answer sets were annotated in Praat [15]. Intonational phrase boundaries were identified through the presence of a pause. Although other intonational phrase boundaries may exist in the data, this is the clearest criterion when the phonetic correlates of these boundaries are not yet known. According to this criterion, there is a total of 428 intonational phrases in the monologue and conversations. 178 of these phrases were excluded due to disfluency, unknown lexical tone at the phrase-final boundary (including contour tone), or difficulty with pitch tracking-leaving 250 intonational phrases for analysis. None of the elicited statements or questions-and-answers were excluded.

Based on the analysis of the data, the following phonetic correlates of intonational phrase boundaries were found: F_0
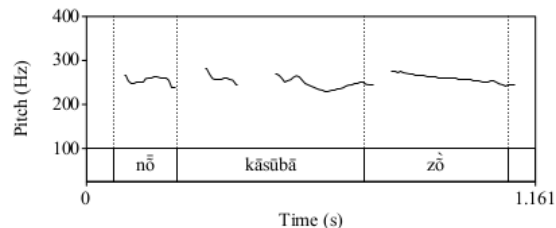

Figure 1: *Pitch contour of a phrase with a final grammatical L tone and H boundary tone. (Subject 1, F)*
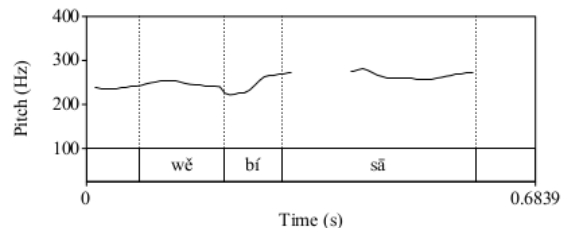

Figure 2: *Pitch contour of a phrase with a final grammatical M tone and H boundary tone. (Subject 1, F)*

movement, non-modal vowel phonation, and lengthening of final segments. These are presented below.

3. Fundamental frequency

Phrases were annotated according to whether they showed no change in phrase-final F_0, whether they showed a rise, or whether they showed a fall-after taking into account lexical tone. After the phrases were annotated, the pitch contours were analyzed in terms of boundary tone. The goal was to provide a consistent and parsimonious account of as many phrases as possible. The resulting analysis is that Bobo has H and L boundary tones, but that these are not obligatory; many phrases do not have boundary tone.

3.1. High boundary tone

In 16 of the intonational phrases in the monologue and conversations, the phrase-final F_0 is raised, suggesting the presence of an H boundary tone. It is unclear what conditions the choice of H boundary tone. The elicited statements do not show any evidence of H boundary tone, suggesting that it might be pragmatic or information structural factors that are not present in the elicitation context. It is present in almost all of the questions in the elicited question-and-answer pairs, but not all questions in the conversations. Figure 1 is an example of phrase-final raising: The final verb zǒ̀ 'eat (perfect)' does not show the phrase-final fall in F_0 expected from the lexical L tone (compare to the pitch contour of tà 'do' in Figure 7). In Figure 2, sā 'go', which has lexical M tone, is similarly raised.

3.2. Low boundary tone

In 53 of the intonational phrases in the monologue and conversation, the phrase-final F_0 is lowered, suggesting the presence of an L boundary tone. Like the H boundary tone discussed above, it is not clear what conditions the choice of L boundary tone. An example of this boundary tone is shown in Figure 3.
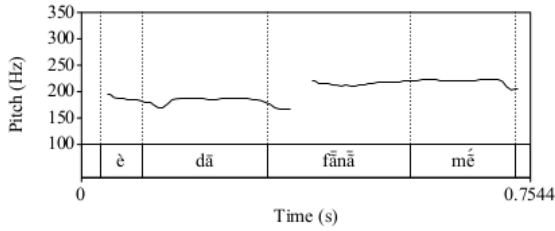
Figure 3: *Pitch contour of a phrase with a final lexical H tone and L boundary tone. (Subject 2, F)*
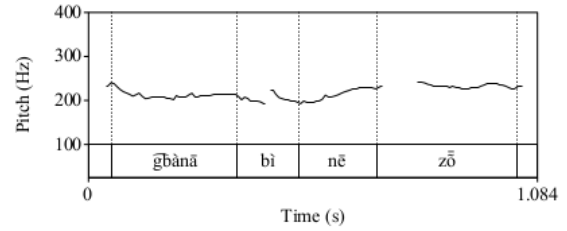

Figure 5: *Pitch contour of a phrase with a final lexical M tone and no evidence of boundary tone (Subject 1, F).*
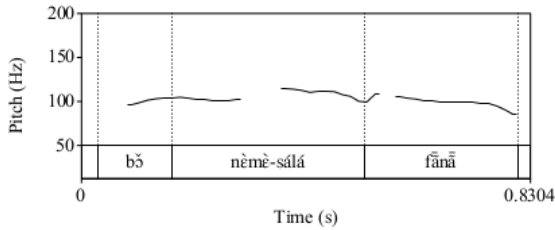

Figure 4: *Pitch contour of a phrase with a final lexical M tone and L boundary tone. (Subject 3, M)*
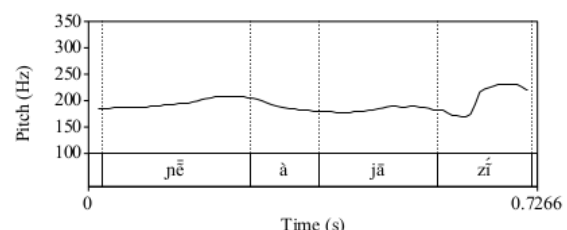

Figure 6: *Pitch contour of a phrase with a final lexical H tone and no evidence of boundary tone. (Subject 2, F)*

The lexically H-toned adverb *mɛ́* 'also' is lowered to the same pitch range as the previous word in the phrase, which is lexically M-toned. If the final lexical tone is M tone, it is also lowered, as in Figure 4. Note the phrase-final fall to L-tone range on the second syllable of *fãnã* 'also'.

3.3. No evidence of boundary tone

The majority intonational phrases (182) in the monologue and narrative do not show evidence of movement in F_0 at the final boundary that could be attributed to a boundary tone. In these phrases, F_0 at final boundaries is determined by the lexical tone of the final word. Figure 5 is a typical example; it ends in the M-toned verb *zɔ̄* 'eat', and F_0 is held steady. Figure 6 is an example of this phenomenon with a phrase-final lexical H tone, and Figure 7 is an example with a phrase-final lexical L tone. All of the elicited statements show this pattern.

3.4. Analysis of boundary tone

As seen above, the data contains evidence of phrase-final raising and lowering of F_0 consistent with the existence of H and L boundary tones. However, there is no evidence of a phrase-final lexical H tone being raised; the raising analyzed as the result of an H boundary tone only occurs on phrase-final lexical L and M tones, as in Figure 1 and Figure 2. Two possible (and competing) explanations are that (a) H boundary tone is never applied when there is a phrase-final lexical H tone, or (b) H boundary tone is present, but has no effect on the surface realization of a phrase-final lexical H tone.

There is a similar pattern with phrase-final lexical L tone. There is no evidence of a phrase-final lexical L tone being lowered to a extra low pitch range, which is what would be expected if the behavior of an L boundary tone was to simply lower the surface realization of pitch indiscriminately. The same possible explanations apply here: (a) L boundary tone is never applied when there is a phrase-final lexical L tone, or (b) L boundary tone is present, but has no effect on the surface realization of a phrase-final lexical L tone.

That data is ambiguous. However, it seems less plausible that the presence or absence of boundary tone is conditioned by the phrase-final lexical tone. It is more likely that H and L boundary tones *can* occur when there is a phrase-final H or L tone, respectively. One explanation for why they have no apparent effect on the surface realization of pitch in these cases uses the conception of tones as linguistic gestures with tone targets. This has been used within an Articulatory Phonology framework to model lexical tone in Mandarin [16] [17]. Under the model of Mandarin tone proposed by Gao [16], H and L tone gestures that are coupled in-phase result in the blending of the H and L tone targets; the H tone is lowered to a middle pitch range.

Extending the model, a blending of a lexical H or M tone target with an L boundary tone would result in a lowered H or M tone; H may be lowered to a middle pitch range, and M lowered to a low pitch range. A lexical L tone, however, would be unaffected because its tone target and the tone target of the L boundary tone are identical. The same pattern would result for H boundary tones: when blended with a L or M lexical tone, we would expect a raised L or lexical M tone, but we would not expect there to be an effect on H lexical tone, as those tone targets are also identical. This pattern fits the evidence from the data.

However, this analysis introduces a major ambiguity: It is not possible to determine whether a lexical H tone that surfaces as H is co-occurring with an H boundary tone; the same problem is true of lexical L tone items that surface with L tone. This presents a challenge for analyzing the percentage of phrases with boundary tone versus the percentage of phrases without, and makes assessing the pragmatic factors that condition the choice of using one of the optional boundary tones difficult. These ambiguous cases make up the majority of the data, at 131 of the 250 non-excluded phrases in the monologue and conversations.
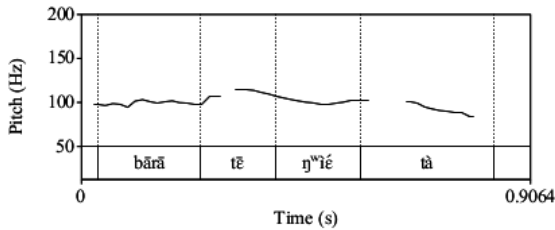
Figure 7: *Pitch contour of a phrase with a final lexical L tone and no evidence of boundary tone. (Subject 3, M).*
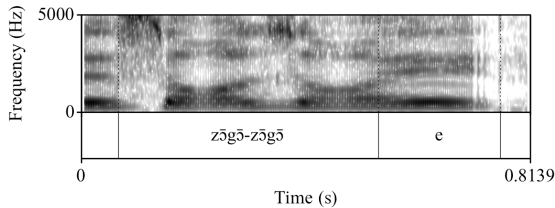

Figure 8: *Creaky phonation in a declarative utterance. (Subject 1, F)*

4. Non-modal vowel phonation

Two primary categories emerge when phonation is considered.

4.1. Phonetic non-modal vowel phonation

Declarative utterances show considerable variability in the phonation of the final segment. A slight majority have either breathy or creaky phonation, with the remainder having modal phonation. If there is breathy or creaky phonation, its extent is not often extreme; it appears to be a gradient phenomenon. This suggests that non-modal phonation is a phonetic consequence of lowered pitch, which is common in phrase-final position. Figure 8 is an example.

4.2. Phonological breathiness

There is a second category of phrases where breathiness is extremely pronounced and in which the final segment may over twice as long as in equivalent non-breathy contexts. This extreme breathiness and lengthening is associated with questions, as in Figure 9. Extreme breathiness in this boundary type appears to be phonologically required, unlike the variable non-modal phonation in declarative statements.

A similar question prosody has been observed in other languages of West Africa. Rialland [11] proposes an areal question prosody in the Sudanic belt of Africa—a regional feature that stretches from Sierra Leone to southern Sudan. Although she does not discuss the question prosody of Bobo, she mentions Dagara, a non-related language spoken in the same region, and Bambara, which is related. Instead of a high terminal contour, this areal question prosody, which she terms "lax question prosody," is characterized by: (a) a falling pitch contour, (b) a sentence final low-vowel such as *a* or *wa*, (c) vowel lengthening, and (d) breathy utterance termination. Bobo shares the last three of these characteristics, although the question particle *wà* is optional.

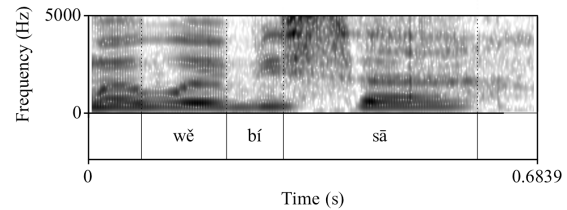This extreme lengthening and breathiness also occurs in

Figure 9: *Breathy phonation and extreme lengthening in a question. (Subject 1, F)*

some declarative utterances. In the examples in this data, this is in contexts in which the speaker goes on to continue—however, it is not in all such contexts. In some cases, there is a high boundary tone associated with this boundary type. The use of H boundary tone appears to be variable. The factors that condition the choice of this boundary type in declarative statements, and the use (or not) of H boundary tones, are not clear.

5. Discussion

In the analysis presented here, Bobo has optional H and L boundary tones. The tone targets of these intonational tones are blended with the tone target of the lexical tone of the syllable at the phrase-final boundary, resulting in a lowered tone if the boundary tone is L, and a raised tone if the boundary tone is H. However, boundary tone is not required to explain F_0 movement for the majority of phrase-final boundaries. This is not surprising considering the prosodic phonologies of other lexical tone languages, such as Mandarin [13] and Cantonese [12], which also have optional bounary tone. However, the ambiguity of the data in a majority of cases means that there are fewer data points available to draw conclusions. Analysis of the remaining data is ongoing.

Breathy vowel phonation is is used to signal questions, a feature Bobo shares with many other languages of the Sudanic belt [11]. This raises the question of how many other prosodic features Bobo shares with other West African languages. Although it is not discussed here, a preliminary analysis suggests that Bobo may not have prosodic focus marking, which has been proposed for Wolof [9] and Buli [10].

The larger question of the nature of the prosodic hierarchy in Bobo also remains to be explored. This analysis only included phrase-final boundaries with pauses, but more data and analysis is needed in to determine whether (and when) the pause corresponds to a phonological difference between different levels of a prosodic hierarchy. Phrases without pauses must also be investigated. Although this work remains, understanding the phonetic phenomena that occur at phrase-final boundaries is the necessary first step forming hypotheses about the underlying phonological structure for further investigation.

6. Acknowledgments

7. References

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