Frank Kügler | Susanne Genzel

On the prosodic expression of pragmatic prominence

The case of pitch register lowering in Akan

Suggested citation referring to the original publication:
Language and speech 55(3), 2011, pp. 331–359
DOI http://dx.doi.org/10.1177/0023830911422182
ISSN (print) 0023-8309
ISSN (online) 1756-6053

Article

Language *and* Speech

On the Prosodic Expression of Pragmatic Prominence: The Case of Pitch Register Lowering in Akan

Language *and* Speech
55(3) 331–359

DOI: 10.1177/0023830911422182
las.sagepub.com
SAGE

Frank Kügler and Susanne Genzel
University of Potsdam, Germany

Abstract
This article presents data from three production experiments investigating the prosodic means of encoding information structure in Akan, a tone language that belongs to the Kwa branch of the Niger-Congo family, spoken in Ghana. Information structure was elicited via context questions that put target words either in wide, informational, or corrective focus, or in one of the experiments also in pre-focal or post-focal position rendering it as given. The prosodic parameters F0 and duration were measured on the target words. Duration is not consistently affected by information structure, but contrary to the prediction that High (H) and Low (L) tones are raised in *ex situ* (fronted) focus constructions we found a significantly lower realization of both H and L tones under corrective focus in *ex situ* and *in situ* focus constructions. Givenness does not seem to be marked prosodically. The data suggest that pragmatic prominence is expressed prosodically by means of a deviation from an unmarked prosodic structure. Results are thus contradicting the view of the effort code that predicts a positive correlation of more effort resulting in higher F0 targets.

Keywords
Akan, effort code, information structure, prosody, register lowering

Introduction

This article addresses two central questions with respect to tone languages. The first one deals with the issue of intonation in a tone language which we will illustrate with data from Akan. The phonetic correlate of tone is F0, hence a Low tone (L) is expressed by means of relatively lower F0 level than a High tone (H). The most salient phonetic correlate of intonation is also F0, that is to say pitch accents and boundary tones are expressed by means of local F0 minima and maxima (Pierrehumbert, 1980; Ladd, 1996; Gussenhoven, 2004). Given the fact that the phonetic correlate F0 is the same for tone and intonation the critical question is thus, how much intonation do tone languages use?

Corresponding author:
Frank Kügler, University of Potsdam, Department of Linguistics, Karl-Liebknecht-Str. 24/25, D – 14476 Potsdam, Germany
Email: kuegler@uni-potsdam.de

According to Ladd (1996, p. 6) intonation expresses post-lexical pragmatic meanings. These refer basically to two aspects, highlighting of information and structuring information. In this paper we are focusing on the former function of intonation. We will present a case of pitch register lowering[1] as the prosodic expression of prominence, which has to our knowledge not been reported yet.

The second issue addressed in this paper concerns the universality of the prosodic expression of prominence. According to Gussenhoven (2002, 2004) the theory of the biological codes represents universal functions of language related to intonation. With respect to prominence Gussenhoven argues that the effort code explains the prosodic expression of focus in terms of higher or later F0 maxima. We will interpret the data of the present study on the prosodic expression of pragmatic prominence in Akan in the light of Gussenhoven's theory of biological codes.

To assess the range of variation of languages and to critically reflect typological generalizations, which usually are based on well studied languages, it is necessary to gain more data by means of controlled studies on less well examined languages. Akan represents a good candidate for this enterprise for two reasons. First, Akan is a level tone language (cf., Pike, 1948). Controlled data on level tone languages, in particular from the African continent, are rare (Zerbian, Genzel, & Kügler, 2010) while controlled data are much more available for contour tone languages like Chinese (e.g., Xu, 1999; Liu & Xu, 2005; Chen, Wang, & Xu, 2009). Second, a large amount of papers deal with aspects of the tonal system, of the information structure, and of the syntax of Akan, which we can base our study on. As yet, however, no study has quantitatively investigated the prosodic expression of information structure in Akan.

In the remainder of the introduction we will present earlier work on Akan tonal phonology, and discuss the issues of intonation in tone languages and intonational universals in more detail. The main finding of the paper is that speakers express intonational function in Akan by means of pitch register lowering, which from a universal perspective contradicts the theory of the biological codes put forward by Gussenhoven (2002, 2004). Contrary to Gussenhoven we will propose that highlighting information in communication is achieved by means of a **deviation** from a neutral register, and Akan represents a case where speakers lower their voice in order to draw the attention of their interlocutors.

1.1 Earlier work on tone in Akan

This section will present an overview of Akan phonology as it emerges from earlier work. Akan belongs to the Kwa branch of the Niger-Congo family and is spoken by about 8.3 million people in Ghana and the Ivory Coast (Christaller, 1933; Lewis, 2009). Akan consists of several dialects, some of which are more mutually intelligible than others (Schachter & Fromkin, 1968). The dialects differ at the level of segments as well as tones (cf., Cahill, 1985; Dolphyne, 1988; Abakah, 2002, 2005a, b; Abakah & Koranteng, 2007; among others). The three main dialects are Asante Twi (2.8 million speakers), Fante (1.9 million speakers) and Akuapim (0.55 million speakers) (Schachter & Fromkin, 1968; Cahill, 1985; Lewis, 2009). This paper concentrates on Asante Twi which has its cultural center in and around the city of Kumasi. Asante Twi is the dialect with the majority of speakers, and we will use the cover term Akan throughout the paper.

Akan is a two-tone language distinguishing between L and H tones, that are transcribed in the tradition of the African tone literature and in line with IPA conventions as [`] and [´] respectively (Dolphyne, 1988). All examples throughout the paper are given in Roman script following the orthographic convention laid out in several dictionaries of Akan (e.g., Christaller, 1875, 1933; Mohr, 1909; Berry, 1960; cf., also Dolphyne, 1988).[2] Tone languages are characterized by the way they use F0 to distinguish lexical or grammatical meaning (e.g., Pike, 1948; Hyman, 2001).

In (1) the lexical meaning of Akan words changes as a function of differences in lexical tone. In (1a) the disyllabic word carries two lexical H tones whereas in (1b), two lexical L tones, and in (1c) the two syllables carry two distinct lexical tones, L and H. In Akan, tone has grammatical function as well (Dolphyne, 1988). In (2), the second tone of the verb determines the aspect of the verb: the habitual form (2a) is characterized by a H tone, and the stative form (2b) by a L tone. The underlying lexical H tone is post-lexically replaced by a grammatical tone. The grammatical function of tone in Akan plays a more important role than its lexical function (Dolphyne, 1988; Manyah, 2006). Among other things, tones in Akan distinguish verb aspect and tense, and identify argument structures of the verb.

(1) a. pápá ‘good’
b. pàpà ‘fan’
c. pàpá ‘father’
(Dolphyne, 1988, p. 52)

(2) a. Kòfí gyìná hó
Kofi stand.HAB LOC
‘Kofi stands there.’
b. Kòfí gyìnà hó
Kofi stand.STAT LOC
‘Kofi is standing there.’
(Dolphyne, 1988, p. 67)

The tone bearing unit (TBU) is the syllable (Stewart, 1965; Dolphyne, 1988; Abakah, 2005a, b). Examples are given in (3). According to Dolphyne (1988) Akan distinguishes three syllable types (V, CV, C), which are either open syllables, or single sonorants that function as syllabic consonants (cf., also Christaller, 1933, p. XXVIII; Stewart, 1965). Any vowel constitutes a syllable, and in the case of two adjacent vowels each of them constitutes its own syllable (3e) (cf., Christaller, 1933, p. XVII; Dolphyne, 1988).

(3) a. ɔ̀-fá ‘he takes it’
b. sò-ḿ ‘hold it’
c. ǹ-sú ‘water’
d. dà-ǹ ‘turn it over’
e. ò-hú-ì ‘he saw it’
(Dolphyne, 1988, p. 52f)

The first syllable in (3a) represents an open syllable without an onset, while the second one contains an onset and nucleus. The data in (3b–d) show examples of syllabic consonants either as prefix or as suffix. In (3b) and (3c) the tone associated with that syllable differs from the tone of the following or preceding syllable, while the tone is equal on both syllables in (3d). Tone bearing prefix consonants such as in (3c) provide evidence that single consonants constitute syllable nuclei. Akan allows no complex onsets as (3c) may suggest (Dolphyne, 1988; Marfo & Yankson, 2008). Tone associates with the rime of the syllable, not with onsets (cf., Yip, 2002).

The distinction of lexically H and L tones is also reflected at the segmental level. According to Manyah (2006), vowels that carry a L tone are significantly shorter than vowels carrying a H tone. The durational difference ranges between 80 and 100 ms. Vowel quality does not differ for different tones (although there is a tendency for H toned vowels being realized more centrally).

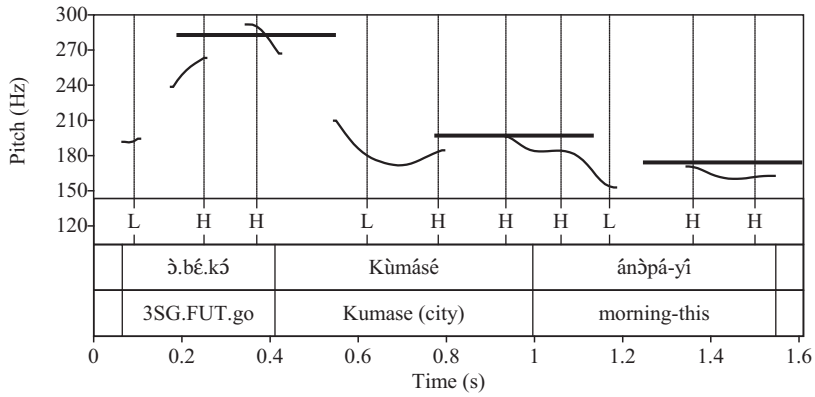

Figure 1. Tonal terracing at three distinct register levels exemplified with sentence (4). L tones between H tones lower the register in a staircase fashion illustrated by horizontal lines.

According to Christaller (1933) Akan has stress, which is further corroborated by an analysis of speech rhythm in Akan oral praise poetry since Akan rhythm shows more common characteristics with English stress timing (Anderson, 2009; Purvis, 2009). However, to our knowledge, no comprehensive analysis of stress in the sense of Hayes (1995) exists, and the exact phonetic details of the "emphasis put on a syllable" (Christaller, 1933, p. XXVIII) remain unclear. Christaller (1933) at least provides a tentative distribution of stress in Akan: He differentiates between stress on verbs and on nouns. Stress in verbs can fall on the prefix or on the stem. In nouns stress lies either on the first H toned syllable, or on the preceding L toned syllable. In nouns containing only L tones the first stem syllable carries the stress, as in *wɔ̀fà* – 'uncle'. However, assuming H tones correlate with stress may be a misleading perceptual impression. Any analysis of stress in a tone language has to be independently motivated.

Akan has been classified as a terraced-level tone language (Clements, 1979; Dolphyne, 1988; Abakah, 2000).[3] Welmers (1959) first introduced the term "terraced-level languages" for describing languages where the realization of phonologically identical tones can be quite different depending on where the tones occur in the utterance. According to Clements (1979) terracing languages display a regular process of register shift which affects the F0 realization of successive tones. The shift of the total pitch register can apply downward (downstep) and/or upward (upstep). An important feature of tone terracing is that there is no limit on the number of register lowerings in a tone group. External limits can be set by lexical, grammatical, and/or phonological factors. Terracing is a process on the level of the pitch register. The terracing property is illustrated in Figure 1, the example is given in (4).

(4) ɔ-bé-kɔ́ Kùmásé ánɔpá yí
3sg-FUT-go Kumase morning this
'He will go to Kumase this morning.'
(Schachter & Fromkin, 1968, p. 105)

Each first H tone in a series of High tones of the utterance in (4) defines a new register line relative to which subsequent tones are scaled. In (4) three distinct pitch register levels exist (cf., horizontal lines in Figure 1).

The terracing effect shown in Figure 1 is analyzed as downstep or downdrift. This phenomenon is also referred to as automatic (downdrift) and non-automatic downstep (downstep) (Stewart, 1965). The terms downstep and downdrift are frequently confused in the literature (Connell, 2001). This is partly due to the fact that researchers refer to these processes as either phonetic or phonological effects. Another reason is that different research traditions use different terminology, for example African tone linguistics vs. intonational phonology (cf., Clements, 1979; Connell & Ladd, 1990 for an overview). Automatic and non-automatic downstep usually represent a lowering of a H tone due to a preceding L tone. In the case of automatic downstep, this L tone is realized phonetically, while it is not in the case of non-automatic downstep. In the latter case, the downstep trigger does not appear on the surface. Based on studies that do not find any phonetic difference between the realization of automatic and non-automatic downstep (Laniran, 1992 for Igbo; Snider, 1998 for Bimoba, 2007 for Chumburung, Genzel & Kügler, 2011 for Akan), we use the term *downstep* for both types of terracing effects. According to Schachter and Fromkin (1968), Dolphyne (1988), and Abakah (2000, 2002) downstep occurs in Akan in a tonal sequence of H-L-H, where the second H tone is lowered with respect to the first H tone, as illustrated in Figure 1.

1.2 Tone languages and intonation

From a typological point of view any language is assumed to have intonation (Bolinger, 1962; Hockett, 1963; Gussenhoven, 2004). In tone languages, F0 distinguishes lexical meaning and expresses grammatical relations by means of tone. Given so, it is worthwhile to find out to what extent the phonetic cue F0 may also express post-lexical meanings. Surveying the literature on this issue reveals that in fact tone languages do express post-lexical meanings by means of F0.

Intonation expresses sentence-level meanings such as highlighting information which commonly is known as focus marking. In one group of tone languages focus marking is accompanied by changes in F0 scaling, in other words an enhancement of the tonal register (Xu, 1999; Liu & Xu, 2005; Chen et al., 2009 for Mandarin Chinese, Sinitic; Pan, 2007 for Thai, Tai; Jannedy, 2007 for Vietnamese, Austro-Asiatic; Leben, Inkelas, & Cobler, 1989; Inkelas & Leben, 1990 for Hausa, Chadic; Schwiertz, 2009 for Beaver, Athabaskan). Xu (1999) showed that all four tones in Mandarin Chinese are articulated with expanded pitch register, for example a H tone is raised higher, and a L tone is lowered. In addition to a more enhanced production of tones under focus, the tonal register after the focus is suppressed. Also, longer durations of focused words have been reported for Thai (Pan, 2007) and Vietnamese (Jannedy, 2007). As another strategy, the Curaçao dialect of Papiamentu, a Caribbean Creole with lexical tone contrasts, employs a particular focus pitch accent to mark prominence (Remijsen & van Heuven, 2005) which resembles the Swedish focal accent (Bruce, 1977).

A second group of tone languages employs a different strategy to express focus, which refers to prosodic domain structure, that is to say an insertion of a phrase break before or after a focused constituent (Frajzyngier, 1989 for Pero, Chadic; Kidda, 1993 for Tangale, Chadic; Kanerva, 1990; Downing, Mtenje, & Pompino-Marschall, 2004; Downing, 2008 for Chichewa, Bantu; Karlsson, House, Svantesson, & Tayanin, 2007 for Kammu, Mon-Khmer; Schwiertz, 2009 for Beaver, Athabaskan). A phrase break is realized by means of phonetic cues such as a pause, final lengthening (Martin, 1970; Lehiste, 1972; Wightman, Shattuck-Hufnagel, Ostendorf, & Price, 1992), and/or F0 register resetting (e.g., the Bantu language Chichewa: Kanerva, 1990; Downing et al., 2004; Downing, 2008; and some Kwa languages spoken in Côte d'Ivoire, yet not Akan: Leben & Ahoua, 2006). In Kammu, a focus is signaled by means of a H boundary tone (Karlsson et al., 2007).

Contrary to languages of the first two groups, a third group of tone languages does not use prosodic means for the expression of prominence at all. These include the Bantu language Northern Sotho (Zerbian, 2006), the Mayan language Yucatec Maya (Kügler & Skopeteas, 2006, 2007; Kügler, Skopeteas, & Verhoeven, 2007; Gussenhoven & Teeuw, 2008), and Navajo which belongs to the Athabaskan language family (McDonough, 2002). Hartmann and Zimmermann (2007) present evidence from production data and perception tests that also Hausa does not use prosodic means for the encoding of focus. Their results go against the findings of Leben et al. (1989) and Inkelas and Leben (1990).

This review shows that besides tonal distinctions of lexical and/or grammatical functions tone languages do use prosodic means for the expression of post-lexical pragmatic meanings, yet not all tone languages necessarily employ prosodic means for the expression of post-lexical pragmatic meanings.[4] Akan has as yet not been analyzed in depth with regard to its intonation and the prosodic expression of focus. Impressionistically, Boadi (1974) reports on tonal raising of both H and L tones on *ex situ* focused words. Thus, we expect Akan to belong to the first group of tone languages that use pitch register in order to express focus.

Another example of intonation in Akan is the expression of sentence mode. Dolphyne (1988, p. 55) reports that interrogatives display a higher pitch register and that a final H tone is realized with a slightly falling F0. According to Hyman (2001) questions in Akan are further characterized as not having downstep. Yet another intonational phenomenon concerns the change of tones of a whole phrase. Abakah (2005a) gives an example in Akan where a complete main clause receives H tones if a certain temporal adverbial appears in the sentence. These facts further show that intonation exists in Akan.

1.3 Intonation and its biological codes

Gussenhoven (2002, 2004) argues that intonational meaning manifests itself in universal and language-specific aspects. The language-specific aspects are coded in the intonational grammar of each language while the universal part is expressed phonetically across all languages. According to Gussenhoven, three biological codes explain the universal aspects of the interpretation of pitch variation, and they are based on physiological properties of the speech apparatus. The frequency code relates dominance relations to pitch height, that is lower pitch is interpreted as more dominant than higher pitch. The effort code relates the amount of energy put into speech production to the amount of emphasis of a particular message, in other words the more effort in production the more emphatic the utterance and the more likely a message comes across. The production code, finally, relates the relative pitch height at the boundaries of utterances to effects of finality, topic initiation, or continuation demands in communication.

To achieve a particular interpretation a speaker can consciously manipulate the code. The expression of emphasis or prominence, hence the manipulation of the effort code, which is most relevant for the present discussion, results in an increase of articulatory precision accompanied with faster vocal cord vibration. In intonation languages the more precise articulation manifests itself as an enhancement of the pitch register. The same effect has been reported for the tone language Mandarin Chinese for H tones (Xu, 1999). Thus, Gussenhoven advocates a correlation that an increase of prominence is achieved by an increase in effort. Gussenhoven further argues that languages have grammaticalized the biological codes, and the effort code represents the expression of focus. However, the theory of biological codes is based mainly on research on intonation languages.

At first sight, the group of tone languages that use prosodic means for the expression of focus would correspond to the grammaticalized function of the effort code such that they use an expanded pitch register to express focus. Since we expect Akan to belong to that group as well, Akan should

also express focus by means of an expansion of pitch register. However, as we will show in this paper, Akan does not behave as expected. Contrary to pitch register expansion, in Akan both H and L tones are lowered, which we analyze as a lowering of the pitch register. In the discussion we will argue that these findings contradict the idea of the effort code.

1.4 The expression of pragmatic prominence in Akan

Prominence is understood as highlighting relevant information within an utterance (e.g., Chafe, 1974). In this sense, the information is in focus. A focus of a sentence represents a word or constituent that receives prominence by means of syntax, morphology, prosody or a combination thereof. In intonation languages such as German or English speakers dominantly use prosodic means to highlight information. This is known as prosodic focus (Ladd, 1980; Gussenhoven, 1984; Ladd, 1996). Semantically, focus defines a set of alternatives from which one element is chosen by the speaker (Rooth, 1985, 1992; Krifka, 2008). If focus highlights new information, parts of a sentence may contain already old information which is usually referred to as given information, defined here as previously mentioned in the discourse (Allerton, 1978; Baumann, 2006).

Prominence in Akan is achieved by means of different linguistic strategies. Consider first the sentence in (5). Akan is a SVO language (Boadi, 1974; Saah, 1988; Ameka, 1992; Marfo & Bodomo, 2005; Kobele & Torrence, 2006). In (5) *Kòfí* is the subject, *Á!má* the object, and the verb is in progressive aspect as indicated by the L toned prefix rè (cf., Dolphyne, 1988).

(5) Kòfí rè-bòá Á!má.
Kofi PROG-help Ama
'Kofi is helping Ama.'
(Marfo & Bodomo, 2005, p. 185; exclamation mark refers to lexical downstep)

From an information structural point of view, the sentence in (5) represents a neutral statement which we consider as being uttered in an out-of-the-blue context (cf., Ladd, 1980). A sentence uttered without any context or as an answer to a very general question of the type "What happened?" is referred to as broad or wide focus (Ladd, 1980; Büring, 1997; Krifka, 2008). We will use the term wide focus here to refer to our neutral statements in the speech materials, which are elicited without context questions.

Contrary to a neutral statement, a focus is elicited by a context question asking explicitly for a particular constituent of the sentence. The element in question belongs to a set of alternatives (cf., Rooth, 1992, 1995; Krifka, 2008). In Akan, *ex situ* focus is encoded syntactically by constituent fronting to the sentence initial position and morphologically by a focus marker (Boadi, 1974; Saah, 1988; Marfo & Bodomo, 2005; Ermisch, 2006; Kobele & Torrence, 2006; Amfo, 2010). In (6) the object *Á!má* is the answer to the preceding question, hence focused and syntactically fronted. In addition to focus fronting, the L tone focus marker *nà* obligatorily follows the fronted constituent. According to Boadi (1974) the focus marker *nà* has a semantic function of putting the constituent in contrast with a set of discourse alternatives, which in our view constitutes a focus in the sense of Rooth (1985, 1992). A further feature of focus fronting in Akan is pronoun resumption in the case of animate focused elements (Boadi, 1974; Saah, 1988; Ermisch, 2006; Amfo, 2010). According to Kobele and Torrence (2006) this feature, however, is optional, and hence does not occur in our speech materials.

(6) a. Kòfí rè-bòá hénà?
Kofi PROG-help who
'Who is helping Kofi?'
(Adapted from Kobele & Torrence, 2006, p. 162)
b. $[Ámá_i]_F$ nà Kòfí rè-bòá $nó_i$.
Ama FM Kofi PROG-help 3.sg
'It is Ama (that) Kofi is helping.'
(Marfo & Bodomo, 2005, p. 185; transcription is modified from the original[5])

While all papers on focus in Akan agree that focus is expressed *ex situ* syntactically by means of focus fronting, Marfo and Bodomo (2005, p. 187) explicitly state that "a constituent cannot be contrastively focused *in situ* in Akan". The authors argue that the focus marker *nà* represents the head of the extra-sentential focus phrase and thus does not appear *in situ*. However, focus may be realized *in situ* as is shown in (7) (Saah, 1988; Ermisch, 2006). According to Saah (1988) the answer in (7) presupposes the existence of an individual who has been asked for in the question, yet is less emphatic compared to an *ex situ* answer. Saah's analysis is that *in situ* focus is a possible strategy (7).

(7) a. Kòfí hù-nù hénà wɔ́ fíè hɔ́?
Kofi see-PAST who LOC house LOC
'Whom did Kofi see in the house?'
b. Kòfí hù-nù $[Kwàmé]_F$ wɔ́ fíè hɔ́.
Kofi see-PAST Kwame LOC house LOC
'Kofi saw $[Kwame]_F$ in the house.'
(Saah, 1988, p. 25; tone and focus-marking added to the original)

Building on the work of Saah (1988), Ermisch (2006) differentiates between informational focus and identificational focus, which corresponds roughly to informational and corrective focus as we use the terms here (see below). In her view, these two focus categories are expressed differently in the syntax, the former with *in situ* focus, and the latter *ex situ*. The instances of *in situ* focus in Saah (1988), Kobele and Torrence (2006), and Ermisch (2006) do not show any occurrence of the focus marker *nà*. The objection put forward by Marfo and Bodomo (2005) was too strong. While preparing the materials for the present study our informants indeed did accept question-answer pairs with *in situ* focus answers.

To address the question of naturalness of the speech data of the present study and to check for any syntactic preference of prominence marking in Akan we conducted a small-scale situation-description task which was carried out before one of the production experiments (Genzel & Kügler, 2010).[6] Pictures illustrating the situations of the mini dialogues used in that production experiment (cf., (8) and (9) below) were shown to the speakers of this study and they were asked to answer simple wh-questions that elicit a focus structure.[7] The speakers got no prepared answers as in the recordings of the experimental materials but were asked to answer spontaneously. With this task we would expect the speakers to choose their most frequent strategy to answer a question such as "What did Addo buy this morning?". In the answers to an informational focus question no instance of an *ex situ* construction was realized as predicted by Ermisch (2006), and in the answers to a corrective focus question three out of 22 answers were realized *ex situ* (for details see Genzel & Kügler, 2010). These figures show that speakers frequently use the syntactically unmarked

structure, which is in line with Saah (1988) and Ermisch (2006). Thus, the experimental set-up of the present study reflects a frequent use of prominence realization. The fact that we find a similar prosodic effect for both *in situ* and *ex situ* focus constructions further supports *in situ* focus occurrence as a natural way of expressing prominence in Akan.

To be more precise with the concept of focus we need to differentiate between different focus types. According to Krifka (2008) the category of focus can be divided into 'informational' and 'corrective' focus. The former focus type is shown in (7) with a wh-question asking for a particular constituent. Corrective focus on the other hand requires an antecedent in the previous discourse that the focus of the sentence would correct. A corresponding context for (7) would be the question "Did Kofi see Addo in the house?" For the present study we will test both informational and corrective focus.[8] We assume an increase of prominence from informational to corrective focus, which corresponds to the discussion of different degrees of emphasis in Boadi (1974) and Saah (1988), or different focus types in Ermisch (2006). From languages such as German, we know that an increase of focus prominence is correlated with a gradual increase of prosodic cues such as pitch height and duration (Baumann, Grice, & Steindamm, 2006).

Besides focus, other elements of a sentence are in the background (cf., Halliday, 1967; Krifka, 2008). We assume these elements to be given, defined as previously mentioned in the discourse. In (7) above, *Kofi*, *in the house* and the verb are mentioned in the question, thus given in the answer. For the present study we will investigate not only the expression of prominence, in other words focus, but also any effect of givenness, hence no or reduced prominence. Prosodically, givenness may be accompanied by deaccentuation (cf., Cruttenden, 2006 for a range of languages, in particular Indo-European intonation languages) or pitch register compression (Xu, 1999 for Mandarin Chinese; Patil, Kentner, Gollrad, Kügler, Féry, & Vasishth, 2008 for Hindi). Since no detailed phonetic data on Akan exist the present study intends to analyze the phonetic correlates F0 and duration in relation to information structure.

1.5 Research question and hypotheses

The goal of this study is to investigate the impact of information structure on the tonal realization of L and H tones in Akan. This will provide insights into the prominence realization in a tone language, and, more generally, add to the question of the universality of the prosodic expression of prominence. We will consider both informational and corrective focus as well as givenness. Since Akan employs two syntactic constructions to express focus the comparison will include *in situ* and *ex situ* prominence marking. A neutral sentence as wide focus for each syntactic construction matched for sentence length (syllables and tone) will serve as a baseline for comparison.

According to Boadi (1974) raising of H and L tones occurs in the case of *ex situ* focus. The question remains whether this prosodic effect is also found in the case of *in situ* focus. If it is the case that tonal raising is the prosodic correlate of focus in Akan we expect it to be realized *in situ* as well.

The impact of givenness on the prosodic structure is unknown. Two distinct effects may arise: (i) no change in tonal realization, (ii) compression of pitch register as in Mandarin Chinese (Xu, 1999) or Hindi (Patil et al., 2008). Deaccentuation as in intonation languages (cf., Cruttenden, 2006) is not expected since lexical tone distinctions have to be maintained in a tone language.

On the basis of Boadi (1974) we assume that Akan belongs to the group of languages that uses prosodic means for the expression of focus. We therefore predict that Akan is comparable to languages such as German, English or Mandarin Chinese. From a typological point of view the

analysis of a terraced-level tone language like Akan thus adds data to the theory of intonational universals.

2 Production experiments

For the present study, data from three different production experiments are presented. The speech materials as well as the speakers differ across the experiments; however, the elicitation of focus on particular elements of the experimental sentences by means of questions was identical throughout the three experiments. Based on the unexpected findings of experiment 1, that is the pitch register lowering under corrective focus, we conducted two further production studies with different speech materials and different speakers to provide more data that corroborate the analysis.

2.1 Method

2.1.1 Design and materials. The first experiment (experiment 1) involved three factors: information structure (wide focus, informational focus, corrective focus, pre-focal and post-focal givenness), syntactic construction (*in situ* or canonical word order as in (7), and *ex situ* as in (6) above), and tone (L, H). Two target words, one carrying lexically L tones (Àddò, (8)) and one carrying a H tone (àmáǹgò, (9)), were embedded in carrier sentences.

(8) Àgyèmàǹ bóà-à Àddò ánɔ̀pá yí.
Agyeman help-PAST Addo morning this
'Agyeman helped Addo this morning.'

(9) Ànúm̀ tɔ́-ɔ́ àmáǹgò ánɔ̀pá yí.
Anum buy-PAST mango morning this
'Anum bought a mango this morning.'

To elicit the desired information structure of a sentence we used mini dialogues. Each sentence was preceded by a question except for sentences in wide focus. The question-answer task allows for a direct control of the presupposition of the proper target sentence which in turn determines the focus structure of a sentence. Wide focus was elicited without a context and the whole sentence is assumed to be in focus. Examples (8) and (9) show the sentences in the wide focus condition with an *in situ* target word.

The questions set up either an informational (10) or a corrective focus (11) on the target word for both syntactic constructions, or the target word in pre-focal (12) or post-focal (13) position for *in situ* occurrences. The examples (10)–(13) illustrate a question-answer set for the *in situ* target word carrying a L tone. The same focus structures are applied for sentences containing the target word carrying the H tone (9).

(10) a. Hwàńǹ nà Àgyèmàǹ bóà-à ánɔ̀pá yí?
whom FM Agyeman help-PAST morning this
'Whom did Agyeman help this morning?'

b. Àgyèmàǹ bóà-à [Àddò]$_F$ ánɔ̀pá yí.
Agyeman help-PAST Addo morning this
'Agyeman helped Addo this morning.'

(11) a. Àgyèmàǹ bóà-à Ànúm̀ ánɔ̀pá yí?
Agyeman help-PAST Anum morning this
'Did Agyeman help Anum this morning?'
b. Dàábí! Àgyèmàǹ bóà-à [Àddò]$_F$ ánɔ̀pá yí.
No! Agyeman help-PAST Addo morning this
'No! Agyeman helped Addo this morning.'

(12) a. Àgyèmàǹ bóà-à Àddò ɛ̀ǹnórà?
Agyeman help-PAST Addo yesterday
'Did Agyeman help Addo yesterday?'
b. Dàábí! Àgyèmàǹ bóà-à Àddò [ánɔ̀pá yí]$_F$.

(13) a. Àgyèmàǹ bɔ̀-ɔ̀ Àddò ánɔ̀pá yí?
Agyeman beat-PAST Addo morning this
'Did Agyeman beat Addo this morning?'
b. Dàábí! Àgyèmàǹ [bóà-à]$_F$ Àddò ánɔ̀pá yí.

The second syntactic construction consists of sentences with the two target words in sentence initial position, with the target word fronted due to focus. In (14) and (16) the target words carrying L and H tones appear in focus position, with the obligatory morphological focus marker *nà*. To make this kind of prominence explicit the literal translation in English contains a cleft construction. The original Akan sentence is not a syntactic cleft construction. In order to identify any prosodic effect of focus in this particular position the phonetic properties of the target word need to be compared with sentence initial non-focused target words. These are given in (15) and (17) for the target word carrying L tone and H tone respectively. The target words appear as canonical pre-verbal subjects.

The whole data set of experiment 1 consisted of 16 sentences (5 information structures × 2 target words *in situ*, plus 3 information structures × 2 target words *ex situ*).

(14) Àddò nà Àgyèmàǹ bóà-à ánɔ̀pá yí.
Addo FM Agyeman help-past morning this
'It was Addo who helped Agyeman this morning.'

(15) Àddò bóà-à Àgyèmàǹ ánɔ̀pá yí.
Addo help-PAST Agyeman morning this
'Addo helped Agyeman this morning.'

(16) Àmáǹgò nà Ànúm̀ tɔ̀-ɔ̀ ánɔ̀pá yí.
mango FM Anum buy-PAST morning this
'It is a mango that Anum bought this morning.'

(17) Àmáǹgò àtè fìrì dùá nó só ánɔ̀pá yí.
mango AUX leave.PAST tree DET down morning this
'A mango has fallen down the tree this morning.'

The second experiment (experiment 2) replicated the first experiment with a different group of speakers concentrating on the *in situ* focus constructions. Two factors (information structure and tone) were studied to gain more evidence for the unexpected focal lowering observed in experiment 1. As for information structure the sentences were uttered without a context question eliciting wide focus, and with context questions eliciting both informational and corrective focus. One disyllabic word carrying lexical H tones (18), and one trisyllabic word carrying lexical L tones (19) on each syllable were embedded in a carrier sentence that was controlled for lexical tone and that resembles the one of experiment 1.

(18) Àfúà hù-nù wɔ́má ánɔ̀pá yí.
Afua see-PAST pestle morning this
'Afua saw a pestle this morning.'

(19) Àfúà hù-nù àtèrè ánɔ̀pá yí.
Afua see-PAST spoon morning this
'Afua saw a spoon this morning.'

A third experiment (experiment 3), again with a different group of speakers, was designed to test for the focal lowering in a different sentence frame in combination with downstep. The target word, that is the proper name in (20) has the tonal specification L-H-L-H, which presents the environment for downstep. Remaining tones in the sentence are low in order to not intervene with other H tones, except for the last H tone which phonetically turns into a L tone at the end of an utterance (Dolphyne, 1988; cf., also Good, 2004 for a similar phenomenon in Saramaccan). The sentence in (20) was recorded without context, and with a context question asking "Is it Kofi Annan speaking?" which contrasts the surnames 'Annan' and 'Gyima'.

(20) ɛ̀-yɛ̀ Kòfí Gyìmá nà ɔ̀-rè-kàsá
PRO-be.PRES Kofi Gyima FM PRO-PROG-speak
'It is Kofi Gyima speaking.'

2.1.2 Participants. In all three experiments speakers were native speakers of Asante Twi as spoken in and around Kumasi. All speakers declared English as their second language. Eleven speakers (6 female and 5 male) participated in experiment 1. Eight participants were students of the University of Ghana in Accra. As for the other three, one was in the army and based in Kumasi, another worked in a pharmacy, and the third one worked as a university lecturer. The average age was 26 years.

In experiment 2, five speakers (4 male, 1 female) who study in Minot, North Dakota, participated. Their average age was 28 years. Five speakers (3 male and 2 female) participated in experiment 3. Their average age was 32 years. All of the speakers lived in Berlin working in different companies or were exchange students at a university in Berlin. Each speaker was paid a small fee for participation.

2.1.3 Recording procedure. The experiments were carried out using presentation software. The question-answer trials were prepared in Akan orthography. The questions, spoken by a young female, were pre-recorded in a quiet room in Berlin directly onto a laptop using Audacity (Version 1.2.6) and a headset (Logitech Internet Chat Headset). The question-answer pairs were presented

to each speaker in a pseudo-randomized order. Items from two other experiments, unrelated to these experiments, were interspersed as fillers.

Participants were digitally recorded onto a laptop via a headset (Logitech Internet Chat Headset) using Audacity (Version 1.2.6). The headphones were binaural with a frequency spectrum from 20 to 20,000 Hz and an acoustic impedance of 32 Ohm with an integrated volume control, so that every participant could adjust the volume. The microphone was an electret condenser type with a sensitivity of –39 dbV/Pascal. The first experiment was carried out in a quiet room in the Linguistics Department at the University of Ghana, the second in a quiet room in Minot, North Dakota, and the third in a quiet room in Berlin.

The participants were familiarized with the task through written and oral instructions, followed by four practice trials. Trials consisted of a visual presentation of the question and its answer on a computer screen, or only the statement in the case of wide focus. Participants heard the prerecorded question over headphones. Simultaneously the target sentence was presented on the screen. The participants were instructed to first listen to the question and to subsequently read the answer quietly. Then, the question was presented again and the participants had to read the answer out loud as a response to the question. If the answer started with *dààbí* 'no' the participant was asked to put a pause after it. If the question was answered without any hesitations, false starts or missing phrasing, the next trial was presented. If there were hesitations the participants were asked to repeat the answer which was the case for 28 out of 264 items (11%) in the first experiment and about equivalent ratios in the other two experiments. Presentation flow was controlled by the experimenter and participants were allowed to take a break whenever they wanted. In total each of the experiments lasted approximately 45 minutes.

2.1.4 Data pre-processing and statistical analysis. The recordings were digitized at a sampling frequency of 44.1 kHz and 32 bit resolution. The target word in all sentences was labeled by hand at the level of the word and the syllable. Labeling in Praat (Boersma & Weenink, 2008) was based on a see-listen-label method, in other words visually evaluating the spectrogram and listening to the sound files. Standard cues for segmental labeling were employed (Turk, Nakai, & Sugahara, 2006) and boundaries were set automatically at zero crossings using a Praat script. For each target word the durations of the word and the syllables were extracted using a Praat script.

The F0 analysis was based on a Hanning window of 0.4 seconds length with a default 10 milliseconds analysis frame. Every pitch object was visually checked for octave jumps and algorithm faults. Those were manually corrected. Applying the Praat smoothing function, the F0 was smoothed at 10 Hz to diminish microprosodic perturbations. Two different measurements were conducted. First, for each syllable of the target word the time-normalized course of the F0 contour was extracted by measuring the F0 at ten equal steps during each syllable. Resulting F0 measures were aggregated per speaker and condition. The aggregated scores were plotted over time steps interpolating between the individual measures. This type of measurement provides phonetic details of the course of the F0 contour. Second, tones were labeled for every target word. The tonal marker was set manually at the middle of each of the tone bearing vowels. We assume the mid-point of each TBU to reflect a phonetic interpretation of a discrete lexical tone. The corresponding F0 was extracted in Hertz (Hz).

The statistical analysis relied on the dependent variables 'F0 (Hz)' and 'duration (ms)'. The scores were subjected to repeated measures ANOVAs with speaker as random factor. Further, the obtained F0 values were aggregated within each participant and each condition to calculate the difference (Δc) of F0 and duration between the wide focus baseline realization and any of

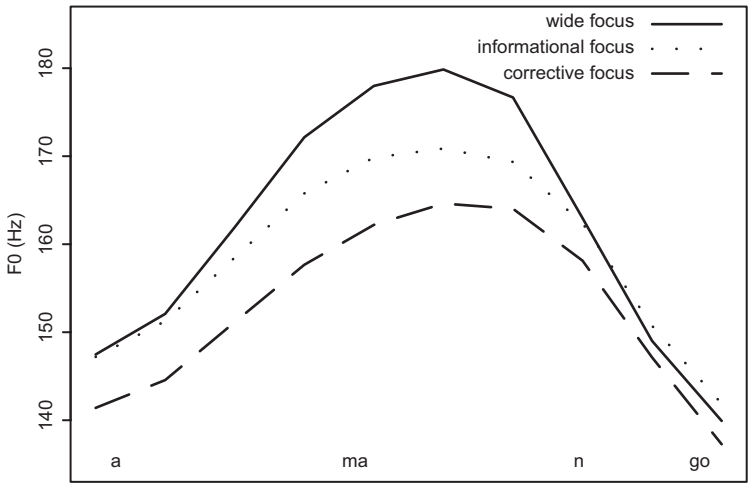

Figure 2. Time-normalized course of F0 by syllable on the target word carrying a H tone, *àmáǹgò*, occurring in *in situ* focus position, aggregated for all speakers (n = 11). The solid line corresponds to the wide focus condition, the dotted line to informational focus, and the dashed line to corrective focus.

the four information structure conditions for the first experiment. For the other two experiments we calculated the difference between the wide focus baseline and the corrective focus conditions.

3 Results

The analysis of information structure effects on the tonal and durational realization comprises two different dimensions of prominence. First, an increase in prominence is expressed from informational to corrective focus compared to neutral wide focus sentences. Second, a decrease in prominence is expressed if the target word is given and the focus of the sentence appears either before or after the target word. In the former case, the target word occurs as post-focally given, in the latter as pre-focally given. The presentation of the results is organized by experimental factors. We will first report the effect of *in situ* focus on the tonal and durational realization across the three experiments. Thereafter we will present results of the effect of syntactic focus construction on the tonal and durational realization comparing *in situ* and *ex situ* focused target words of experiment 1. Finally we will elaborate on the effect of givenness on the tonal and durational realization of experiment 1. The presentation will consider H and L tones separately.

3.1 The effect of in situ *realized focus on tone and duration*

Overall, a gradual decrease in F0 height can be observed with increasing prosodic prominence. Figure 2 shows the course of F0 for the target word *àmáǹgò* of experiment 1. The second syllable carries a lexical H tone. The solid line displays the wide focus condition which serves as the baseline for comparison. The dotted line represents the target word in informational focus, the dashed line in corrective focus. In all three conditions F0 increases towards and decreases from an F0 maximum on the syllable that carries the lexical H tone.

The scaling of the H tone differs as a function of information structure. It is realized lower if focused. The aggregated mean F0 for wide focus is at 181 Hz, for informational focus at 172 Hz, and for corrective focus at 166 Hz (cf., Table 1). On average the lowering of corrective focus *in situ*

Table 1. Mean F0 values in Hertz for H and L tones, averaged across speakers and tones with standard deviation in parentheses, are given for the three different production experiments. The amount of F0 difference in semitones (Δ (st)) is calculated between the wide (wFoc) and corrective (cFoc) focus condition. The averaged data from experiment 1 are also split by syntactic focus construction, *in situ* and *ex situ* focus.

	H tone			L tone		
	wFoc	cFoc	Δ (st)	wFoc	cFoc	Δ (st)
Exp 1	214 (68)	195 (70)	1.6 ***	153 (40)	145 (38)	0.9 n.s.
Exp 1 *in situ*	181 (44)	166 (41)	1.5 *	143 (39)	135 (36)	1.0 **
Exp 1 *ex situ*	248 (72)	224 (67)	1.8 ***	162 (40)	155 (37)	0.8 n.s.
Exp 2	150 (35)	140 (32)	1.2 *	134 (34)	127 (31)	0.9 n.s.
Exp 3	146 (32)	140 (30)	0.7 *	132 (29)	129 (28)	0.4 n.s.

Significance levels: * < 0.05; ** < 0.01; *** < 0.001; n.s. not significant.

amounts to 1.5 st. Equivalent figures are found in the other two experiments (cf., Table 1), though the lowering effect only amounts to 1.2 st in experiment 2 and to 0.7 st in experiment 3.

To test for a significant effect of focus in experiment 1, a 3 × 2 repeated measures ANOVA was performed with Focus and Syntactic Construction as fixed factors and Subject as random factor. The main effect of Syntactic Construction will be discussed later in the next section. The analysis revealed a significant main effect of Focus, $F(2, 10) = 17.4$, $p < 0.001$ for the H tone in experiment 1. Post-hoc *t*-tests showed no significant effect for informational focus compared to the wide focus baseline, but a significant lowering of corrective focus compared to wide focus for *in situ* focus, $t(1, 10) = 3.0$, $p < 0.05$. A repeated measures ANOVA for experiment 2 with Focus as the fixed factor and Subject as the random factor revealed a significant lowering of the H tone in the case of corrective focus compared to wide focus, $F(1, 4) = 10.0$, $p < 0.05$. An identical repeated measures ANOVA for experiment 3 with Focus as the fixed factor and Subject as the random factor revealed also a significant lowering of the H tone in the case of corrective focus compared to wide focus, $F(1, 4) = 14.6$, $p < 0.05$. Recall that in experiments 2 and 3 the factor Focus comprises only two levels, that is the distinction between wide and corrective focus.

The durational figures showed no consistent pattern across experiments. The duration of the target word carrying the H tone in experiment 1 was on average 58 ms shorter in the corrective focus condition compared to the wide focus. The durational reduction amounts to 10.3% of the average word duration in wide focus. A 3 × 2 repeated measures ANOVA that was identical to the one carried out for F0, was carried out for duration. The factor Focus showed a main effect, $F(2, 10) = 9.1$, $p < 0.01$. Post-hoc *t*-tests only showed a significant reduction of duration in the case of corrective focus compared to wide focus, $t(1, 10) = 2.5$, $p < 0.05$. However, for experiments 2 and 3 no significant difference in duration between focus conditions was observed.

Figure 3 shows the course of F0 on the target word *Àddò*. Again, the solid line displays the wide focus condition which serves as the baseline for comparison. For the target word carrying L tones a similar gradual decrease in F0 height with increasing prosodic prominence can be observed as for the target word carrying a H tone. On the first syllable F0 falls towards a L tone target. F0 on the second syllable remains rather flat at a level of, on average, between 130 to 140 Hz. Generally it becomes clear that the second lexical tone is realized lower than the first one. This seems mainly to be due to the fact that the F0 on the first syllable is a transition from a preceding H tone to the L tone target associated with this syllable (cf., (8)).

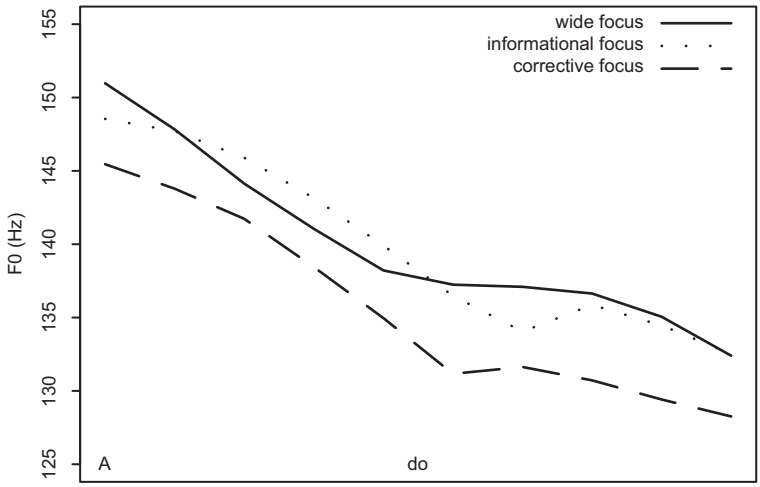

Figure 3. Time-normalized course of F0 by syllable on the target word carrying L tones, *Àddò*, in *in situ* position, aggregated for all speakers (n = 11). The solid line corresponds to the wide focus condition, the dotted line to informational focus, and the dashed line to corrective focus.

Again, a 3 × 2 repeated measures ANOVA was performed with Focus and Syntactic Construction as the fixed factors and Subject as the random factor. The factor Focus approached significance, $F(2, 9) = 2.9$, $p = 0.077$.[9] Post-hoc t-tests only showed a significant lowering of corrective focus compared to wide focus for *in situ* focus, $t(1, 9) = 2.9$, $p < 0.01$. On average the lowering was about 1.0 semitone in experiment 1 (cf., Table 1).

Given the lowering effect of L tones in corrective focus compared to the wide focus baseline the question remains whether both L tones equally participate in the lowering effect. To test this, a further repeated measures ANOVA was performed with Syllable (first vs. second syllable carrying a lexical L tone) as the fixed factor and Subject as the random factor. The analysis revealed a significant difference between the two lexical L tones, $F(1, 9) = 7.3$, $p < 0.05$. Post-hoc t-tests showed then that only the second of the two L tones was significantly lower in the corrective focus condition compared to the wide focus condition, $t(1, 9) = 4.2$, $p < 0.01$.

In experiments 2 and 3 corrective focus causes a similar lowering effect on L tones, yet the comparisons did not yield any significance, $F(1, 4) = 3.1$, $p > 0.05$ for experiment 2, $F(1, 4) = 1.2$, $p > 0.05$ for experiment 3. In experiment 3, the L tone precedes the downstepped H tone, and may therefore not be systematically affected.

Given the different participation of L tones in the lowering found in experiment 1, we also performed a repeated measures ANOVA with Syllable (first vs. second vs. third lexical L tone) as the fixed factor and Subject as the random factor for experiment 2 (target word *àtèrè* 'spoon') comparing wide focus with corrective focus. If only the last L tone may participate in the lowering effect as in experiment 1, the insignificant main effect for Syllable may be masked by the fact that the target word is realized with three L tones. Thus, the ANOVA tests any participation of the individual lexical tones in the lowering effect. The analysis revealed a highly significant effect of Syllable, $F(2, 4) = 35.8$, $p < 0.001$. A repeated measures ANOVA for each of the three tones with Focus as the fixed factor and Subject as the random factor only showed a significant lowering of the third lexical L tone, $F(1, 4) = 8.6$, $p < 0.05$.

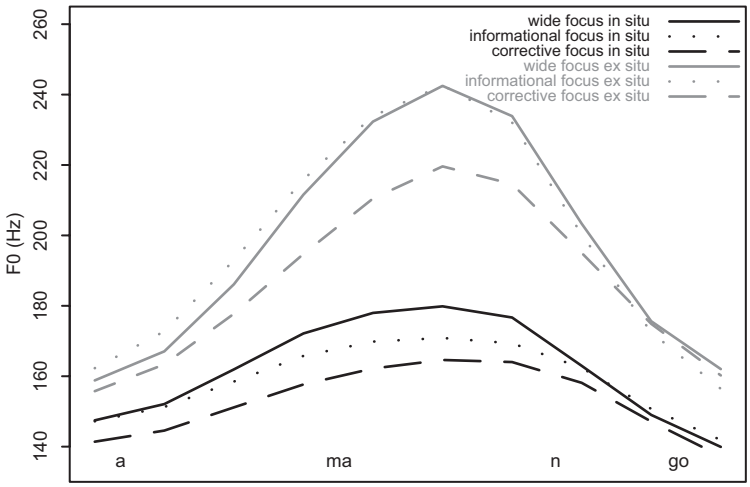

Figure 4. Time-normalized course of F0 by syllable on the target word carrying a H tone, *àmáǹgò*, aggregated for all speakers (n = 11). Black lines refer to the *in situ* target word occurrence, grey lines to the *ex situ* ones. The solid lines correspond to the baseline condition (wide focus), the dotted lines to informational focus, and the dashed lines to corrective focus.

As far as duration is concerned, in none of the three experiments we obtained a significant effect for the target word carrying L tones, and no consistent pattern was observed. The durational change between the wide focus baseline and the corrective focus condition in experiment 1 was a reduction of 15 ms on average, while it was an increase of 20 ms on average in experiment 2, and no difference in experiment 3.

3.2 The effect of ex situ *realized focus on tone and duration in comparison to* in situ *focus*

The analysis so far has considered the occurrence of target words in sentence medial, in particular post-verbal position which corresponds syntactically to the canonical or neutral word order in Akan (e.g., Kobele & Torrence, 2006). For the expression of prominence speakers of Akan may, however, choose a different syntactic construction which is accompanied by morphological focus marking (cf., (6b)). To provide evidence for any prosodic effect of *ex situ* focus two wide focus sentences with the target words appearing in sentence initial position served as a baseline for comparison in experiment 1.

Figure 4 shows the time-normalized course of F0 aggregated for all speakers for the target word carrying the H tone appearing *in situ* (black lines) and *ex situ* (grey lines). The solid lines correspond to the wide focus, respectively. Dotted lines correspond to informational focus, and dashed lines to corrective focus conditions. Two facts become obvious from that comparison. First, the sentence initial rendition of the target word is overall higher in F0 than the *in situ* (medial) one. Syllables carrying a L tone are on average 30 Hz higher, the syllable carrying a H tone is on average 80 Hz higher. The 3 × 2 repeated measures ANOVA with Focus and Syntactic Construction as fixed factors and Subject as random factor exposed a significant main effect of Syntactic Construction, $F(1, 10)$ =

41.0, $p < 0.001$. The fact that the overall higher realization of initial target words compared to medial ones is significant is expected in a terraced-level tone language (cf., Figure 1 above).

Second, the H tone in the corrective *ex situ* focus rendition is lower than in informational focus and in the wide focus condition. Post-hoc *t*-tests show that the comparison between the baseline and the informational focus condition yields no significance, $t(1, 10) = 0.7$, $p > 0.05$ while the average lowering of 1.8 st (cf., Table 1) in corrective focus compared to the wide focus baseline is significant, $t(1, 10) = 5.5$, $p < 0.001$. The amount of lowering in the *ex situ* construction (1.8 st) is higher than in the *in situ* construction (1.5 st) (cf., Table 1).

The durational patterns in sentence initial position differ from those of the *in situ* construction. Overall, no shortening of word duration between the wide focus baseline and the two focus conditions is observed. On average the durational differences are very small, 8 ms lengthening in informational focus and 7 ms shortening in corrective focus. The 3 × 2 repeated measures ANOVA did not reveal any significant differences for duration.

Also for the target word carrying L tones the overall higher realization of *ex situ* target words compared to *in situ* realizations can be observed. The average difference between these two is about 30 Hz across conditions. The 3 × 2 repeated measures ANOVA with Focus and Syntactic Construction as the fixed factors and Subject as random factor showed a significant main effect of Syntactic Construction, $F(1, 9) = 87.1$, $p < 0.001$.

Comparing the L tone in *ex situ* position across focus conditions we observe an overall lowering (cf., Table 1). As reported above, the factor Focus in the 3 × 2 repeated measures ANOVA with Focus and Syntactic Construction as fixed factors and Subject as random factor approached significance, $F(2, 9) = 2.9$, $p = 0.077$. Post-hoc *t*-tests for *ex situ* focused words, however, did not reveal any significant difference between the wide focus condition and informational focus, $t(1, 9) = 0.4$, $p > 0.05$, or between wide focus and corrective focus, $t(1, 9) = 1.8$, $p > 0.05$.

The durational patterns of the L tone target word in sentence initial position did not show any significant difference. On average the target word shortened about 5 ms in informational focus and 16 ms in corrective focus compared to the wide focus condition.

3.3 The effect of givenness on tone and duration

If the preceding context question contains a word or constituent that is repeated in the target answer sentence, this element is considered to be given. At the same time the focus of the sentence appears elsewhere in that sentence, either before the target word or after it. Figure 5 shows the course of F0 on the target word *àmáŋgò* comparing the wide focus condition as the baseline with the target word when pre-focally given, and when post-focally given. We observe a difference between a pre-focal and a post-focal target word. The syllable of the target word carrying the H tone in the post-focal condition is realized lower than in both the wide focus and pre-focal condition (Figure 5).

A repeated measures ANOVA for the H tone with Givenness as the fixed factor and Subject as the random factor revealed a significant main effect of Givenness, $F(2, 10) = 9.2$, $p < 0.001$. Post-hoc *t*-tests exposed that only the post-focal givenness condition showed a significant lowering effect of 1.4 semitones on average compared to wide focus, $t(1, 10) = 4.1$, $p < 0.005$. In pre-focal position there was no significant lowering effect compared to wide focus.

The overall word duration decreases with a decrease in prominence assuming that given words are less prominent. Compared with the mean word duration of 536 ms in wide focus, pre-focally given words are on average 21 ms shorter in duration, while the shortening of post-focally given words amounts to 51 ms on average. However, a repeated measures ANOVA with Givenness as the fixed factor and Subject as the random factor revealed no significant main effect.

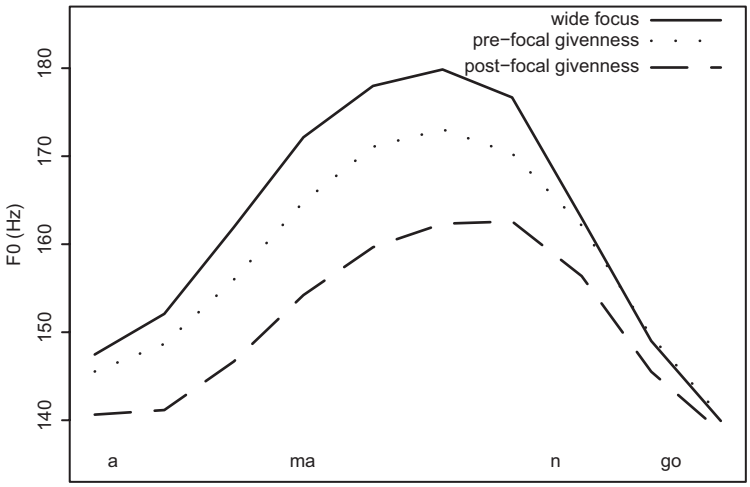

Figure 5. Time-normalized course of F0 by syllable on the target word carrying a H tone, *àmáǹgò*, in *in situ* position, aggregated for all speakers (n = 11). The solid line corresponds to the wide focus condition, the dotted line to pre-focal givenness, and the dashed line to post-focal givenness.

For the target word carrying L tones, *Àddò*, no significant effect of givenness was observed, $F(1, 9) = 1.4$, $p > 0.05$. Also for duration, the repeated measures ANOVA yielded no significance, although the means across speakers show a durational decrease of 17 ms on average in post-focal condition, and 29 ms in pre-focal condition.

4 Discussion

4.1 Intonation in tone languages

This study presented the results of three production experiments on Akan, a two-tone language spoken in Ghana. The main question under investigation was whether sentence-level pragmatic meanings (Ladd, 1996) such as focus and givenness may be prosodically encoded in a tone language despite the fact that the phonetic correlate F0 is functionally used to distinguish lexical and core grammatical meanings of tones. Languages indeed differ with respect to the prosodic properties they use for the expression of prominence or focus if at all. In the introduction we discussed that languages do differ as a function of their typological profile in the use of prosodic properties. For intonation languages like Wolof, for instance, no effects of focus on the intonation have been found (Rialland & Robert, 2001), while for other intonation languages such as German and English numerous studies exist that show such effects. On the other hand certain tone languages, for example Mandarin Chinese (Xu, 1999, 2005), show similar effects as intonation languages in the prosodic expression of focus.

The expectations for Akan were that speakers employ prosodic means for the expression of informational and corrective focus (Boadi, 1974). The results of the present study indeed corroborate the expectation, yet in an unexpected way. While the hypothesis based on Boadi's (1974) claim was that the prosodic expression of focus would result in tonal raising as in Mandarin Chinese, English or German, the data of the three independent production studies showed a pitch register lowering effect in the case of corrective focus. This effect is robust for lexical H tones, and only

marginally observed for L tones. In the following, this effect will be discussed in light of the theory of the biological codes of intonation.

4.2 Deviation from a neutral register

The main finding of this paper is that the prosodic expression of pragmatic prominence in Akan goes against expectations and, more strikingly, against the prosodic effect of tonal or register raising and durational lengthening in relation to focus (e.g., Ladd, 1996; Gussenhoven, 2004; Féry & Kügler, 2008). In Akan, we find a gradual decrease in F0 height with increasing prosodic prominence. However, duration was not affected in a systematic way. Comparing a pragmatically neutral rendition of a target word embedded in a sentence with renditions of the same target word in informational and in corrective focus we observed pitch register lowering for lexically H and certain L tones. The lowering was significant only in the case of corrective focus.

In light of a theory of the biological foundations of intonation such as the biological codes (Gussenhoven, 2002, 2004), the results of Akan pitch register lowering appear to go against an assumption made based on the effort code. According to the effort code putting more effort into the speech production mechanism correlates with more precise supralaryngeal articulatory movements (de Jong, 1995) and less undershoot of articulatory targets in terms of Lindblom's (1990) hyper- and hypo-speech theory of speech production. The more precise articulation does also affect the laryngeal coordination and thus the properties of tone and intonation which in turn means an expansion of pitch movements, hence the pitch register (Gussenhoven, 2002, 2004). Gussenhoven relates this effect to emphasis, a general communicative goal of a speaker to get his message across. From a grammatical point of view the effort code is related to the expression of focus which is phonetically realized by means of relatively wide F0 excursions. In particular the phonetic and phonological details of the prosodic expression of focus revealed a tonal or register raising in Germanic languages such as English (Cooper et al., 1985; Eady & Cooper, 1986; Eady et al., 1986), Dutch (Swerts, Krahmer, & Avesani, 2002), and German (Baumann et al., 2006; Baumann, Becker, Grice, & Mücke, 2007; Féry & Kügler, 2008).

The prosodic expression of focal prominence by means of pitch register lowering contradicts the idea of the effort code which predicts its deviation from a neutral voice only in one direction, in other words an expansion of pitch register which causes a raising of tones. On the basis of the present findings we would suggest an alternative view on the prosodic expression of focus. Given the fact that the prosodic expression of focus differs from a neutral register (wide focus) it seems plausible that it is not the direction of change, in other words raising as in Germanic languages and as predicted by the effort code, that does matter but the **deviation** from the neutral register.

Since the durational measurements did not show a consistent pattern across the three experiments, the observed durational reduction of target words of experiment 1 does not seem to correlate with the effect of pitch register lowering. However, one may assume a correlation between segmental duration and F0. If focus causes a durational reduction of segments there is less time to reach a specific tonal target. According to Xu and Sun (2001) the vocal folds need a certain amount of time to accommodate a higher or lower F0. Less time or shorter duration means thus that any continuous F0 change results in lower F0 maxima or higher F0 minima. Since we did not find a consistent durational reduction in our data we assume no direct correlation between the segmental duration and the realization of lower H and L tones under focus. Also the inconclusive durational patterns do not hint at target undershoot as would have been a prediction of Lindblom's (1990) hyper- and hypo-speech theory of speech production. The precision in articulation still remains, but

the pitch register is lowered, which causes the tonal target to be realized lower. For the target words carrying L tones the lowering effect would also go against the undershoot view since this would predict somewhat higher L tones. This fact points to the direction that the deviation of F0 in corrective focus cannot be a consequence of a durational change.

A further hint for the argument that the deviation from a neutral pitch register matters regardless of which direction the deviation goes, comes from languages that use prosodic phrasing as a prosodic cue for the expression of focus, for instance Chichewa (e.g., Kanerva, 1990; Downing et al., 2004). According to Downing et al. (2004, p. 184) focused words or phrases in Chichewa are recognized because they deviate in some sense from an unmarked prosodic structure. This deviation from a neutral phrasing is the crucial point of view in relation to an effort driven theory.

Evidence from unrelated languages also shows that corrective focus is realized in strikingly different ways (Ladd, 1996, p. 177). According to Ladd, corrective focus in Italian, for instance, induces post-focal deaccentuation of larger constituents although deaccentuation usually does not apply (Swerts et al., 2002). Moreover, Akan does not seem to be an exceptional case employing pitch register lowering in the prosodic expression of corrective focus. Gili Fivela (2008) reported a similar lowering for Italian in correlation with corrective focus. Even for English, Cooper and Sorensen (1981, p. 3) report that focus occasionally is expressed with "unusual low F0" (cf., Liberman & Pierrehumbert, 1984, for a similar prediction in relation to low pitch accents). And also the data by Xu (1999, 2005) on Mandarin Chinese reveal not only tonal raising, but also lowering for the L tone. Thus, the fact of lower pitch register as a prosodic expression of focus cannot be regarded as an exceptional case of language variation. And given the idea that a deviation from neutral register may guide listeners' attention to central informational parts of an utterance, more languages are expected to employ deviant patterns.

Anecdotal evidence for the deviation account comes from classroom experience at the university level. As a teacher, one may raise one's voice to attract the attention of students mumbling or whispering. However, the first author frequently employs the opposite strategy of lowering his voice to achieve the goal of directing attention towards the content of the lecture. This example simply shows that the communicative function of highlighting information that is correlated with intonation can be achieved by means of different strategies.

4.3 On the universality of the prosodic expression of givenness

This study tested not only the prosodic expression of focus but also any effect of givenness on the tonal realization. The property of givenness arises through a focus elsewhere in the sentence. Languages appear to distinguish between these different positions with respect to givenness. Cruttenden (2006) surveyed a great variety of languages that do show post-focal deaccenting, which means that no tonal correlates after the focus appear. Yet, languages like Hindi or Mandarin Chinese, for instance, do not show a complete deletion of tonal cues after a focus but post-focal register compression that still allows tones to be realized (Patil et al., 2008; Xu, 1999). Since tone languages rely on the expression of tonal distinctions for lexical and grammatical reasons, we would not expect complete tonal deletions after a focus. However, register changes as is the case in Mandarin Chinese may well be an issue. In contrast to post-focal position, pre-focally given words, constituents or phrases may or may not be prosodically marked. In German, for instance, pitch accents may well be realized before a focus (Baumann, 2006). If pre-focally realized the scaling of these accents appears in a lower pitch register, an effect which Féry and Kügler (2008) relate to givenness.

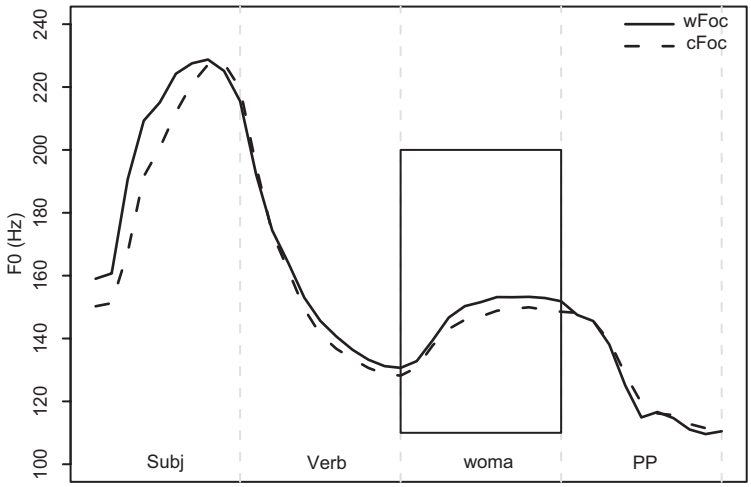

Figure 6. Time-normalized course of F0 by syllable for the sentence *À fúà hùnùù wɔ́má ánɔ̀pá yí*, aggregated for all speakers (*n* = 5). The target word *wɔ́má* carries two H tones. The target word is highlighted. The solid line corresponds to the wide focus condition, the dashed line to corrective focus.

In Akan we do not find register effects exclusively attributable to givenness. The position of the focus towards the given element is relevant for its prosodic realization since a distinction between pre-focal and post-focal givenness with respect to its prosodic expression is observed. For lexical L and H tones associated with words occurring in pre-focal position we did not find any significant difference in the tonal realization compared to the neutral realization. This observation rules out an alternative explanation for the focus lowering effect. According to one reviewer an alternative interpretation of the pitch register lowering due to focus reported here could be a global register lowering affecting the whole utterance. The global lowering may arise if one assumes an influence from the negation marker *dààbí* 'no'. During the data elicitation, speakers were asked to clearly pause after the negation marker. This instruction was given to ensure no further effect on the following target sentence. All speakers acted according to this instruction, and evaluation of the recordings revealed a clear pause in all recordings.

The fact that pre-focal givenness does not show any significant lowering provides evidence against a global interpretation of register lowering. If the sentences containing a corrective focus would be consistently realized in an overall lower register as a consequence of the negation marker, we would have expected a clear pre-focal effect in our materials of experiment 1.

Figure 6 provides further evidence that the pitch register lowering effect is a local one rather than a global one. In Figure 6 the averaged course of F0 across all speakers of the whole utterance containing the target word carrying H tones from experiment 2 is shown. This sentence perspective on the F0 course as employed for instance by Remijsen and van Heuven (2005) allows for a conclusive decision of global or local implementation of the lowering effect.

From the comparison of the wide focus renditions with that of corrective focus it follows that the lowering takes place on the target word itself. The F0 of the previous H tone associated with the subject of the utterance is scaled exactly at the same height. In summary, the data of the present study suggests that the pitch register lowering induced by corrective focus is a local effect affecting the focused word and the stretch of utterance after it (cf., Figure 5).

Therefore we found a lowering of the pitch register in post-focal position for both lexically L and H tones. The observed post-focal lowering of tones compared to the wide focus baseline turns out to be a tonal realization in a lower register that previously has been triggered by focal lowering. Thus, post-focal tones in Akan are lowered not because of the fact that givenness reduces any articulatory effort or any degree of prominence but because of focal lowering.

4.4 Pitch register lowering and categories of focus in Akan

Following Krifka (2008) we distinguish between informational and corrective focus throughout the paper. The latter has been shown to be prosodically realized by means of pitch register lowering while the former does not differ from wide focus or out-of-the-blue utterances. From this distinction the question arises whether there is a concept such as informational focus in Akan.[10] Hartmann (2008) claims that there is only one category of focus and she presents evidence from German and Hausa supporting this claim. The variance between different types of focus then is claimed to be gradient. While this is certainly true for German, Akan clearly distinguishes between a corrective focus and other types of focus. One interpretation that might explain this sharp distinction could be the very fact that Akan as a tone language uses F0 primarily as a cue to express tone. Hence, F0 is not used to distinguish between a wide and an informational focus. In the case of corrective focus, on the other hand, an additional pragmatic prominence comes into play which speakers may want to express even prosodically. This additional prominence is correlated with a stronger communicative goal to emphasize a certain part of an utterance, and speakers of Akan draw attention to that kind of information by means of pitch register lowering.

4.5 Positional effects on prosody

A third conclusion of this paper concerns the comparison between *in situ* and *ex situ* focused elements. Our data do not support Boadi's (1974) claim that both L and H tones are raised in *ex situ* focus. On the contrary, Figure 4 clearly shows a significant F0-lowering in the case of corrective focus for both *in situ* and *ex situ* cases. Thus, the prosodic expression of focal prominence by means of pitch register lowering is similar in different syntactic focus constructions and independent of any other linguistic marking of focus may it be syntax and morphology in the case of *ex situ* focus.

Possibly, Boadi interpreted the overall higher pitch register at the beginning of a sentence as an effect of focus on the tonal realization. In his data, Boadi did not compare the pretended raised tone with a baseline. Being overall higher at the beginning of an utterance simply reflects the start of an utterance but does not express prominence. The tendency of speakers across languages to start higher at the beginning of an intonation phrase led Gussenhoven (2002, 2004) to propose the production code, which he assumes to be a physiological correlation of more subglottal pressure at the beginning of an intonation phrase. The data in our study very clearly disentangle the positional effect from the information structural effect in that we compare the corrective focus case in both focus constructions with an equivalent neutral baseline realization.

4.6 Summary

Given the fact that Akan uses intonation, for instance to distinguish between questions and statements, the question of the present study was to what extent pragmatic prominence influences the scaling of tones, which is determined by the pitch register. We showed that pragmatic prominence induces pitch register lowering in the case of corrective focus independent of syntactic

construction. The lowered pitch register is maintained in a phrase so that post-focal tones are scaled relative to the lowered register. The pragmatic meaning of contrast is expressed prosodically but the prosodic expression is constrained by the tonal phonology of Akan.

Acknowledgements

This paper is part of the research project D5 "Tonal structure and information structure" within the Collaborative Research Centre on Information Structure at Potsdam University which is funded by the German research foundation DFG (SFB 632). Parts of this paper have been presented at the University of Ghana, January 2009, at the annual meeting of *Phonetik und Phonologie-5* in Cologne, March 2009, and at the workshop on Intonation and Meaning, Barcelona, September 2009. We thank all participants for valuable discussion. We would like to thank, in alphabetical order, a number of people who contributed to this work: Akua Appiah-Akuramaa, Dinah Baer-Henney, Afua Blay, Daniel Büring, Heiner Drenhaus, Kofi Dorvlo, Laura Downing, Ines Fiedler, Sophia Jähnigen, Annie Rialland, Kofi Saah, Bernadett Smolibocki, Anne Schwarz, Hubert Truckenbrodt, Ruben van de Vijver, and Malte Zimmermann. This paper has benefited from the detailed and thorough thoughts of two reviewers, Bettina Braun and Bert Remijsen as well as the Associate Editor Marc Swerts.

Notes

1. The notion of pitch register is used in a non-uniform way in the linguistic literature (see Rietveld & Vermillion, 2003 for an overview). We assume here that the pitch register sets reference lines relative to which tones are scaled (Clements, 1979).
2. Akan orthography uses symbols from Roman script as well as additional symbols from the IPA with their corresponding IPA value. For instance, the grapheme <ɛ> represents a half-open unrounded front vowel (Dolphyne, 1988, p. 7). In total, Akan uses seven vowel and 16 consonant letters.
3. Clements (1979, p. 537) lists a number of other languages that show tone terracing, which are not limited to sub-Saharan languages such as Niger-Congo (e.g., Yoruba) or Bantu (e.g., Sotho), but also occur in Nilo-Saharan (e.g., Luo) and Chadic languages (e.g., Ga'anda), as well as in some native North American languages such as Acatlán Mixtec.
4. This grouping is not a generic property of tone languages. A similar grouping can be achieved for intonation languages which, however, are not the focus of the present paper. Group one would include languages that express focus with higher or later pitch peaks such as German (see Braun, 2006; Féry & Kügler, 2008; Kügler, 2008; Kügler & Genzel, submitted) or English (see Cooper, Eady, & Mueller, 1985; Eady & Cooper, 1986; Eady, Cooper, Kloouda, Mueller, & Lotts, 1986; Bartels & Kingston, 1994). Group two refers to languages such as Bengali employing a boundary tone as a demarcation of a focus phrase (Hayes & Lahiri, 1991), and group three to languages such as Wolof that do not show any prosodic reflex of focus at all (Rialland & Robert, 2001).
5. A subscripted F stands for the focused element relative to the preceding question. The domain of focus is indicated by square brackets.
6. The situation-description task was based on similar tasks proposed in the Questionnaire on Information Structure QUIS (Skopeteas et al., 2007). The task was adapted for the purposes of the present study (e.g., matching of target words).
7. One reviewer was asking for potential syntactic priming effects (cf., Bock, 1986). We do not see any influence of syntactic priming on the basis of this task and the corresponding answers. The wh-question asking for an informational focus had a syntactically fronted wh-word which was also followed by the focus particle *nà*. The corresponding question eliciting corrective focus had the contrasted element *in situ*. If syntactic priming would matter here, we would have expected more *ex situ* answers for informational focus, but the reverse was the case. In addition, we found an overall preference for *in situ* focus marking.
8. Informational and corrective focus corresponds to what Ladd (1980) classifies as narrow focus. The concept of corrective focus often includes the notion of contrastive focus. For a detailed discussion about the concept of contrast see Zimmermann (2008) and Repp (2010).

9. One of the eleven speakers had creaky voice during the second syllable thus no F0 measurement was obtained.
10. Thanks to Bert Remijsen who pointed us to this issue.

References

Abakah, E. N. (2000). A closer look at downstep in Akan. *Afrika und Übersee*, *83*, 1–23.

Abakah, E. N. (2002). The low tone in Akan. In T. Schumann, M. Reh, R. Kießling, & L. Gerhardt (Eds.), *Aktuelle Forschungen zu afrikanischen Sprachen* (pp. 193–210). Köln: Köppe.

Abakah, E. N. (2005a). Tone rules in Akan. *Journal of West African Languages*, *XXXII*(1–2), 109–134.

Abakah, E. N. (2005b). Tone in Akan nominals. In M. E. Kropp Dakubu & E. K. Osam (Eds.), *Studies in the Languages of the Volta Basin* (pp. 193–218). Legon: University of Ghana.

Abakah, E. N., & Koranteng, L. (2007). The interaction of tone, syntax and semantics in Akan. In M. E. Kropp Dakubu, G. Ahanlig-Pare, E. K Osam, & K. K. Saah (Eds.), *Studies in the Languages of the Volta Basin*, *4*(2) (pp. 63–86). Legon: University of Ghana.

Allerton, D. J. (1978). The notion of 'givenness' and its relations to presupposition and to theme. *Lingua*, *44*(2–3), 133–168.

Ameka, F. (1992). Focus constructions in Ewe und Akan: A comparative perspective. In C. Collins & V. Manfredi (Eds.), *Proceedings of the Kwa comparative syntax workshop M.I.T.* (pp. 1–25). Cambridge, MA: MIT Dept. of Linguistics and Philosophy.

Amfo, N. A. A. (2010). Lexical signaling of information structure in Akan. *Linguistics*, *48*, 95–225.

Anderson, J. C. (2009). Preliminary to preliminary: Speech rhythm in Akan (Twi). In J. C. Anderson, C. R. Green, & S. G. Obeng (Eds.), *African linguistics across the discipline* (pp. 133–143). Bloomington: IULC Publications.

Bartels, C., & Kingston, J. (1994). Salient pitch cues in the perception of contrastive focus. In P. Bosch & R. van der Sandt (Eds.), *Focus and Natural Language Processing*, *IBM Working Papers on Logic and Linguistics*, *6* (pp. 1–10). Heidelberg: IBM.

Baumann, S. (2006). *The intonation of givenness: Evidence from German*. Tübingen: Niemeyer.

Baumann, S., Becker, J., Grice, M., & Mücke, D. (2007). Tonal and articulatory marking of focus in German. In J. Trouvain & W. J. Barry (Eds.), *Proceedings of the 16th ICPhS* (pp. 1029–1032). Saarbrücken: University of Saarland.

Baumann, S., Grice, M., & Steindamm, S. (2006). Prosodic marking of focus domains: Categorical or gradient? In R. Hoffmann & H. Mixdorff (Eds.), *Proceedings of Speech Prosody 2006* (pp. 301–304). Dresden: TUDpress.

Berry, J. (1960). *English, Twi, Asante, Fante dictionary*. Accra: Presbyterian Book Depot.

Boadi, L. A. (1974). Focus-marking in Akan. *Linguistics: An International Review*, *140*, 5–57.

Bock, J. K. (1986). Syntactic persistence in language production. *Cognitive Psychology*, *18*, 355–387.

Boersma, P., & Weenink, D. (2008). Praat: Doing phonetics by computer (Version 5.0.35) [Computer program]. Retrieved November 23, 2007, from http://www.praat.org/

Bolinger, D. L. (1962). Intonation as a universal. In H. G. Lunt (Eds.), *Proceedings of the Ninth International Congress of Linguistics* (pp. 833–844). The Hague: Mouton.

Braun, B. (2006). Phonetics and phonology of thematic contrast in German. *Language and Speech*, *49*(4), 451–493.

Bruce, G. (1977). *Swedish word accents in sentence perspective*. Lund: Gleerup.

Büring, D. (1997). *The meaning of topic and focus: The 59th Street Bridge accent*. London/New York: Routledge.

Cahill, M. (1985). *An autosegmental analysis of Akan nasality and tone* (MA thesis). University of Texas at Arlington.

Chafe, W. L. (1974). Language and consciousness. *Language*, *50*(1), 111–133.

Chen, S.-W., Wang, B., & Xu, Y. (2009). Closely related languages, different ways of realizing focus. In M. Uther, R. Moore, & S. Cox (Eds.), *Proceedings of Interspeech 2009* (pp. 1007–1010). Brighton: International Speech Communication Association.

Christaller, J. G. (1875). *A grammar of the Asante and Fante language*. Basel: German Evangelical Mission.

Christaller, J. G. (1933). *Dictionary of the Asante and Fante language called Tshi (Twi)*. Basel: Evangelical Missionary Society.

Clements, G. N. (1979). The description of terraced-level tone languages. *Language*, *55*(3), 536–558.

Connell, B. (2001). Downdrift, Downstep, and Declination. Paper presented at Typology of African Prosodic Systems, Workshop Bielefeld University, Germany (http://www.spectrum.uni-bielefeld.de/TAPS/Connell.pdf).

Connell, B., & Ladd, D. R. (1990). Aspects of pitch realization in Yoruba. *Phonology*, *7*, 1–29.

Cooper, W. E., Eady, S. J., & Mueller, P. R. (1985). Acoustical aspects of contrastive stress in question-answer contexts. *Journal of the Acoustical Society of America*, *77*, 2142–2156.

Cooper, W. E., & Sorensen, J. M. (1981). *Fundamental frequency in sentence production*. New York: Springer.

Cruttenden, A. (2006). The de-accenting of old information: A cognitive universal. In G. Bernini & M. L. Schwartz (Eds.), *Pragmatic organization of discourse in the languages of Europe* (pp. 311–355). Berlin: Mouton de Gruyter.

De Jong, K. J. (1995). The supraglottal articulation of prominence in English: Linguistic stress as localized hyperarticulation. *Journal of the Acoustical Society of America*, *97*(1), 491–504.

Dolphyne, F. A. (1988). *The Akan (Twi-Fante) language: Its sound systems and tonal structure*. Ghana: University Press.

Downing, L. J. (2008). Focus and prominence in Chichewa, Chitumbuka and Durban Zulu. In M. Zygis & S. Fuchs (Eds.), *ZAS Papers in Linguistics*, *49* (pp. 47–65). Berlin: Zentrum Für Allgemeine Sprachwissenschaft, Sprachtypologie und Universalienforschung.

Downing, L. J., Mtenje, A., & Pompino-Marschall, B. (2004). Prosody and information structure in Chichewa. In S. Fuchs & S. Hamann (Eds.), *ZAS Papers in Linguistics*, *37* (pp. 167–186). Berlin: Zentrum für Allgemeine Sprachwissenschaft, Sprachtypologie und Universalienforschung.

Eady, S. J., & Cooper, W. E. (1986). Speech intonation and focus location in matched statements and questions. *Journal of the Acoustical Society of America*, *80*, 402–415.

Eady, S. J., Cooper, W. E., Klooda, G. V., Mueller, P. R., & Lotts, D. W. (1986). Acoustical characteristics of sentential focus: Narrow vs. broad and single vs. dual focus environments. *Language and Speech*, *29*, 233–251.

Ermisch, S. (2006). Focus and topic Akan constructions in Akan. In S. Ermisch (Ed.), *Frankfurter Afrikanistische Blätter 18* (pp. 51–68). Köln: Köppe.

Féry, C., & Kügler, F. (2008). Pitch accent scaling on given, new and focused constituents in German. *Journal of Phonetics*, *36*, 680–703.

Frajzyngier, Z. (1989). *A grammar of Pero*. Berlin: Dietrich Reimer Verlag.

Genzel, S., & Kügler, F. (2010). How to elicit semi-spontaneous focus realizations with specific tonal patterns. *Working Papers of the SFB 632*, *Interdisciplinary Studies on Information Structure (ISIS) 13* (pp. 77–102). Universitätsverlag Potsdam, Germany.

Genzel, S. & Kügler, F. (2011). Phonetic realization of automatic (downdrift) and and non-automatic downstep in Akan. Proceedings of the 17th International Congress of Phonetic Sciences, 735–738.

Gili Fivela, B. (2008). *Intonation in production and perception*. Alessandria: Edizioni dell'Orso.

Good, J. (2004). Tone and accent in Saramaccan: Charting a deep split in the phonology of a language. *Lingua*, *114*, 575–619.

Gussenhoven, C. (1984). *On the grammar and semantics of sentence accents*. Dordrecht: Foris.

Gussenhoven, C. (2002). Intonation and interpretation: Phonetics and phonology. In B. Bel & I. Marlin (Eds.), *Proceedings of the First International Conference on Speech Prosody* (pp. 47–57). Aix-en-Provence: Laboratoire Parole et Langage.

Gussenhoven, C. (2004). *The phonology of tone and intonation*. Cambridge, UK: Cambridge University Press.

Gussenhoven, C., & Teeuw, R. (2008). A moraic and a syllabic H-tone in Yucatec Maya. In E. Z. Herrera & P. M. Butrageño (Eds.), *Fonología instrumental: Patrones fónicos y variación* (pp. 49–71). Mexico City: El Colegio de México.

Halliday, M. A. K. (1967). *Intonation and grammar in British English*. The Hague: Mouton.

Hartmann, K. (2008). Focus and emphasis in tone and intonation languages. In A. Steube (Ed.), *The discourse potential of underspecified structures* (pp. 389–411). Berlin: de Gruyter.

Hartmann, K., & Zimmermann, M. (2007). In place – out of place? Focus in Hausa. In K. Schwabe & S. Winkler (Eds.), *On information structure, meaning and form: Generalizing across languages* (pp. 365–403). Amsterdam: Benjamins.

Hayes, B. (1995). *Metrical stress theory: Principles and case studies*. Chicago: Chicago University Press.

Hayes, B., & Lahiri, A. (1991). Bengali intonational phonology. *Natural Language & Linguistic Theory*, *9*, 47–96.

Hockett, C. F. (1963). The problem of universals in language. In J. H. Greenberg (Ed.), *Universals of language* (pp. 1–29). Cambridge, MA: MIT Press.

Hyman, L. M. (2001). Tone systems. In M. Haspelmath, E. König, H. E. Wiegand, & H. Steger (Eds.), *Language typology and language universals: An international handbook* (pp. 1367–1380). Berlin: Mouton de Gruyter.

Inkelas, S., & Leben, W. R. (1990). Where phonology and phonetics intersect: The case of Hausa intonation. In J. Kingston & M. E. Beckman (Eds.), *Papers in Laboratory Phonology I: Between the Grammar and Physics of Speech* (pp. 17–34). Cambridge, UK: Cambridge University Press.

Jannedy, S. (2007). Prosodic focus in Vietnamese. In S. Ishihara, S. Jannedy, & A. Schwarz (Eds.), *Working Papers of the SFB632, Interdisciplinary Studies on Information Structure (ISIS) 8* (pp. 209–230). Potsdam: University Press Potsdam.

Kanerva, J. M. (1990). Focusing on phonological phrases in Chichewa. In S. Inkelas & D. Zec (Eds.), *The phonology-syntax connection* (pp. 145–161). Chicago: Chicago University Press.

Karlsson, A., House, D., Svantesson, J.-O., & Tayanin, D. (2007). Prosodic phrasing in tonal and ton-tonal dialects of Kammu. In J. Trouvain & W. J. Barry (Eds.), *Proceedings of the 16th International Congress of Phonetic Sciences* (pp. 1309–1312). Saarbrücken: University of Saarland.

Kidda, M. (1993). *Tangale phonology*. Berlin: Dietrich Reimer Verlag.

Kobele, G., & Torrence, H. (2006). Intervention and focus in Asante Twi. In I. Fiedler & A. Schwarz (Eds.), *ZAS Papers in Linguistics 46* (pp. 161–184). Berlin: Zentrum für Allgemeine Sprachwissenschaft, Sprachtypologie und Universalienforschung.

Krifka, M. (2008). Basic notions of information structure. *Acta Linguistica Hungarica*, *55*, 243–276.

Kügler, F. (2008). The role of duration as a phonetic correlate of focus. In P. A. Barbosa, S. Madureira, & C. Reis (Eds.), *Proceedings of the Speech Prosody 2008 Conference* (pp. 591–594). Campinas, Brazil: Editora RG/CNPq.

Kügler, F., & Genzel, S. (submitted). Information structure, sentence length, and position effects on duration in German.

Kügler, F., & Skopeteas, S. (2006). Interaction of lexical tone and information structure in Yucatec Maya. In A. Belotel-Grenié & M. Grenié (Eds.), *Proceedings of the Second International Symposium on Tonal Aspects of Languages* (pp. 83–88). La Rochelle: Université de La Rochelle.

Kügler, F., & Skopeteas, S. (2007). On the universality of prosodic reflexes of contrast: The case of Yucatec Maya. In J. Trouvin & W. Barry (Eds.), *Proceedings of the 16th International Congress of Phonetic Sciences* (pp. 1025–1028). Saarbrücken: University of Saarland.

Kügler, F., Skopeteas, S., & Verhoeven, E. (2007). Encoding information structure in Yucatec Maya: On the interplay of prosody and syntax. In S. Ishihara, S. Jannedy, & A. Schwarz (Eds.), *Working Papers of the SFB632, Interdisciplinary Studies on Information Structure (ISIS) 8* (pp. 187–208). Potsdam: University Press Potsdam.

Ladd, D. R. (1980). *The structure of intonational meaning: Evidence from English*. Bloomington: Indiana University Press.

Ladd, D. R. (1996). *Intonational phonology*. Cambridge, UK: Cambridge University Press.

Laniran, Y. (1992). Phonetic aspects of tone realization in Igbo. *Progress Reports from Oxford Phonetics*, *5*, 35–51.

Leben, W. R., & Ahoua, F. (2006). Phonological reflexes of emphasis in Kwa languages of Cote d'Ivoire. In P. Newman & L. M. Hyman (Eds.), *Studies in African linguistics* (pp. 145–158). Columbus: The Department of Linguistics and the Center for African Studies, Ohio State University.

Leben, W. R., Inkelas, S., & Cobler, M. (1989). Phrases and phrase tones in Hausa. In P. Newman & R. Botne (Eds.), *Current approaches to African linguistics* (pp. 45–61). Dordrecht: Foris.

Lehiste, I. (1972). The timing of utterances and linguistic boundaries. *Journal of the Acoustical Society of America*, *51*(6B), 2018–2024.

Lewis, M. P. (Ed.) (2009). *Ethnologue: Languages of the world*, *Sixteenth edition*. Dallas, TX: SIL International. Retrieved May 19, 2009, from http://www.ethnologue.com/

Liberman, M., & Pierrehumbert, J. (1984). Intonational invariance under changes in pitch range and length. In M. Aronoff & R. T. Oehrle (Eds.), *Language sound structure: Studies in phonology presented to Morris Halle* (pp. 157–233). Cambridge, MA: MIT Press.

Lindblom, B. (1990). Explaining phonetic variation: A sketch of the H&H theory. In W. J. Hardcastle & A. Marchal (Eds.), *Speech production and speech modelling* (pp. 403–439). Heidelberg: Kluwer.

Liu, F., & Xu, Y. (2005). Parallel encoding of focus and interrogative meaning in Mandarin intonation. *Phonetica*, *62*, 70–87.

Manyah, K. A. (2006). Relation between tone and vowel quality in Twi. In A. Belotel-Grenié & M. Grenié (Eds.), *Proceedings of the Second International Symposium on Tonal Aspects of Languages* (pp. 37–40). La Rochelle: Université de La Rochelle.

Marfo, C., & Bodomo, A. (2005). Information structuring in Akan question-word fronting and focus constructions. *Studies in African Linguistics*, *34*(2), 179–208.

Marfo, C., & Yankson, S. (2008).The structure of the CCV syllabus of the Akan. *Concentric: Studies in Linguistics*, *34*(2), 85–100.

Martin, J. G. (1970). On judging pauses in spontaneous speech. *Journal of Verbal Learning and Verbal Behavior*, *9*(1), 75–78.

McDonough, J. (2002). The intonation of Navajo focus and interrogative constructions. In A. Carnie, H. Harley, & M. A. Willie (Eds.), *Formal approaches to functional phenomena* (pp. 191–206). Amsterdam: John Benjamins.

Mohr, A. T. (1909). *A dictionary of English-Tshi (Asante)*. Basel: Evangelical Missionary Society.

Pan, H. (2007). Focus and Taiwanese unchecked tones. In C. Lee, M. Gordon, & D. Büring (Eds.), *Topic and focus: Cross-linguistic perspectives on meaning and intonation* (pp. 195–213). Dordrecht: Springer.

Patil, U., Kentner, G., Gollrad, A., Kügler, F., Féry, C., & Vasishth, S. (2008). Focus, word order, and intonation in Hindi. *Journal of South Asian Linguistics*, *1*, 53–70.

Pierrehumbert, J. (1980). *The phonology and phonetics of English intonation*. Bloomington: Indiana University Linguistics Club.

Pike, K. L. (1948). *Tone languages*. Ann Arbor: University of Michigan Press.

Purvis, T. M. (2009). Speech rhythm in Akan oral praise poetry. *Text & Talk*, *29*(2), 201–218.

Remijsen, B., & van Heuven, V. J. (2005). Stress, tone, and discourse prominence in the Curaçao dialect of Papiamentu. *Phonology*, *22*(2), 205–235.

Repp, S. (2010). Defining 'contrast' as an information-structural notion in grammar. *Lingua*, *120*(6), 1333–1345.

Rialland, A., & Robert, S. (2001). The intonational system of Wolof. *Linguistics*, *39*(5), 893–939.

Rietveld, T., & Vermillion, P. (2003). Cues for perceived pitch register. *Phonetica*, *60*, 261–272.

Rooth, M. (1985). *Association with focus*. Amherst: University of Massachusetts.

Rooth, M. (1992). A theory of focus interpretation. *Natural Language Semantics*, *1*(1), 75–116.

Rooth, M. (1995). Focus. In S. Lappin (Ed.), *The handbook of contemporary semantic theory* (pp. 271–298). Oxford: Blackwell.

Saah, K. K. (1988). Wh-questions in Akan. *Journal of West African Languages*, *18*, 17–28.

Schachter, P., & Fromkin, V. (1968). Phonology of Akan: Akuapem, Asante, Fante. *Working Papers in Phonetics*, *9*, 1–268.

Schwiertz, G. (2009). *Intonation and prosodic structure in Beaver (Athabaskan): Explorations on the language of the Danezaa*. Cologne: University of Cologne.

Skopeteas, S., Fiedler, I., Hellmuth, S., Schwarz, A., Stoel, R., Fanselow, G., Krifka, M., & Féry, C. (2007). Questionnaire on information structure. In S. Ishihara, M. Schmitz, & A. Schwarz (Eds.), *Working Papers of the SFB632, Interdisciplinary Studies on Information Structure (ISIS) 4*. Potsdam: University Press Potsdam.

Snider, K. L. (1998). Phonetic realisation of downstep in Bimoba. *Phonology*, *15*, 77–101.

Snider, K. L. (2007). Automatic and nonautomatic downstep in Chumburung: An instrumental comparison. *Journal of West African Languages*, *34*(1), 105–114.

Stewart, J. M. (1965). The typology of the Twi tone system. Preprint from *The Bulletin of the Institute of African Studies*, *1*, 1–27.

Swerts, M., Krahmer, E., & Avesani, C. (2002). Prosodic marking of information status in Dutch and Italian: A comparative analysis. *Journal of Phonetics*, *30*(4), 629–654.

Turk, A., Nakai, S., & Sugahara, M. (2006). Acoustic segment durations in prosodic research: A practical guide. In S. Sudhoff, D. Lenertová, R. Meyer, S. Pappert, P. Augurzky, I. Mleinek, N. Richter, & J. Schließer (Eds.), *Methods in empirical prosody research* (pp. 1–27). Berlin: Mouton de Gruyter.

Welmers, W. (1959). Tonemics, morphotonemics and tonal morphemes. *General Linguistics*, *4*, 1–9.

Wightman, C. W., Shattuck-Hufnagel, S., Ostendorf, M., & Price, P. J. (1992). Segmental durations in the vicinity of prosodic phrase boundaries. *Journal of the Acoustical Society of America*, *91*, 1707–1717.

Xu, Y. (1999). Effects of tone and focus on the formation and alignment of f0 contours. *Journal of Phonetics*, *27*(1), 55–105.

Xu, Y. (2005). Speech melody as articulatorily implemented communicative functions. *Speech Communication*, *46*, 220–251.

Xu, Y., & Sun, X. (2001). Maximum speed of pitch change and how it may relate to speech. *Journal of the Acoustical Society of America*, *111*, 1399–1413.

Yip, M. (2002). *Tone*. Cambridge, UK: Cambridge University Press.

Zerbian, S. (2006). *Expression of information structure in the Bantu language Northern Sotho*. Berlin: ZASPiL 45.

Zerbian, S., Genzel, S., & Kügler, F. (2010). Experimental work on prosodically-marked information structure in selected African languages (Afroasiatic and Niger-Congo). Workshop on Experimental Approaches to Focus, Speech Prosody 2010. Chicago.

Zimmermann, M. (2008). Contrastive focus and emphasis. *Acta Linguistica Hungarica*, *55*, 347–360.