TONAL PROPERTIES OF THE AKAN PARTICLE *NA*

Wim A. van Dommelen & Dorothee Beermann

Department of Language and Literature, NTNU, Trondheim, Norway
wim.van.dommelen@ntnu.no dorothee.beermann@ntnu.no

ABSTRACT

This paper investigates the tonal realization of the particle *na* in the West African tone language Akan. It features lexical as well as grammatical tone. In previous linguistic studies, *na* as focus marker has been analyzed as low (L), *na* as an element that affects the logical or temporal interpretation of complex sentences as high (H). For the present purposes, eight speakers of Akan read a number of sentences containing *na* either as a focus or as a narrative marker. We further distinguished (1) the focus *na* occurring in questions and (2) the narrative *na* occurring sentence-initially and sentence-medially. Results of acoustic measurements indicated that the tone of *na* as a focus marker is low. For the particle's function as a narrative marker regardless of its position, both H and L tones were measured. Thus, these results do not support the assumption of a high tone *na*.

Keywords: Akan, tone, focus, narrative particle

1. INTRODUCTION

Akan is a well-studied language with respect to its grammar as well as its tonal structure, including the interaction of tone and intonation structure. A summary of previous work on Akan tone and intonation can be found in Kügler [8]. In linguistic studies of Akan, the particle *na* has been associated with two tones allegedly representing two different grammatical functions. *Nà* with a low tone has been analyzed as focus marker, while *ná* with a high tone has been analyzed by Boadi [2, 3] as an element that effects the logical as well as the temporal interpretation of a complex sentence. The present study presents a phonetic pitch analysis of *na* in its two main grammatical functions as a focus and a narrative marker (for the latter function, see [10]). Our work is based on an Akan text corpus of 7943 phrases corresponding to 97138 word tokens created by Beermann and Agyeiwaa [1]. The corpus is not annotated for tone. While we started from the standard categorization of a L-tone *na* and a H-tone *na*, based on pilot studies, we revised this assumption. For the present study, we have distinguished four different types of *na*: (1) as focus marker co-occurring with a question word, (2) as focus marker in statements, (3) as sentence-initial narrative particle, and (4) as sentence-medial narrative particle. Following standard assumptions, it was postulated that as focus marker it should have L-tone as against H-tone when functioning as a narrative particle independent of the context of its occurrence. Pitch data extracted from recordings of a group of speakers of Akan Twi were used to investigate whether this dichotomy can be maintained.

2. METHOD

2.1. Speech material and recordings

The speech material used for the present study consisted of 20 isolated sentences selected to contain the particle *na* in its different functions. The sentences were extracted from an Akan text corpus that consists of orthographically transcribed utterances chosen from different sources like radio interviews, oral reports, etc., varying in length between 2 and 19 words [1]. Below, sentences illustrating occurrences of different types of *na* will be presented in their orthographic form, i.e. without any indication of tone.

Recordings took place in the department's sound-treated studio using a Shure KSM44 microphone and were stored on hard disk using 44.1 kHz sampling frequency and 16-bit quantization. Participants read the block of sentences printed on paper four times, thus resulting in 80 utterances for each speaker.

2.2. Participants

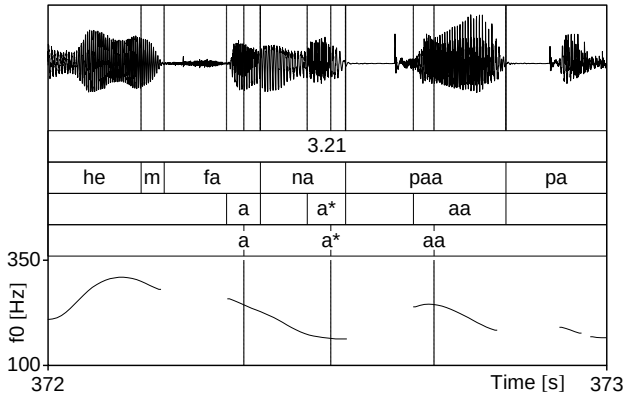
A group of eight Akan Twi speaking subjects (four females and four males) aged 23 – 28 years could be recruited to participate in the study. They were also speakers of at least one additional West African language and English. All were students at the Norwegian University of Science and Technology and received a payment for their participation.

2.3. Tone analysis

Recordings were analyzed using the Praat [4] program. To facilitate visual and auditory inspection, TextGrid tiers were created indicating sentence number, and syllable and vowel boundaries (see Fig. 1). Pitch analysis was performed using Praat's autocorrelation method with speaker-dependent adjustments to optimize results. Pitch contours were

smoothed and hand-corrected where appropriate. Measuring points selected to represent tones were determined after careful auditory evaluation and involved the syllabic nucleus in *na* (Fig. 1: a*; henceforth called *target*) and the vowels in the preceding and/or following context (for sentence-medial and -initial *na*, respectively).

Figure 1: Waveform, annotation and pitch contour of relevant syllables in *Enti ɛhemfa na paapa akɔhye?* ('Where could dad be?').



Relative tone height was determined by extracting measuring points' f0 values expressed in semitones re 100 Hz. For sentence-initial *na*, f0 height was calculated as the difference between the value for the target and that for the following vowel. Calculation of relative target height for sentence-medial *na* was more complicated. If both abutting vowels had either higher (Fig. 1) or lower f0 values than the target, the relative value for the latter was defined as the mean f0 difference between the value for the target and those for the abutting vowels (see Figures 2, 3, 5 and 6). If the three measuring points had monotonically rising values, the target value was considered a rise with the preceding one as a reference. Relative height of the target was thus calculated as the difference between its f0 value and the one of the preceding point, leaving the third point out of the calculation (see Figures 4 and 7). Similarly, a target in the course of a monotonic fall was calculated with the preceding one as a reference. In addition, the relative position of the target within the rise/fall was expressed in percent of rise/fall range.

3. RESULTS

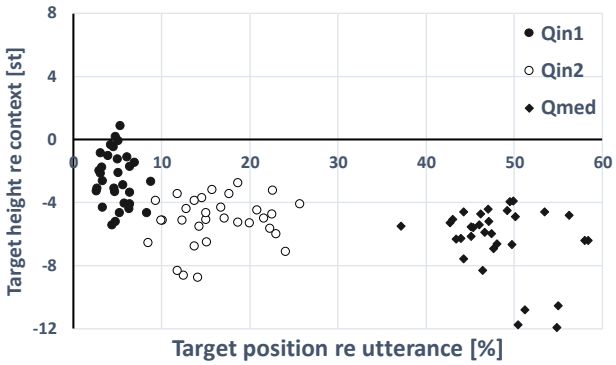
3.1 *Na* as focus marker co-occurring with a question word

Three of the 20 recorded sentences contained *na* co-occurring with a question word. Sentence-medial *na* occurred together with *ɛhemfa* ('where') in *Enti ɛhemfa na paapa akɔhye?* (see Fig. 1; Qmed in Fig. 2). An example of sentence-initial *na* is Qin2, where *adɛn* can be glossed as 'what':

(Qin2) Na adɛn?
'What is it?'

From the analysis results for the three sentences presented in Figure 2 it can be seen that the particle's tone generally lies lower than its context. Whereas in Qin1 some of the sentence-initial *na* tokens had virtually the same height as the following vowel, tokens in Qin2 appeared to lie clearly lower (on average -5.2 st vs. -2.5 st in Qin1). Still lower values were found for the particle in sentence-medial position (Qmed: -6.3 st). Unsurprisingly, testing the three observed distributions pooled together against a value of 0 st revealed a highly significant effect ($t(94) = -18.9$; $p < 0.001$). The data revealed a weak tendency for *na* at later positions in the utterance to have a lower tone value (Pearson product-moment correlation coefficient across the three sentences $r = 0.590$; $N = 95$; $p < 0.001$).

Figure 2: Relative height of tonal target in sentence-initial (Qin) and sentence-medial (Qmed) *na* in questions.



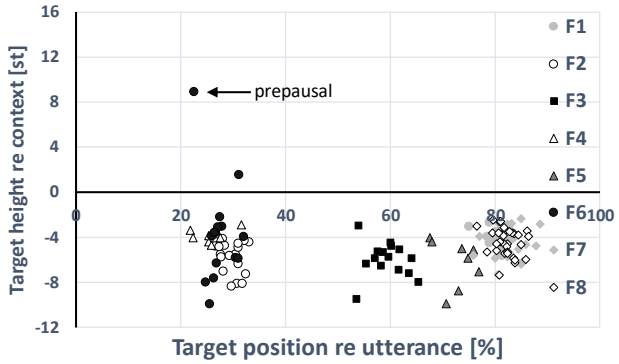
3.2 *Na* as focus marker in statements

The present speech material contained relatively many *na* particles that were categorized as focus marker. An example of this type is (F7), where *na* gives prominence to *ansa* ('before'):

(F7) Dumdum nkanea no ansa na wɔada.
'Turn off the light before you sleep.'

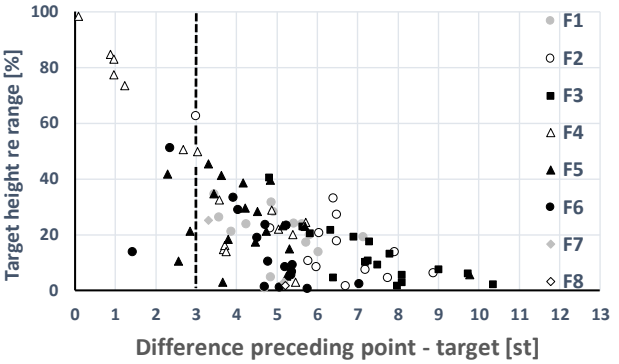
Figure 3 depicts occurrences of tokens where both preceding and following segments had either higher or lower f0 values. Almost all of them appeared to have a lower tone than the surrounding context (on average -4.7 st, significantly different from 0 st; $t(135) = -26.7$; $p < 0.001$). The highly positive exception of +8.9 st (F 6) may be explained by the following pause made by the speaker.

Figure 3: Relative height of tonal target in *na* as focus (F) marker in statements.



All other tokens of *na* as focus marker were found in falling contours. As can be seen from the top left corner in Figure 4, only five occurrences did not include a substantial fall from the preceding vowel to *na*. Those particles' tone was not more than about 1 st lower. Additionally, their values were in the upper part of the fall's range (> 73 %). The majority of *na* target values had a relative fall of 3 st and more (indicated by a dotted line; this criterion has been chosen as a lower boundary for the pitch fall to become perceptually relevant; cf. 't Hart [5]; see also section 4 Discussion). All selected values appeared to lie towards the lower end of the range of the fall, from approximately 40 % to almost 0 %. Therefore, they can be considered to represent a low tone.

Figure 4: Relative height of tonal target in *na* as focus (F) marker in statements occurring in falling contours.



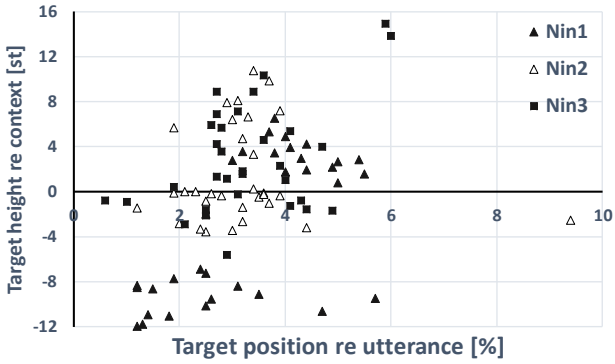
3.3 *Na* as narrative particle in sentence-initial position

In three of the present sentences, narrative particle *na* occurred in initial position. In Nin1 (Fig. 5) it connects the statement that follows to the preceding discourse:

(Nin1) Na ne nsɛm no, ne nteaseɛ tɔ sini ma me kakra.
'To me his comment on this issue was not straight forward.'

Results for all three occurrences of narrative particle *na* in sentence-initial position were ambiguous (Fig. 5). The particles shared the property of being sentence-initial with Qin1 and Qin2 described in section 3.1 but had strongly varying target values. Ranges observed were -12.0 st – +6.5 st for Nin1, -3.6 st – +10.8 st for Nin2, and -5.6 st – +14.9 st for Nin3. Mean values for sentences Nin1, Nin2, and Nin3 varied correspondingly (-3.1 st, 1.3 st, and 2.9 st, respectively). As a whole, the three distributions did not differ significantly from 0 st ($t(96) = 0.62$; $p = 0.535$).

Figure 5: Relative height of tonal target in sentence-initial narrative particle (Nin) *na*.

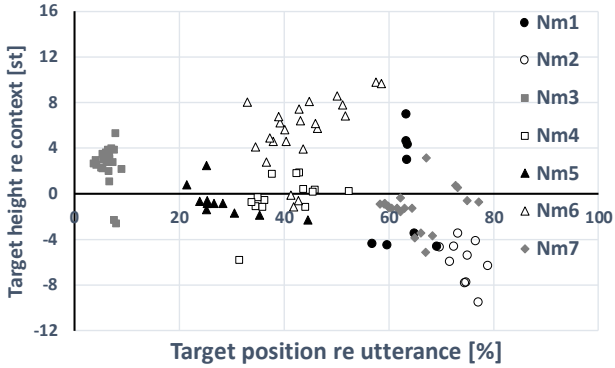


3.4 *Na* as narrative particle in sentence-medial position

Seven occurrences involved narrative particle *na* in sentence-medial position. An example involving *na* translated as 'and' indicating two overlapping ('*Stand while talking to me*') or two events following each other is denoted as Nm5 in Figure 6:

(Nm5) Sɔre na ka asɛm ko no kyerɛ me.
'*Stand up and tell me!*'

Figure 6: Relative height of tonal target in sentence-medial narrative particle (Nm) *na*.

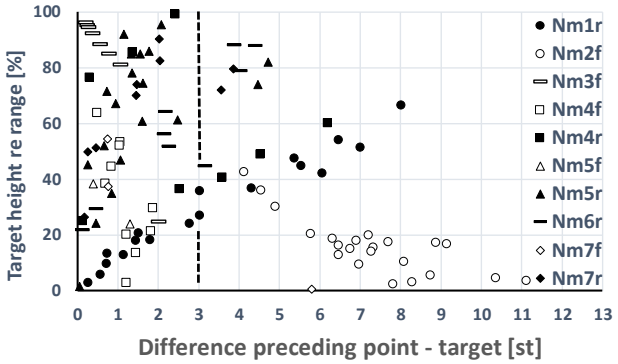


As shown in the figure, *na*'s tone was found to vary between high and low relative to the neighboring segments. For all sentences besides Nm7 both

positive and negative values were observed. Averaged across those sentences, there was no significant difference from 0 st ($t(124) = 0.30$; $p = 0.764$).

Further, *na* was also found in rising as well as falling pitch contours (closed and open symbols, respectively, in Fig. 7). The overall picture is more complicated than the results for *na* as focus marker presented in Figure 4. Considering f0 movements < 3 st, data points for Nm1r in the lower left corner indicate low target values. In contrast, most of Nm3f data are in the left top corner, thus representing high values. As to f0 movements > 3 st, mainly rising Nm1r and falling Nm2f appear to be involved. Target values for the former are centered around the middle of the pitch range. This seems to suggest that the rise is due to the following segment rather than to the tone of *na* itself. Target values for Nm2f are in the lower range (20 % - 0 %) with relatively large falls ranging between approximately 4 st and 11 st, thus representing *na* with a low tone.

Figure 7: Relative height of tonal target in sentence-medial *na* as narrative particle in falling (Nmf) and rising (Nmr) contours.



4. DISCUSSION

Acoustic analysis of the present speech material enabled us to draw some conclusions about the tonal properties of the particle *na* in its different grammatical functions. In accordance with previous linguistic analyses ([2, 3]), *na* as focus marker co-occurring with a question word appeared to have a L-tone. For sentence-medial positions, lower values were found than for the sentence-initial condition. Still, also a relatively small pitch rise from the target to the next vowel in the latter condition can be assumed to be perceptually relevant. Evidence presented by Hsu, Evans & Lee [6] suggest that human listeners are especially sensitive to pitch rises in speech. This may be particularly true for native speakers of a tone language (Krishnan & Gandour [7]; Liu [9]).

Furthermore, the picture for *na* as focus marker in statements was clear. In a considerable number of cases, its tone was lower than that of the preceding as well as the following vowel. The fact that in seven sentences similar target values were measured indicates that the results can be considered robust. Further, focus marker *na* was observed in the middle of pitch falls. Mostly, its tone was close to the next L-tone segment. This allows the conclusion that the particle had a L-tone.

Contrary to expectations, results for *na* as a narrative marker were ambiguous. This was true for the particle occurring in sentence-initial as well as sentence-medial position. Sentence-initially, its tone was found to vary between higher and lower than the following segment. Similar results were found for narrative *na* in sentence-medial position. Here, in a number of cases it also occurred in the middle of a pitch fall or rise with largely inconclusive values. It might be speculated that the presence of L and H tones could be due to different sentence contexts implying different meanings. However, *na*'s tone included both negative and positive values across all sentences. This seems to exclude the possibility of different realizations by the readers induced by different context conditions. At the same time, it is thinkable that individual readers consistently had either H-tone or L-tone realizations based on their personal interpretation. To answer this question, we investigated the distributions of target values for individual speakers. It appeared that in the sentences with *na* as narrative particle, only a minority (18.3 %) of speakers had both L and H tones. Most of them were thus consistent in their production (81.7 %, divided into 39.2 % H and 42.5 % L). Future research could focus on the question whether listeners associate L-tone versus H-tone realization of the narrative particle *na* with different interpretations.

5. ACKNOWLEDGMENTS

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