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Variation in the prosody of focus in head- and head/edge-prominence languages

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Abstract

This study explored the prosodic realization of focus in four typologically unrelated languages: American English, Paraguayan Guaraní, Moroccan Arabic, and K'iche'. American English and Paraguayan Guaraní mark prosodic prominence culminatively on the head of the prosodic unit, whereas Moroccan Arabic and K'iche' mark prosodic prominence demarcatively on the right edge of the prosodic unit. To allow for cross-linguistic comparisons, the same interactive task was used for all four languages in their respective countries. Utterances were elicited in which a color-denoting adjective, a shape-denoting noun, or the noun phrase consisting of the adjective and the noun was focused. Data from each language were annotated phonologically using an autosegmental-metrical approach and analyzed acoustically. The results suggest that the prosodic realization of focus is partially orthogonal to the distinction between head-prominence and head/edge-prominence languages, and may be due to differences in macro-rhythm. American English and Paraguayan Guaraní, the head-prominence languages, share deaccenting as a means for marking non-focused expressions, but only English uses pitch accent type to mark focused elements. Moroccan Arabic, a head/edge-prominence language, uses phrasing and duration cues to focus, but K'iche', also a head/edge-prominence language, does not. In addition, American English shares phrasing cues, and both American English and Paraguayan Guaraní share duration cues with Moroccan Arabic, despite their structural prosodic differences.
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Keywords: Prosody; Focus; Typology; Moroccan Arabic; K'iche'; Paraguayan Guaraní

1. Introduction

In many languages, information-structural properties of utterances, including information about focus, are conveyed by the prosody of the utterance. A diverse range of phonetic and phonological properties contribute to the prosodic marking of focus across languages, including the presence, type, and location of pitch accents and boundary tones, duration and timing, f0 range, and the alignment of pitch targets to the segmental string (Féry, 2013; Jun, 2005; Ladd, 2008). This project specifically looks at the prosodic marking of focus within the noun phrase, which has previously been studied in English (e.g., Ito and Speer, 2006; Katz and Selkirk, 2011), and which exhibits cross-linguistic variation in that some languages may not mark this type of focus prosodically (Swerts et al., 2002). The development of a cross-linguistic theory of the relationship between prosody and focus requires detailed analyses of the prosodic marking of focus in a wide range of languages. The goal of this project was to advance the development of such a theory through the exploration of how

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focus is prosodically marked in the noun phrase in four typologically unrelated languages: American English and three languages whose prosody is comparatively under-described, namely Paraguayan Guaraní (Tupí-Guaraní), Moroccan Arabic (Arabic) and K'iche' (Mayan). Our approach is grounded in both a formal semantic/pragmatic theory of focus and a formal phonological theory of prosodic structure.

To obtain comparable data on the four languages, we conducted an experiment, an interactive game, similar to that described by Krahmer and Swerts (2001). The data gathered in this experiment inform our detailed discussion in Section 2 of the prosodic structures of Paraguayan Guaraní, Moroccan Arabic, and K'iche'. Our discussion relies on Jun's (2005, 2014) framework of prosodic typology and incorporates the distinction between head- and head/edge-prominence languages, as well as the macro-rhythm parameter. The experiment, which we conducted in the countries in which the four languages are spoken, is described in Section 3, together with our theoretical assumptions about the information-structural notion of focus. Section 4 presents in more detail the results of the experiment and describes the prosodic realization of focus in the noun phrase in each language. Section 5 compares the prosodic realization of focus in the noun phrase across the four languages and Section 6 concludes the article.

2. Prosodic structures of the languages under investigation

This section introduces the prosodic structures of the four languages under investigation. We assume an autosegmental-metrical approach in which high and low f0 targets are associated with prominent syllables and phrase edges (Ladd, 2008). The f0 targets associated with prominent syllables are pitch accents; the f0 targets associated with phrase edges are boundary tones. These boundary tones may associate with either the left or the right edge of a phrase. Since the prosodic structures of Paraguayan Guaraní, Moroccan Arabic, and K'iche' are under-described, we begin by describing what is known about the prosody of each of these languages, based on previous descriptions and our own data. The examples from our data were produced in an interactive game task, described in Section 3, in which native speakers of each language instructed another native speaker to fill numbered boxes with objects of different shapes and colors.

Our descriptions of the prosodic structure of the four languages follow Jun's (2005, 2014) prosodic typology. Jun (2014) outlined three orthogonal parameters on which the prosodic structure of languages can vary. The first parameter is the type of word prosody: whether or not the language has lexical stress, tone/lexical pitch accent, both, or neither. The second parameter is whether phrase-level prosodic prominence is marked on the head of the phrase, the edge of the phrase, or both. Head-prominence languages are characterized by phrase-level prominence-marking on the phrase head, which is identified either as the head of a word through lexical stress, pitch accent, or tone, or as the head of the phrase through post-lexical pitch accenting (Jun, 2014, p. 527). Edge-prominence languages are characterized by phrase-level prominence-marking on the left or right edge of the phrase through boundary tones. The typology outlined by Jun (2005) only distinguishes between head- and edge-prominence languages; however, Jun (2014) added a third category of languages, namely, head/edge-prominence languages, which are characterized by both head- and edge-marking of phrasal prominence. The third parameter in Jun's (2014) typology is degree of macro-rhythm. Strong macro-rhythm is characterized by regular alternations of high and low f0 targets (regardless of whether these alternations are the result of pitch accents, boundary tones, or both), whereas weak macro-rhythm is characterized by irregular alternations in f0. Degree of macro-rhythm is determined based on three criteria: (i) the number of possible phrase-medial pitch accents, accentual phrase tones, and/or word tones, (ii) the type (e.g., rising, falling, flat, etc.) of the most common phrase-medial pitch accents, accentual phrase tones, and/or word tones, and (iii) the frequency or domain of the pitch accents, accentual phrase tones, and/or word tones (Jun, 2014, p. 526). Macro-rhythm strength is gradient; however, Jun (2014) categorizes languages into three groups: strong, medium, and weak macro-rhythm. How macro-rhythm is realized depends on the prosodic structure of the language. For example, one way in which a head-prominence language can have strong macro-rhythm is by having a small inventory of pitch accents, of which the most frequent is rising or falling, and relatively little deaccenting so that the regularity of the alternations of high and low f0 targets is maximized. In an edge-prominence language or a head/edge-prominence language without pitch accents, strong macro-rhythm can be realized by frequent accentual phrase tones.

Given that the prosodic structures of three of the languages we examined are relatively under-described, the following descriptions of these languages' prosodic structures are unavoidably based on a smaller sample of sentence types and contexts than the English description. Our overall approach to describing these languages was conservative and we avoided positing pitch accents or levels of prosodic structure without strong evidence for their existence. Future research may reveal additional information about the prosodic structures of these languages.

2.1. American English

American English exhibits both prominence-lending pitch accents associated with lexically stressed syllables and unit-demarcating boundary tones associated with the right edges of prosodic phrases (Beckman et al., 2005). The pitch accent

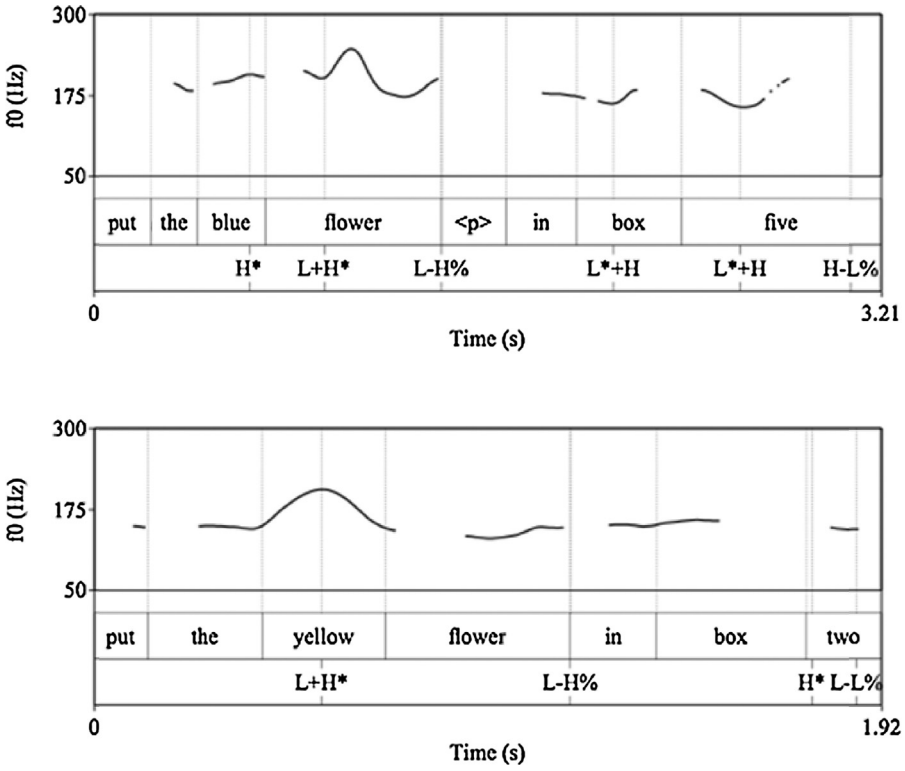

Fig. 1. Two American English utterances with an utterance-medial intonational phrase break.

inventory of American English includes H*, !H*, L+H*, L*+H, and L* pitch accents.[1] The boundary tone inventory of American English includes L- and H- intermediate phrase accents and L% and H% intonational phrase boundary tones. As the end of an intonational phrase also necessarily includes the end of an intermediate phrase, there are four possible phrase accent/boundary tone sequences at the end of an utterance: L-L%, L-H%, H-L%, and H-H%.

The American English examples in Fig. 1 illustrate the difference in alignment that characterizes prominence-lending pitch accents vs. unit-demarcating boundary tones.[2] In the top panel of Fig. 1, a rising pitch accent is realized on the stressed initial syllable of *flower* and the intonational phrase *put the blue flower* is realized with a rising phrase accent/boundary tone sequence on its right edge. We can confirm that the first rise is aligned with the stressed syllable of *flower*, rather than with the right edge of the phrase, by comparing this utterance to the utterance in the bottom panel of Fig. 1.[3] In the bottom panel of Fig. 1 an unaccented word (*flower*), intervenes between *yellow*, which is realized with a rising pitch accent on its stressed syllable, and the rising boundary tone at the right edge of the intonational phrase (*put the yellow flower*). Thus, the same rise-fall-rise contour is aligned differently in the two utterances: the first rise is aligned with the stressed syllable of the noun in the top panel, but with the stressed syllable of the adjective in the bottom panel. In both utterances, the second rise is associated with the right edge of the prosodic phrase, which is a full intonational phrase. An intonational phrase boundary is distinguished from an intermediate phrase boundary by a larger f0 excursion, more phrase-final lengthening, and, optionally, a following pause. A pause following the noun phrase can be seen clearly in the top hand panel of Fig. 1; however, a full intonational phrase break was also identified after the noun phrase in the bottom panel of Fig. 1, despite the lack of a clear pause in the speech signal. In this utterance, the word *flower* was not pitch accented, and the f0 rise on *flower* was therefore interpreted as a rising (L-H%) phrase accent/boundary tone sequence.

[1] In ToBI (Tone and Break Indices) annotation (Beckman and Ayers Elam, 1997), a star (*) indicates the tone aligned with the stressed syllable. An exclamation mark (!) represents a down-stepped pitch accent.

[2] In these, and the following figures, the labels for both pitch accents and accentual phrase tones have been aligned with the middle of the prosodic word, rather than with a particular f0 target, to improve the legibility of the tonal sequences. The *y*-axes have been scaled separately to capture each talker's f0 range.

[3] The top panel of Fig. 1 contains a H-L% phrase accent/boundary tone sequence. It should be noted that a H- phrase accent upsteps the following L% boundary tone, leading to a plateau.

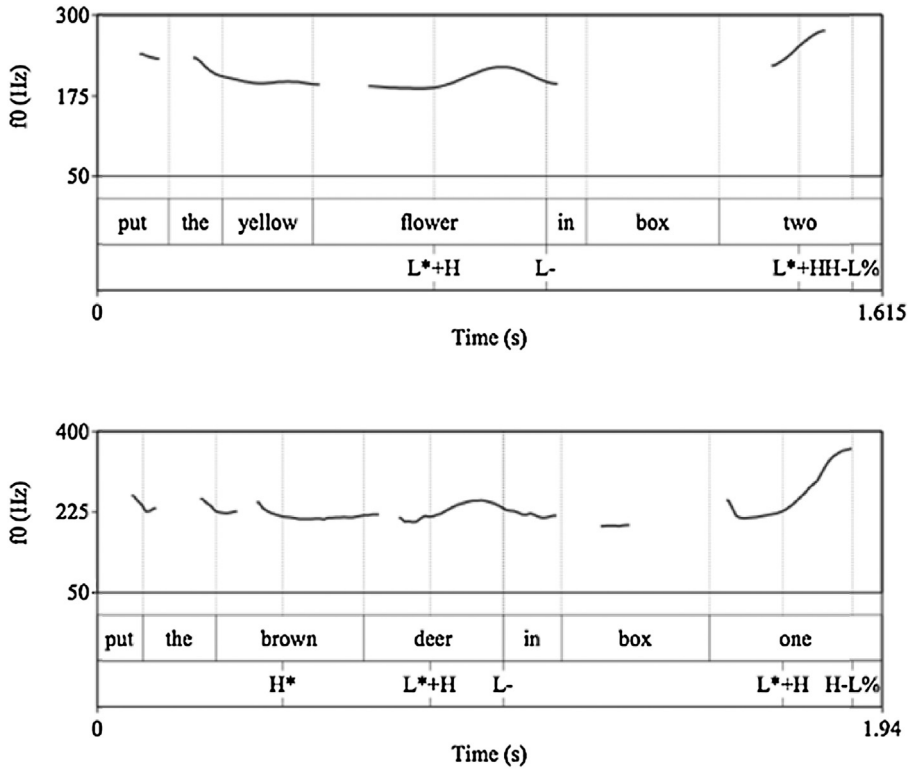

Fig. 2. Two American English utterances consisting of two intermediate phrases within an intonational phrase.

The difference between intonational phrases and intermediate phrases in American English is further illustrated in Fig. 2. In both panels of Fig. 2, the rising pitch accent on the stressed syllable of the noun (*flower* and *deer*, respectively) is followed by a low intermediate phrase accent, causing a slight fall in f0 on the second syllable. Fig. 2 also shows that more than one intermediate phrase can be realized within an intonational phrase. Similarly, the top panel of Fig. 1 and the bottom panel of Fig. 2 demonstrate that more than one pitch accent can be realized within a prosodic phrase, regardless of its size (intermediate or intonational).

Prominence-lending pitch accents and the absence of phrase accents associated with word-length units lead to the categorization of American English as a head-prominence language in Jun's (2014) typology. With respect to macro-rhythm, the large inventory of pitch accents in American English, of which the most frequent is H*, as well as relatively frequent deaccenting, lead to the categorization of American English as exhibiting medium macro-rhythm (Jun, 2014, p. 528).

2.2. Paraguayan Guaraní

Previous research on Paraguayan Guaraní suggests that, like English, it exhibits prominence-lending pitch accents associated with lexically stressed syllables and unit-demarcating boundary tones at the right edges of prosodic phrases (Clopper and Tonhauser, 2013). Most lexical roots in Paraguayan Guaraní exhibit final stress, although some, especially borrowings, can also exhibit penultimate or antepenultimate stress. Word-level stress can also shift away from the final syllable by the addition of lexically unstressed suffixes (Gregores and Suárez, 1967; Adelaar, 1994). Lexical stress is indicated in the orthography of the language: non-final stressed syllables with an oral vowel nucleus are marked with an acute accent on that vowel (e.g., *óga* 'house') and stressed syllables in all positions with a nasal vowel nucleus are marked with a tilde (e.g., *hatã* 'hard'); final stressed syllables with an oral vowel nucleus are unmarked (e.g., *apyka* 'chair').

The intonational inventory of Paraguayan Guaraní includes rising (LH) and falling (HL) pitch accents and L% and H% intonational phrase boundary tones (Clopper and Tonhauser, 2013).[4] Clopper and Tonhauser (2013) found, based on an

[4] As described by Clopper and Tonhauser (2013), the low tone target in both the rising and falling pitch accents is typically associated with the stressed syllable in Paraguayan Guaraní. The pitch accents could therefore be transcribed as L*+H and H+L* in a language-specific ToBI system; however, as alignment does not seem to be contrastive in Paraguayan Guaraní, the * notation has been omitted.

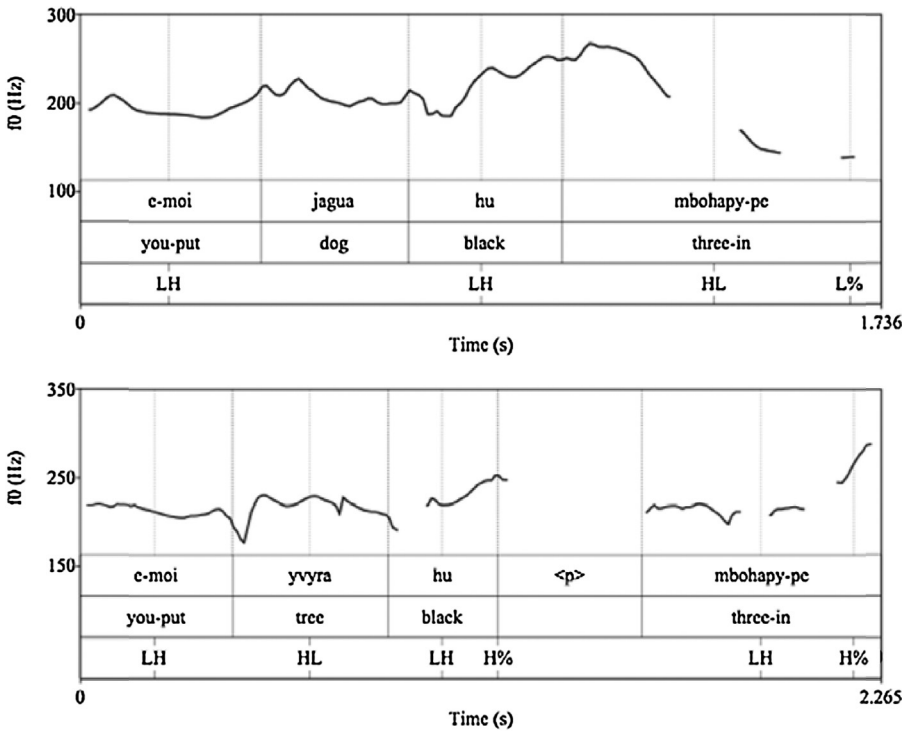

Fig. 3. Two Paraguayan Guaraní utterances showing variation in pitch accent type and position and in phrasing (one vs. two intonational phrases).

experimental investigation of two-word utterances composed of a proper name and a verb, that the two most common contours were a hat pattern, consisting of a rising pitch accent on the proper noun subject and a falling pitch accent on the verb, and a two peak pattern, consisting of a rising pitch accent on each word. The data obtained in the current study provided no evidence for additional pitch accent types and confirmed that the rising pitch accent is more frequent than the falling pitch accent (see Section 4). Intonational phrase boundaries were identified based on f0 excursions, phrase-final lengthening, and optionally, pauses. Our data provide no evidence for a level of phrasing below the intonational phrase.

The two pitch accent types attested in Paraguayan Guaraní are illustrated in Fig. 3. The top panel shows an utterance with rising pitch accents on the verb *e-moi* 'you put' and the adjective *hũ* 'black' and a falling pitch accent on the number *mbohapy* 'three'. The noun *jagua* 'dog' is unaccented. This Paraguayan Guaraní utterance was produced as a single prosodic unit. The bottom panel provides evidence that pitch accent type is independent of phrase position. In this utterance, the phrase-medial noun *yvyra* 'tree' is realized with a falling pitch accent and the phrase-final adjective *hũ* 'black' is realized with a rising pitch accent. The utterance in the bottom panel of Fig. 3 was produced as two intonational phrases with a H% boundary tone at the right edge of each phrase.

Like English, prominence-lending pitch accents and the absence of phrase accents associated with word-length units lead to the categorization of Paraguayan Guaraní as a head-prominence language. Paraguayan Guaraní's smaller inventory of pitch accents, of which the rising pitch accent is the most frequent, leads to the categorization of Paraguayan Guaraní as exhibiting stronger macro-rhythm than English, although Paraguayan Guaraní also exhibits some deaccenting. Thus, despite their similar categorization as head-prominence languages, English and Paraguayan Guaraní differ in their macro-rhythmic properties, with Paraguayan Guaraní exhibiting strong macro-rhythm, and English, medium.

2.3. Moroccan Arabic

Moroccan Arabic exhibits lexical stress, which is realized on the word-final syllable if it is a CVC and on the penultimate syllable otherwise (cf. *selh* ˈ*æm* 'type of coat' with *ma* ˈ*gæna* 'watch, meter'; Benkirane, 1998, p. 348). Unlike other dialects of Arabic, such as Lebanese (Chahal, 2001) and Egyptian Arabic (Hellmuth, 2006), previous research has indicated that Moroccan Arabic does not exhibit pitch accents associated with stressed syllables. Rather, the right edges of prosodic units can receive prominence-lending boundary tones and both the left and right edges of prosodic units can receive phrase-demarcating boundary tones (Benkirane, 1998). Our own data are consistent with Benkirane's description. Intonational phrases were realized with a high (%H) boundary tone at the left edge and rising (LH%) or falling (HL%)

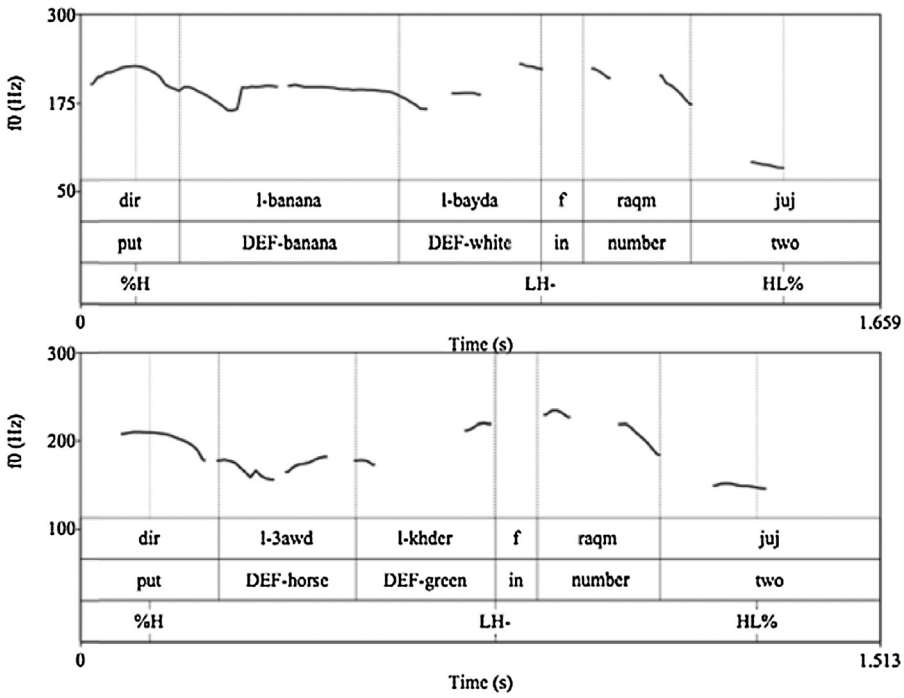

Fig. 4. Two Moroccan Arabic utterances illustrating the lack of post-lexical pitch accenting in the language.

boundary tones at the right edge. In addition, we observed intermediate phrases, which were realized with a rising (LH-) phrase accent at the right edge. As these phrasal units were significantly larger than a word, they were characterized as intermediate, rather than accentual, phrases, similar to English. Intonational phrase boundaries are distinguished from intermediate phrase boundaries by larger f0 excursions, more phrase-final lengthening, and optionally, pauses. Our data provide no evidence for f0 excursions associated with stressed syllables, which is indicative of a lack of post-lexical pitch accents.

In the Moroccan Arabic example in the top panel of Fig. 4, we see a rising phrase accent at the end of the noun phrase (*l-banana l-bayda* (DEF-banana[5] DEF-white) 'the white banana'), but no f0 movements indicative of post-lexical pitch accents on the penultimate stressed syllable of *l-banana* (DEF-banana) 'the banana' or *l-bayda* (DEF-white) 'white'. The contour in the example in the bottom panel of Fig. 4 is identical to the contour in the example in the top panel of Fig. 4, although in the bottom panel the noun phrase consists of a noun and an adjective with final stress rather than penultimate stress. Specifically, in the utterance in the bottom panel of Fig. 4, the final stressed syllable of the noun *l-3awd*[6] (DEF-horse) 'the horse' is realized without an associated f0 movement and the final stressed syllable of the adjective *l-khder* (DEF-green) 'green' is realized with a rising phrase accent. The Moroccan Arabic examples in Fig. 5 show utterances without an intermediate phrase break after the noun phrase, resulting in a single prosodic unit. The utterance in the top panel ends with a HL% boundary tone, resulting in a high plateau between the initial %H and final HL% boundary tones, whereas the utterance in the bottom panel ends with a LH% boundary tone, resulting in a fall after the initial %H tone and a rise at the end of the phrase. Thus, similar to intermediate phrase accents in English, the initial tone of a bitonal intonational phrase boundary tone in Moroccan Arabic is aligned immediately after the preceding tone. The final tone of the bitonal intonational phrase boundary tone is aligned with the right edge of the phrase.

The combination of word-level stress and the absence of prominence-lending pitch accents suggest that Moroccan Arabic is a head/edge-prominence language in Jun's (2014) typology, although it also does not exhibit phrase accents associated with word-length units. Although Moroccan Arabic has a relatively small inventory of intermediate phrase accents and boundary tones, intermediate phrases do not appear at regular intervals. Also, as can be seen in Figs. 4 and 5, these intermediate phrases often form plateaux, rather than alternating rising or falling patterns, with intonational phrase tones. Moroccan Arabic should thus, like American English, be further categorized as exhibiting medium macro-rhythm.

[5] The gloss DEF stands for 'definite'.

[6] The orthographic representations of Moroccan Arabic used in this paper reflect accepted practices among Moroccans for online communication using the Roman alphabet; *3* represents the Arabic letter 'ayn, which it visually resembles.

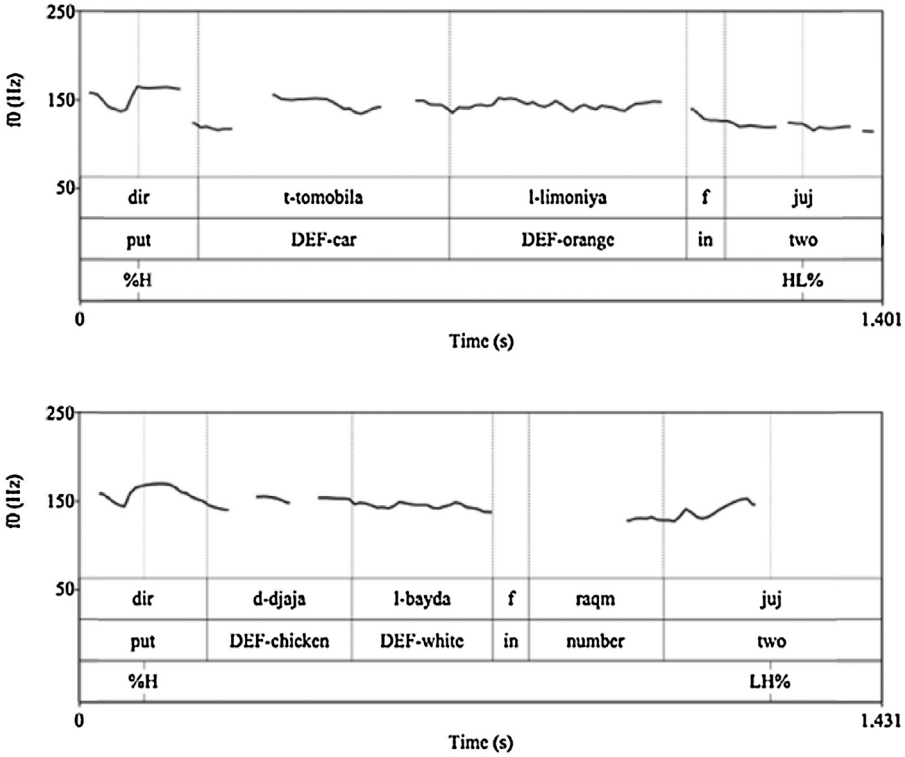

Fig. 5. Two Moroccan Arabic utterances consisting of a single prosodic unit with different final boundary tones.

2.4. *K'iche'*

Although researchers agree that K'iche' exhibits lexical stress, their descriptions are inconsistent with respect to the extent to which stress position is predictable. Larsen (1988) and Nielsen (2005) described K'iche' stress as word-final. However, Henderson (2012) claimed that K'iche' stress is word-final, unless the final syllable is light non-root material, in which case the final root syllable is stressed.

K'iche' was described by Nielsen (2005) as having both pitch accents associated with lexically stressed syllables as well as accentual phrase tones associated with the right edges of word-length prosodic units. The default accent on content words was claimed to be L+H*, which also marks the boundary of an accentual phrase, except when the final syllable of the phrase is not stressed, in which case it also receives a Ha[7] accentual phrase tone (Nielsen, 2005, p. 48). In addition, Nielsen (2005, pp. 50–56) argued that the intonational system of K'iche' has two levels of phrasing above the accentual phrase; namely, both H- and L- intermediate phrase accents and H% and L% intonational phrase boundary tones. However, our own research suggests a less complex prosodic structure in which prominence-lending f0 movements are associated with prosodic edges rather than prosodic heads, similar to Moroccan Arabic. In particular, the final syllable of each prosodic word (i.e., each unit capable of being its own accentual phrase) in K'iche' is realized with a rising boundary tone, regardless of lexical stress position (Yasavul, 2013, pp. 151–155). This consistent alignment of the f0 rise with the end of the prosodic word suggests an absence of alignment of these tonal movements with stress, and thus, a lack of post-lexical pitch accents. Instead, we propose that K'iche' has a rising accentual phrase accent, LHa, and two intonational phrase boundary tones, L% and H%. As these phrasal units are approximately the size of a word, they are characterized as accentual, rather than intermediate, phrases (cf. American English and Moroccan Arabic). Intonational phrase boundaries are distinguished from accentual phrase boundaries by more extreme f0 excursions and, optionally, pauses. We found no evidence for a level of phrasing between the accentual phrase and the intonational phrase in our data. Similar to Paraguayan Guaraní, but unlike American English and Moroccan Arabic, K'iche' does not exhibit intermediate phrases. The f0 patterns of K'iche' are illustrated in Figs. 6 and 7, and are representative of the patterns found for the K'iche' utterances.

[7] The accentual phrase tones in K'iche' are transcribed as Xa (e.g., Ha or LHa), with the ''a'' representing ''accentual phrase'', to distinguish them from higher-level phrase tones, which are transcribed as X- and X% (see also Nielsen, 2005).

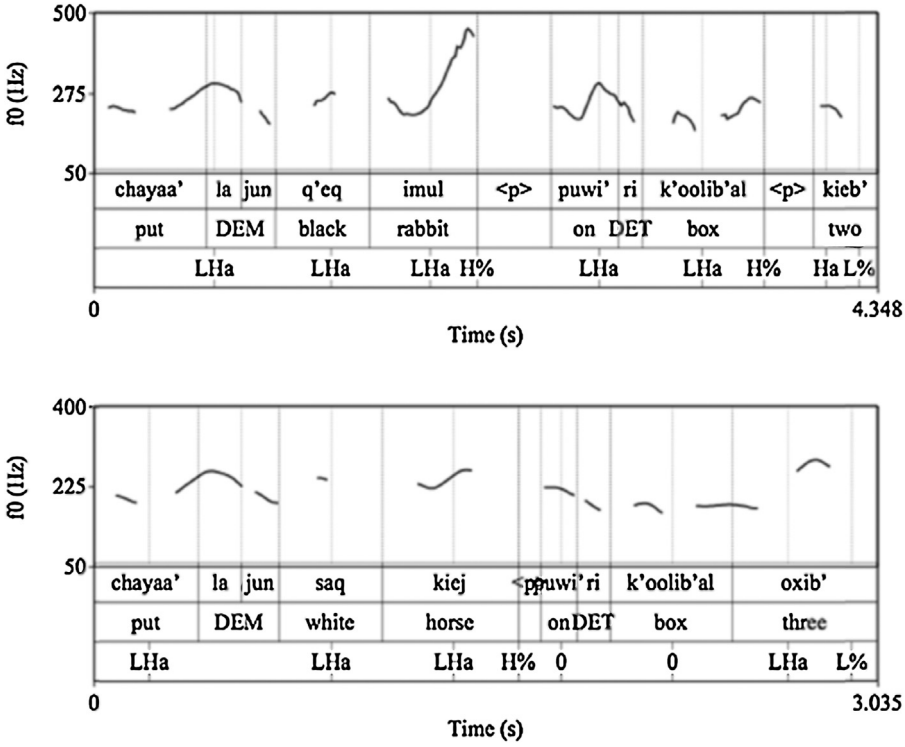

Fig. 6. K'iche' examples showing the word *k'oolib'al* 'box', with and without an accentual phrase tone.

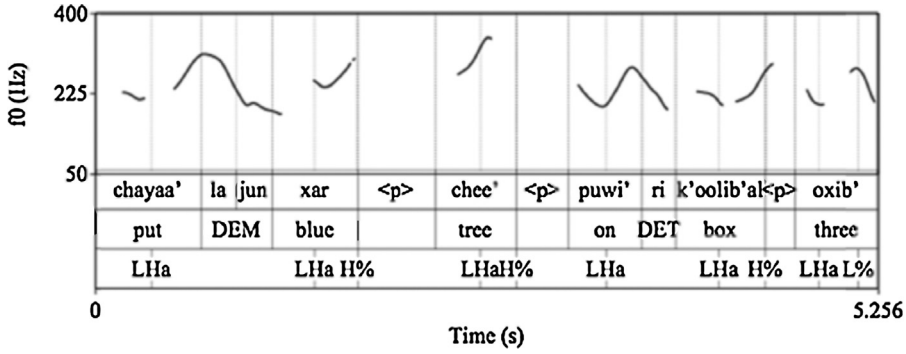

Fig. 7. K'iche' example showing an intonational phrase break within the noun phrase (between the adjective and the noun).

The utterance in the top panel of Fig. 6 shows rising f0 movements indicative of accentual phrase tones,[8] LHa, on nearly every content word, including the word *k'oolib'al* 'box'. This regular realization of accentual phrase tones was one of the more typical patterns in our data: 98% of the target adjectives and 100% of the target nouns were produced as separate accentual phrases. However, the utterance in the bottom panel of Fig. 6 shows no pitch movement associated with an accentual phrase tone on the same word, *k'oolib'al* 'box', showing that de-phrasing of content words is possible in K'iche'. In our data, this dephrasing was limited mostly to the noun *k'oolib'al* 'box', the head of a clause-final prepositional phrase, which was dephrased in 62% of the utterances. The utterances in these two panels show the noun phrase (*q'eq imul* 'black rabbit' and

[8] The target words in this experiment all contain the same stress pattern, making it difficult to determine if these movements are associated with the stressed syllable or the phrase edge. However, data from other experiments gathered from the same participants involving Spanish loan words with penultimate stress (see Yasavul, 2013) point to these movements being associated with phrase boundaries, rather than stressed syllables.

saq kiej 'white horse') produced within the same intonational phrase; for these utterances, while we see a rise on both adjectives (*q'eq* and *saq*) due to the accentual phrase tone, the rise is not nearly as large as the one on the nouns (*imul* and *kiej*), which is a result of the confluence of the LHa accentual phrase tone and a H% intonational phrase boundary tone. These utterances can be compared to the utterance in Fig. 7, in which the adjective and noun were produced in two separate intonational phrases. Here, we see both a large rise on *xar* 'blue', and a following pause, indicated in the first tier as <p>, indicating an intonational phrase break. As can be seen at the end of all three utterances, K'iche' also has a L% intonational phrase boundary tone, which is realized by a fall in f0.

The combination of lexical stress and accentual phrases leads to the categorization of K'iche' as a head/edge-prominence language in Jun's (2014, p. 531) typology. In addition, the presence of only one accentual phrase type, which is rising, and, in our data, the realization of nearly every content word as its own accentual phrase, leads to the characterization of K'iche' as exhibiting strong macro-rhythm, as also argued by Jun (2014). Thus, despite their similar categorization as head/edge-prominence languages, Moroccan Arabic and K'iche' differ in their macro-rhythmic properties.

2.5. Prosodic structure summary

According to Jun's (2005, 2014) typology, all four of the languages examined in this study are lexical stress languages. However, American English and Paraguayan Guaraní are head-prominence languages, whereas Moroccan Arabic and K'iche' are head/edge-prominence languages. Within the head-prominence languages, Paraguayan Guaraní exhibits stronger macro-rhythm than English. Within the head/edge-prominence languages, K'iche' exhibits stronger macro-rhythm than Moroccan Arabic.

Given that information structure is conveyed by prosody in many languages, Jun (2005, p. 441) proposed that the prosodic marking of information structure, including focus, corresponds to some extent to the post-lexical prosodic structure of a language. For example, the location and type of prominence-lending pitch accents is used to distinguish focused from non-focused expressions in many head-prominence languages, including English (Jun, 2005), Italian (Grice et al., 2005), Romanian (Manolescu et al., 2009), European Portuguese (Frota, 1997, 2002), and Russian (Meyer and Mleinek, 2006). In contrast, the location of prominence-lending boundary tones is used to mark focused expressions as prominent in head/edge-prominence languages such as Northern Bizkaian Basque (Elordieta, 2007) and Japanese (Venditti et al., 2008), and in edge-prominence languages like Korean (Jun, 2005). In these languages, phrase boundaries are inserted before or after focused expressions to set them apart from non-focused expressions. Thus, the prominence-marking function of pitch accents in head-prominence languages is realized through phrasing in edge- and head/edge-prominence languages (see also Féry, 2013). However, head-prominence languages like Spanish (Face, 2002), Brazilian Portuguese (Fernandes, 2007), and Chaha (Li, 2002) use both pitch accents and boundary tones to mark prominent expressions. In addition, some phonetic realizations of prominence are observed in head, head/edge-, and edge-prominence languages. For example, pitch range expansion of focused expressions is observed in both head-prominence languages, such as German (Braun, 2006; Féry and Kügler, 2008), head/edge-prominence languages, such as Farsi (Scarborough, 2007), and edge-prominence languages, such as Japanese (Venditti et al., 2008). These findings suggest that the prosodic realization of focus is orthogonal to the head-, head/edge-, and edge-prominence distinction. The current study further explores these relationships between prosodic structure and the phonological and phonetic marking of focus, based on data from the four aforementioned languages.

Given Jun's (2005) remarks, we expect these typological differences in prosodic prominence marking to impact the prosodic marking of focus in these four languages. We predict that the two head-prominence languages, English and Paraguayan Guaraní, will mark focus on phrase heads and that the two head/edge-prominence languages, Moroccan Arabic and K'iche', will mark focus on the phrase head and/or the phrase edge. Given that the two head/edge-prominence languages in this study exhibit lexical stress but no post-lexical pitch accents, we expect most of the prosodic marking of focus in these languages to occur at phrase edges.

Orthogonal to the distinction based on prominence marking is the distinction between strong and medium macro-rhythm within each prominence-marking category. The degree of macro-rhythm has previously been found to impact the marking of focus: Egyptian Arabic and Lebanese Arabic are both head-prominence languages but differ in their macro-rhythm, with Egyptian Arabic having strong, and Lebanese Arabic having medium macro-rhythm (Jun, 2014, p. 535). This difference in macro-rhythm is reflected in the prosodic marking of focus: Lebanese Arabic makes use of deaccenting to mark focus, whereas Egyptian Arabic does not (Chahal and Hellmuth, 2014). We predict that macro-rhythm will also play a role in the marking of focus among the languages studied here. Given that Paraguayan Guaraní, with strong macro-rhythm, has a smaller pitch accent inventory than American English, with medium macro-rhythm, pitch accent type may serve different functions in the two languages and therefore play different roles in the marking of focus across languages. In addition, the similarities and differences in macro-rhythm across and within prominence-marking categories, respectively, may lead to similarities in the prosodic marking of focus for languages such as American English and

Moroccan Arabic that differ in their overall prosodic structure. Specifically, we predict that the languages with stronger macro-rhythm (Paraguayan Guaraní and K'iche') will make use of strategies to mark focus that do not disrupt regular alternations in f0, such as increased duration, and that the languages with weaker macro-rhythm (American English and Moroccan Arabic) will make use of strategies to mark focus that disrupt alternations in f0, including dephrasing, deaccenting, and different pitch accents on focused and non-focused expressions. If the predicted results are obtained, they would provide further evidence for Jun's (2014) addition of macro-rhythm to the characterization of prosodic typology, as this dimension would help explain potential similarities between languages that differ in their status as head- or head/edge-prominence languages, as well as differences between languages that are similar in their status as head- or head/edge-prominence languages.

3. Methodology

The same interactive game was used to elicit comparable data about prosodic focus marking in all four languages. In the game, a native speaker participant (the ''Director'') instructed a native speaker confederate (the ''Follower'') to place tiles depicting colored shapes into numbered boxes on a game board. For each language, the same frame sentence was used throughout the experiment to maximize comparability of the utterances produced in each language. The frame sentences consisted of a verb meaning 'put', followed by a noun phrase that denoted the colored shapes and an expression that denoted the numbered box. Specific instantiations of the frame sentences produced in each language are given in (1). A crucial difference between the languages is the order of the adjective (denoting the color) and the noun (denoting the shape) in the noun phrase: in Paraguayan Guaraní and Moroccan Arabic the adjective follows the noun in the noun phrase, and in the other two languages the adjective precedes the noun. The interactive game was designed to elicit utterances of these frame sentences in which the adjective, the noun, or the entire noun phrase was focused.

(1) a. Put the orange lion in box one.

b. E-moi jagua sayju peteĩ-me [Paraguayan Guaraní]
you-put dog yellow one-in
'Put the yellow dog in (box) one.'

c. Dir l-banana l-bayda f raqm juj [Moroccan Arabic]
put DEF-banana DEF-white in number two
'Put the white banana in number two.'

d. Chayaa' la jun saq imul puwi' ri k'ooliba'l kieb' [K'iche']
put DEM[9] white rabbit on DET box two
'Put the white rabbit in box two.'

3.1. Focus

We assume that a focus is an expression that is information-structurally prominent. Specifically, we follow Rooth (1992) in assuming that a declarative sentence has a focus semantic value, in addition to its ordinary semantic value. The focus semantic value of a sentence is a set of propositions, obtained by replacing the meaning of the focus of the sentence with alternatives of the same type. For example, if the adjective *orange* in the English sentence *Put the orange lion into box 1* is focused, the focus semantic value of the sentence is a set of propositions of the form 'Put the x lion into box 1', where x denotes a property. Thus, the focus semantic value in this example is the set of propositions {Put the orange lion into box 1, put the blue lion into box 1, put the happy lion into box 1, put the furry lion into box 1, . . .}. For the purposes of this paper, we assume, with e.g., Han (2000) and Kaufmann (2012), that the imperative sentences elicited in our experiment denote propositions, like declarative sentences.

According to Rooth (1992), a sentence with a particular focus is felicitous only if the focus semantic value of the sentence (i.e., a set of propositions) subsumes a set of alternative propositions provided by the context in which the sentence was uttered.[10] We assume that this contextually given set of alternatives, i.e., the Question under Discussion (Roberts, 2012a), may be provided by an interrogative sentence or by an implicit question that the uttered sentence is taken to address. In the example in (2), the Question under Discussion that B's utterance addresses is provided by A's

[9] We follow Larsen (1988, p. 312) in translating the combination of the definite article *la* with the indefinite article *jun* as a single demonstrative, glossed DEM.

[10] To clarify that focus under Rooth's (1992) definition is inherently contrastive, Katz and Selkirk (2011) refer to this focus as ''contrastive focus''.

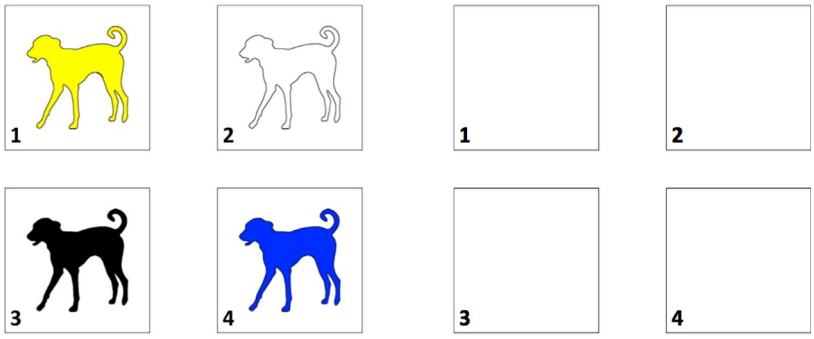

Fig. 8. Sample game boards (color online) given to the Director (left) and the Follower (right) on an experimental trial.

question. Following Hamblin (1973), we assume that A's question denotes a set of propositions of the form 'Put the x lion into box 1', where x is a color. Thus, the question denotes the set {Put the orange lion into box 1, put the yellow lion into box 1, put the blue lion into box 1, . . .}.

(2) Context: A and B are playing a game in which B instructs A how to fill boxes on a game board.
A: Which color lion should I put into box 1?
B: Put the orange lion into box 1.

If the adjective *orange* in B's utterance is focused, the alternatives introduced by B's utterance subsume those denoted by A's question, rendering the dialog in (2) acceptable. If, on the other hand, the noun *lion* in the sentence B utters is focused, the focus semantic value of the sentence B utters would be a set of propositions of the form 'Put the orange x into box 1', where x denotes a property of entities. Thus, the focus semantic value would be a set of propositions like {Put the orange lion into box 1, Put the orange chair into box 1, Put the orange suitcase into box 1, . . .}. Since this set does not subsume the meaning of A's question, B's utterance with focus on *lion* is predicted to not be felicitous in response to A's question.

In our experiment we exploit the idea that the focus of an uttered sentence is constrained by the Question under Discussion that the utterance addresses. Specifically, we assume that if the Question under Discussion is a set of alternatives of the form 'Put the x lion into box 1', then the adjective is a focus in the answer utterance, whereas if the Question under Discussion is a set of alternatives of the form 'Put the orange x into box 1', then the noun is a focus in the answer utterance. We assume that languages that prosodically mark focus of a sentence may differ in the particular phonetic and phonological devices used to mark focus.

3.2. Procedure

Each experimental session consisted of four blocks of trials. The fourth block involved a different manipulation of focus condition than the first three blocks. The data from the fourth block were therefore not included in the current analysis, and this condition will not be further described (but see Turnbull et al. (under review) for a description of the fourth block). The Director (the native speaker participant) and the Follower (the native speaker confederate) were seated across from each other at a table. For each trial, the Director was given a sheet of paper, showing a completed game board with four boxes with four colored shapes, as shown in the left panel of Fig. 8. The Follower was given a blank game board, shown in the right panel of Fig. 8. The Follower could see the Director's face, but not the Director's board. Five tiles were placed in between the Director and the Follower, where both could see them. The complete set of tiles had pictures of one of five shapes in one of five colors, for a total of 25 unique tiles. The shape and color terms in each language were selected to maximize sonority for ease of prosodic analysis. The color terms were further constrained to native terms in each language. The color and shape terms selected for each language are shown in Table 1.

After giving the Director and the Follower their game boards, and placing five tiles on the table between them, the experimenter then described the five tiles to the Director and the Follower, using the language being investigated. The first block of trials was the Noun Phrase Focus condition: for the trials in this block, the five tiles included the four colored shapes on the Director's board (e.g. orange lion, yellow deer, . . .), along with one extra tile, also unique in color and shape. The experimenter pointed out that the five tiles depicted objects that differed in both shape and color. The second and third blocks of trials were the Noun Focus and Adjective Focus conditions. In the Noun Focus condition, the five tiles depicted five different shapes of the same color (e.g. orange lion, orange deer, . . .), and the experimenter pointed out that the five tiles depicted objects that differed in shape but not in color. In the Adjective Focus condition, the five tiles depicted the

Table 1
Color and shape terms selected for each language. English glosses are shown in parentheses.[a]

Language	Color terms	Shape terms
English	blue, brown, green, orange, yellow	deer, flower, lion, owl, train
Guaraní	hovy (blue), hũ (black), morotĩ (white), pytã (red), sayju (yellow)	jagua (dog), kure (pig), yvyra máta (tree), guyra (bird), yvoty (flower)
Moroccan Arabic	bayda (white), khder (green), limoniya (orange), ramadiya (gray), zerqa (blue)	djaja (chicken), 3awd (horse), banana (banana), warda (flower), tomobil (car)
K'iche'	keq (red), q'an (yellow), q'eq (black), saq (white), xar (blue)	ala (boy), chee' (tree), imul (rabbit), kar (fish), kiej (horse)

[a] A description of the stress patterns in each language is provided in Section 2.

same shape in five different colors (e.g. orange lion, yellow lion, . . .), and the experimenter pointed out that the five tiles depicted objects that differed in color but not in shape. The order of the Adjective Focus and Noun Focus blocks was counterbalanced across the Directors in each language.

Each trial consisted of four turns. On each turn, the Director instructed the Follower to put a particular tile into a particular numbered box: first box 1, then box 2, and so on. The Directors were told to use the same frame sentence for each utterance, and to always say both the shape-denoting noun and the color-denoting adjective in their instructions. At the completion of each trial, the Director looked at the Follower's board to confirm that the tiles had been placed correctly.

Throughout the experiment, the explicit task of the Director was to instruct the Follower which colored shape to put into which box. Furthermore, the experiment procedure made it clear which box was to be filled in any given turn. As a consequence, the Question under Discussion addressed by the Director's utterances was implicit, but inferable from the experimental task. For example, in the Noun Focus condition, all of the tiles depicted objects of the same color (e.g. orange) that differed in shape. The Question under Discussion for this block was therefore 'Which orange things should be put into which box?'. For the first turn, the Question under Discussion was 'Which orange thing should be put into box 1?', i.e. a set of alternative propositions like {Put the orange lion into box 1, Put the orange deer into box 1, Put the orange flower into box 1, . . .}. For the second turn, the Question under Discussion was 'Which orange thing should be put into box 2?', i.e. a set of alternative propositions like {Put the orange lion into box 2, Put the orange flower into box 2, . . .}, and likewise for the other two turns. Thus, on any turn in this condition, the noun of the Director's uttered sentence was focused in order for the Director's utterance to be felicitous in the context in which it was uttered.[11]

In the Adjective Focus condition, the color but not the shape of the objects differed across tiles (see Fig. 8). Thus, for the Adjective Focus trials, the Questions under Discussion addressed by the Director (assuming e.g. tiles with only dogs) were of the form 'A dog of which color should be put into box 1?', 'A dog of which color should be put into box 2?', etc. In the Director's answer utterances to these questions, the adjective was focused. Finally, in the Noun Phrase Focus condition, all of the tiles depicted objects that differed both in color and shape. The Questions under Discussion that utterances in this block addressed were thus of the form 'A thing of which color and which shape should be put into box 1?', 'A thing of which color and which shape should be put into box 2?', etc. In the Director's answer utterances, the entire noun phrase was focused.

In each of the three experimental blocks, the participants completed four trials with four boxes each, producing 16 utterances in each focus condition (Noun Focus, Adjective Focus, and Noun Phrase Focus), for a total of 48 utterances. The utterances produced by the Directors were recorded using a high-quality head-mounted microphone and solid-state digital recorder. The digital recording of each Director was segmented into separate sound files by utterance, for a total of 48 sound files per Director. The individual files were labeled for focus condition, trial number, and box number. The focus condition labels were not transparent, in order to reduce the potential for bias in analysis.

3.3. Participants

Data from 10 native speaker Directors were analyzed for each language. The American English Directors (6 female, 4 male) were all monolingual undergraduates at the Ohio State University, and ranged in age from 18 to 21 years old ($M = 19$). The participants received partial course credit for their time. One female American English speaker (age 27) served as the Follower.

[11] We assume that the expressions in the Director's utterances that denote the box numbers were realized as contrastive topics (see Büring, 2003; Roberts, 2012b): these expressions are foci with respect to the general Question under Discussion 'Tiles of which color and which shape should be put into which box?', but are given in the sub-Questions under Discussion addressed by the Director's utterances (e.g. 'Which orange tile should be put into box 1?').

The Paraguayan Guaraní Directors (5 female, 5 male) were all bilingual speakers of Spanish and Paraguayan Guaraní, recruited from the San Lorenzo, Paraguay community and ranged in age from 18 to 51 years old (M = 33). The participants were paid for their time. Two female speakers of Paraguayan Guaraní (ages 49 and 51) served as the Followers.

The Moroccan Arabic Directors (2 female, 8 male) were all native Arabic speakers, recruited from the Fez, Morocco community, and ranged in age from 18 to 49 years old (M = 26). All of the Moroccan Arabic Directors had some proficiency in French and six of the Moroccan Arabic Directors were also native speakers of Berber. The participants were paid for their time. One male native Moroccan Arabic speaker (age 26) served as the Follower.

The K'iche' Directors (6 female, 4 male) were all bilingual Spanish and K'iche' speakers, recruited from the Santa María Tzejá, Ixcán, Guatemala community, and ranged in age from 25 to 46 years old (M = 34). The participants were paid for their time. One male native K'iche' speaker (age 35) served as the Follower.

3.4. Data annotation and acoustic analysis

The analyses presented in Section 4 are based on the utterances produced in the second and third boxes of each trial in the three aforementioned blocks. Utterances in the first and fourth boxes were excluded to reduce the impact of initial and final prosodic effects on the interpretation of the results. Utterances containing disfluencies or errors were also discarded prior to analysis. To distinguish pauses marking prosodic boundaries from pauses reflecting disfluencies, the distribution of pause durations in each language was examined. Long outliers in the pause duration distributions were treated as disfluencies and utterances with these long pauses were therefore excluded. The analysis was based on 215 American English utterances, 218 Paraguayan Guaraní utterances, 168 Moroccan Arabic utterances, and 186 K'iche' utterances (each out of a total of 240 possible utterances: 2 boxes $\times$ 4 trials $\times$ 3 focus conditions $\times$ 10 subjects).[12]

The data for each language were phonologically transcribed according to language-specific guidelines. The American English and Paraguayan Guaraní data were transcribed using existing autosegmental-metrical frameworks (American English: MAE-ToBI (Mainstream-American English-Tone and Break Indices, Beckman and Ayers Elam, 1997); Paraguayan Guaraní: following Clopper and Tonhauser (2013)). The Moroccan Arabic and K'iche' data were transcribed using transcription schemata which followed the principles of the autosegmental-metrical framework (see also Benkirane (1998) for Moroccan Arabic and Nielsen (2005) for K'iche') (see Section 2). For the under-described languages, the development of these transcription schema furthered our understanding of the languages' prosodic structures, and as we learned more about the languages' prosodic structures, these new insights led to refinements of the transcription schema. Thus, the development of the transcription schemata and the descriptions of the languages' prosodic structures went hand-in-hand. The American English data were transcribed by the first author, the Paraguayan Guaraní data were transcribed by the fifth and sixth authors, the Moroccan Arabic data were transcribed by the second author, and the K'iche' data were transcribed by the fourth author. ToBI annotation has been found to be extremely reliable within languages (Syrdal and McGory, 2000), and prior to this study, each of the transcribers was trained in MAE-ToBI transcription and had substantial experience in the transcription and analysis of the prosody of the relevant language from prior research projects. The transcription process for each language also involved substantial consultation among all of the authors to determine the appropriate prosodic description of each of the under-described languages. Utterances for which an annotator was uncertain were discussed with the other authors until a consensus was reached.

In addition to the phonological transcriptions, the durations of the nouns and adjectives were measured for all four languages.[13] The durations of the stressed syllables in the nouns and adjectives were not measured separately because syllable boundaries were not reliably identifiable across languages, given the selection of maximally sonorous target words. Although the target words varied in length, since the same target words were used in all three focus conditions, the relative duration of nouns and adjectives can be compared within a language across conditions.

3.5. Statistical analysis

The phonological and phonetic data were analyzed separately for each language using mixed-effects regression models with focus condition (Adjective Focus, Noun Focus, Noun Phrase Focus) as a fixed effect and random intercepts

[12] More Moroccan Arabic and K'iche' utterances were excluded compared to the American English and Paraguayan Guaraní utterances due to larger numbers of disfluencies. This difference may be due to the fact that, as the American English subjects were university students, and some of the Paraguayan Guaraní subjects had participated in previous studies, they were more adept at performing these types of tasks compared to the Moroccan Arabic and K'iche' subjects; however, this explanation is speculative.

[13] Data on f0 scaling, for English, and f0 slopes, for Paraguayan Guaraní, were also extracted; these results are discussed by Turnbull et al. (under review).

Table 2
Counts of pitch accent realizations on the nouns and adjectives in each of the three focus conditions in American English and Paraguayan Guaraní.

English	Adjective			Noun		
	Unaccented	High	Rising	Unaccented	High	Rising
Adjective focus	0	39 (53%)	35 (47%)	17 (23%)	31 (42%)	26 (35%)
Noun focus	23 (33%)	36 (51%)	11 (16%)	1 (1%)	14 (20%)	55 (79%)
NP focus	11 (15%)	45 (63%)	15 (21%)	5 (7%)	21 (30%)	45 (63%)
Total	34 (16%)	120 (56%)	61 (28%)	23 (11%)	66 (31%)	126 (59%)
Guaraní	Noun			Adjective		
	Unaccented	HL	LH	Unaccented	HL	LH
Adjective focus	42 (53%)	14 (18%)	23 (29%)	10 (13%)	18 (23%)	51 (65%)
Noun focus	27 (39%)	15 (21%)	28 (40%)	6 (9%)	14 (20%)	50 (71%)
NP focus	28 (41%)	15 (22%)	26 (38%)	8 (12%)	9 (13%)	52 (75%)
Total	97 (44%)	44 (20%)	77 (35%)	24 (11%)	41 (19%)	153 (70%)

for directors, adjectives, and nouns, to control for variation in speaking rate and differing lengths of the target words[14]. The presence and type of pitch accent on the noun and the adjective were examined for American English and Paraguayan Guaraní. To allow for the use of binomial logistic mixed-effects regression models, the pitch accent type for English was simplified to a binary distinction between rising and non-rising pitch accents. Noun and adjective durations and the presence of prosodic phrase boundaries above the level of the prosodic word before, within, and after the target noun phrase were examined for all four languages. In the duration analyses, additional fixed effects of following prosodic phrase boundary and, for American English and Paraguayan Guaraní, presence of a pitch accent were included to control for these prosodic effects on duration. The significance of the fixed factors was determined using log-likelihood comparisons of models with and without each fixed effect. When the focus condition factor was significant, pairwise comparisons of the factor levels were obtained using two separate models with treatment contrasts with the Adjective Focus and Noun Focus conditions as the reference levels. For the linear models predicting duration, *p*-values were estimated using Markov Chain Monte Carlo (MCMC) simulations (Baayen et al., 2008).

4. Cross-linguistic marking of focus

4.1. American English

Previous accounts of focus in American English found that focused elements are realized with a pitch accent, most likely a rising pitch accent, and that non-focused elements are likely to be deaccented (Ladd, 2008). This pattern is also observed within the noun phrase, where either the focused noun or the focused adjective is likely to be produced with a rising pitch accent (Ito and Speer, 2006). Our results are consistent with previous descriptions, suggesting that our task was appropriate for eliciting the desired prosodic patterns. As shown in the top section of Table 2, we found that the majority of nouns and adjectives were produced with a pitch accent. The adjectives were more likely to receive a high (H*) pitch accent than a rising (L+H* or L*+H) pitch accent whereas the nouns were produced with more rising pitch accents than high (H* or !H*) pitch accents. As shown in Table 3, mixed-effects models revealed significant effects of focus condition on the observed pitch accent patterns. For adjectives, focus condition was a significant predictor of the presence of a pitch accent and the type of accent produced. Adjectives were categorically accented in the Adjective Focus condition and were less likely to be unaccented in the Noun Phrase Focus condition (15%) than in the Noun Focus condition (33%). Among the accented adjectives, rising pitch accents were produced more frequently in the Adjective Focus condition than in the Noun or Noun Phrase Focus conditions. The Noun and Noun Phrase Focus conditions did not differ in adjective pitch accent type. For nouns, focus condition was also a significant predictor of both the presence of a pitch accent and pitch accent type. Nouns were more likely to be unaccented in the Adjective Focus condition (23%) than in the Noun (1%) or Noun Phrase (7%) Focus conditions. Among the accented nouns, rising pitch accents were produced more frequently in the Noun and Noun Phrase Focus conditions than in the Adjective Focus condition. The Noun and Noun Phrase Focus conditions did not differ in the presence of a pitch accent or noun pitch accent type.

The use of prosodic phrase breaks to mark focus was also examined. For this analysis, both intermediate and intonational phrase boundaries were included as a prosodic phrase break. As shown in the top section of Table 4, phrase

[14] Random slopes were not included to avoid model over-specification.

Table 3
Summary of the effects of focus condition in the American English mixed-effects modeling analysis.

	Focus condition	Adj vs. N	Adj vs. NP	N vs. NP
Adjectives				
Accenting	$\chi^2 = 41.81$, $p < .001$	n/a[a]	n/a	$p < .01$
Pitch accent type	$\chi^2 = 19.80$, $p < .001$	$p < .001$	$p < .001$	n.s.
Duration	n.s.	–	–	–
Nouns				
Accenting	$\chi^2 = 22.55$, $p < .001$	$p < .005$	$p < .005$	n.s.
Pitch accent type	$\chi^2 = 26.15$, $p < .001$	$p < .001$	$p < .001$	n.s.
Duration	$\chi^2 = 17.92$, $p < .001$	$p_{MCMC} < .001$	$p_{MCMC} < .001$	n.s.
Phrase breaks				
Before the NP	n.s.	–	–	–
Within the NP	n.s.	–	–	–
After the NP	$\chi^2 = 16.60$, $p < .001$	$p < .005$	$p < .005$	n.s.

[a] Accenting was categorical for adjectives in the Adjective Focus condition, so pairwise comparisons are not possible.

Table 4
Total number of noun phrases and percentages of prosodic phrase boundaries before, within, and after the target noun phrase in each focus condition in each of the four languages.[a]

	Total NPs	Before the NP	Within the NP	After the NP
English				
Adjective focus	74	3%	1%	39%
Noun focus	70	7%	6%	66%
NP focus	71	6%	4%	59%
Guaraní				
Adjective focus	79	19%	5%	19%
Noun focus	70	24%	7%	11%
NP focus	69	17%	0%	16%
Arabic				
Adjective focus	59	0%	14%	44%
Noun focus	60	2%	18%	43%
NP focus	49	2%	12%	65%
K'iche'				
Adjective focus	66	8%	23%	20%
Noun focus	62	16%	16%	23%
NP focus	58	14%	14%	24%

[a] Phrase breaks were defined as prosodic phrase boundaries above the level of the prosodic word. Thus, for English and Moroccan Arabic, phrase breaks included intonational and intermediate phrase breaks; for Paraguayan Guaraní and K'iche', phrase breaks included only intonational phrase breaks.

breaks immediately before the target noun phrase were rare (5%);[15] prosodic phrase breaks within the target noun phrase (between the adjective and noun) were also rare (4%). Prosodic phrase breaks immediately after the target noun phrase were more common (54%) than breaks in other positions. In general, unaccented words were not followed by phrase breaks: only one of the unaccented nouns, and two of the unaccented adjectives were followed by a phrase break. The mixed-effects models revealed significant effects of focus condition on the observed phrasing patterns. Focus condition was a significant predictor of the presence of a prosodic phrase break after the noun phrase. Breaks were produced more often after the noun phrase in the Noun Phrase (59%) and Noun (66%) Focus conditions than in the Adjective Focus (39%) condition. Breaks after the noun phrase did not differ in the Noun and Noun Phrase Focus conditions. The effect of focus condition was not significant for phrase breaks before or within the noun phrase.

[15] The majority of these breaks were produced when the Directors produced the verb and the determiner as a prosodic phrase separate from the adjective and noun. This pattern provides evidence that syntactic and prosodic phrases do not necessarily align (see also, e.g., Shattuck-Hufnagel and Turk, 1996). Thus, we do not assume a strict mapping between prosodic structure and syntactic structure within or across languages.

Table 5
Mean adjective and noun durations in each focus condition in each of the four languages. Standard deviations are shown in parentheses.

English	Adjective duration (ms)	Noun duration (ms)
Adjective focus	329 (94)	361 (118)
Noun focus	337 (81)	416 (113)
NP focus	338 (101)	412 (142)
Guaraní	**Noun duration (ms)**	**Adjective duration (ms)**
Adjective focus	306 (83)	380 (130)
Noun focus	349 (120)	391 (114)
NP focus	333 (97)	405 (120)
Arabic	**Noun duration (ms)**	**Adjective duration (ms)**
Adjective focus	365 (96)	370 (91)
Noun focus	397 (86)	379 (95)
NP focus	398 (98)	399 (112)
K'iche'	**Adjective duration (ms)**	**Noun duration (ms)**
Adjective focus	371 (126)	414 (107)
Noun focus	333 (101)	421 (107)
NP focus	362 (92)	428 (104)

Finally, duration effects were also examined. As mentioned above, to account for variability in word length, random intercepts for word were included in the linear mixed-effects model, as well as fixed effects for pitch accent and following phrase boundary to account for these prosodic effects on duration. As shown in the top section of Table 5, nouns were, on average, longer than adjectives, consistent with noun-phrase-final lengthening. Nouns were also longer in the Noun and Noun Phrase Focus conditions than in the Adjective Focus condition, but focus condition did not have a significant effect on adjective duration. Both adjectives ($\chi^2 = 24.87$, $p < .001$) and nouns ($\chi^2 = 5.36$, $p = .021$) were longer when they were followed by a prosodic phrase break ($M_{adj} = 476$ ms, $M_{noun} = 506$ ms) than when they were not ($M_{adj} = 329$ ms, $M_{noun} = 391$).

In summary, English uses deaccenting, type of pitch accent, phrasing, and duration to mark focus in the noun phrase, consistent with previous research (Breen et al., 2010; Ladd, 2008; Ito and Speer, 2006). Adjectives were always accented in the Adjective Focus condition, and were less likely to be unaccented in the Noun Phrase Focus condition than in the Noun Focus condition, and nouns were more likely to be unaccented in the Adjective Focus condition than in the Noun or Noun Phrase Focus conditions. These findings show that for the Noun and Adjective Focus conditions, the focused element is generally accented, and the non-focused element is more likely to be unaccented. Both of these processes lend prosodic prominence to the focused element. For the Noun Phrase Focus condition, both members of the noun phrase were generally accented, lending prosodic prominence to the entire phrase. As for pitch accent type, adjectives received rising pitch accents more frequently in the Adjective Focus condition compared to the other two focus conditions; nouns received rising pitch accents more frequently in the Noun and Noun Phrase Focus conditions than in the Adjective Focus condition. Specifically, the focused element received a more prosodically prominent pitch accent type, and in the case of the Noun Phrase Focus condition, the head of the phrase, the noun, received a more prosodically prominent pitch accent. We also observed more phrase breaks after nouns in the Noun Phrase and Noun Focus conditions than in the Adjective Focus condition, again lending prosodic prominence to either the focused element (the noun in the Noun Focus condition) or the head of the focused phrase (the noun in the Noun Phrase Focus condition). Finally, the noun was longer in duration in the Noun and Noun Phrase Focus conditions than in the Adjective Focus condition, consistent with increased prosodic prominence for the head of the focused element. Although these patterns were statistically robust, no one cue is completely predictive of focus condition. For example, it is not the case that for each utterance in the Noun Focus condition, the noun received a rising pitch accent and the adjective was deaccented. Because English, and, as will be discussed in the following sections, the other languages, make use of multiple cues to mark focus in the noun phrase, it is not necessary that each cue categorically signals the focused element, or that the same cues are used to mark the different focus conditions.

4.2. Paraguayan Guaraní

As shown in the second section of Table 2, in Paraguayan Guaraní, most of the adjectives (89%) were produced with a pitch accent, but 44% of the nouns were unaccented. Rising (LH) accents were more common for both adjectives and

Table 6
Summary of the effects of focus condition in the Paraguayan Guaraní mixed-effects modeling analysis.

	Focus condition	Adj vs. N	Adj vs. NP	N vs. NP
Adjectives				
Accenting	n.s.	–	–	–
Pitch accent type	n.s.	–	–	–
Duration	$\chi^2 = 13.56$, $p = .001$	n.s.	$p_{MCMC} < .05$	$p_{MCMC} < .05$
Nouns				
Accenting	$\chi^2 = 12.80$, $p = .002$	$p < .005$	$p < .005$	n.s.
Pitch accent type	n.s.	–	–	–
Duration	$\chi^2 = 7.96$, $p = .019$	$p_{MCMC} < .05$	$p_{MCMC} < .05$	n.s.
Phrase breaks				
Before the NP	n.s.	–	–	–
Within the NP	n.s.	–	–	–
After the NP	n.s.	–	–	–

nouns than falling (HL) accents. The relative frequency of rising and falling pitch accents is consistent with previous work (Clopper and Tonhauser, 2013) and suggests that rising pitch accents are the default pitch accent type in intonational phrase-medial position.

Focus condition was a significant predictor of the presence of a pitch accent on the noun, as shown in Table 6. Nouns were more likely to be unaccented in the Adjective Focus condition (53%) than in the Noun (39%) or Noun Phrase (41%) Focus conditions. Among the accented nouns, however, focus condition was not a significant predictor of pitch accent type (rising vs. falling). Focus condition was also not a significant predictor of either the presence or type of pitch accent on the adjective in Paraguayan Guaraní.

As shown in the second section of Table 4, prosodic phrase breaks (i.e., intonational phrase breaks, as Paraguayan Guaraní does not have intermediate phrases) immediately before the target noun were somewhat common in Paraguayan Guaraní (19%); prosodic breaks immediately after the target noun phrase (after the adjective) were also somewhat common (16%). However, prosodic phrase breaks within the target noun phrase (between the noun and adjective) were rare (4%). In addition, unaccented items were not frequently followed by a phrase break: only three of the unaccented nouns, and one of the unaccented adjectives, were followed by a phrase break. The effect of focus condition on the observed phrasing patterns was not significant.

As shown in the second section of Table 5, adjectives were, on average, longer than nouns, consistent with noun-phrase-final lengthening, given that in Paraguayan Guaraní, the adjective follows the noun. Nouns were longer on average when they were produced with a pitch accent ($M = 351$ ms) than when they were unaccented ($M = 301$ ms, $\chi^2 = 22.29$, $p < .001$), consistent with our previous findings on the phonetic realization of prosodic prominence in the language (Clopper and Tonhauser, 2013). Focus condition was a significant predictor of both adjective and noun duration. Adjectives were significantly longer in the Noun Phrase Focus condition than in the Adjective and Noun Focus conditions. However, nouns were significantly longer in the Noun Phrase and Noun Focus conditions than in the Adjective Focus condition, consistent with our previous research demonstrating lengthening of focused expressions (Clopper and Tonhauser, 2013).

In summary, Paraguayan Guaraní uses deaccenting and duration to mark focus in the noun phrase. Nouns were more likely to be unaccented in the Adjective Focus condition than in the Noun and Noun Phrase Focus conditions, lending prosodic prominence to the focused Adjective; however, adjectives did not show a similar pattern of deaccenting. This asymmetry between noun and adjective pitch accenting may be due to word order in Paraguayan Guaraní: because the adjective follows the noun, it is more likely to be phrase final and receive a pitch accent. The focused expression also tended to be longer than the same expression when it was not focused: both adjectives and nouns were longer in the Noun Phrase Focus condition, lending prosodic prominence to the entire focused phrase, and nouns were longer in the Noun Focus condition than in the Adjective Focus condition. However, again, adjectives did not show a similar pattern, possibly due to their phrase-final position.

4.3. Moroccan Arabic

Moroccan Arabic, as noted above in Section 2, does not exhibit post-lexical pitch accents. Therefore, only phrasing and word duration will be discussed as potential cues to focus. As shown in the third section of Table 4, prosodic phrase breaks (including both intonational and intermediate phrase boundaries) immediately before the target noun were rare

Table 7
Summary of the effects of focus condition in the Moroccan Arabic mixed-effects modeling analysis.

	Focus condition	Adj vs. N	Adj vs. NP	N vs. NP
Duration				
Adjectives	$\chi^2 = 13.11$, $p = .001$	n.s.	$p_{MCMC} < .01$	$p_{MCMC} < .01$
Nouns	$\chi^2 = 11.34$, $p = .003$	n.s.	$p_{MCMC} < .005$	n.s.
Phrase breaks				
Before the NP	n.s.	–	–	–
Within the NP	n.s.	–	–	–
After the NP	$\chi^2 = 19.68$, $p < .001$	n.s.	$p < .005$	$p < .005$

Table 8
Summary of the effects of focus condition in the K'iche' mixed-effects modeling analysis.

	Focus condition	Adj vs. N	Adj vs. NP	N vs. NP
Duration				
Adjectives	n.s.	–	–	–
Nouns	n.s.	–	–	–
Phrase breaks				
Before the NP	n.s.	–	–	–
Within the NP	n.s.	–	–	–
After the NP	n.s.	–	–	–

(1%); breaks within the noun phrase (between the noun and the adjective) were somewhat more common (15%). Breaks immediately after the target noun phrase (after the adjective) were relatively frequent (50%).

As shown in Table 7, the mixed-effects models revealed significant effects of focus condition on the observed phrasing patterns. Focus condition was a significant predictor of a prosodic phrase break after the noun phrase. Breaks were produced more often after the noun phrase in the Noun Phrase Focus condition (65%) than in the Adjective (44%) or Noun (43%) Focus conditions. The difference between the Adjective and Noun Focus conditions was not significant. Focus condition also did not affect the patterns of prosodic phrase breaks before or within the target noun phrase.

As shown in the third section of Table 5, the average durations of the adjectives and nouns were similar overall. However, nouns were longer when they were followed by a prosodic phrase break ($M = 422$ ms) than when they were not ($M = 380$ ms, $\chi^2 = 12.81$, $p < .001$). Focus condition was a significant predictor of both adjective and noun duration. Adjectives were significantly longer in the Noun Phrase Focus condition than in the Adjective and Noun Focus conditions. Similarly, nouns were significantly longer in the Noun Phrase Focus condition than in the Adjective Focus condition. None of the other pairwise comparisons were significant. Thus, Noun Phrase Focus was realized with longer adjectives and nouns in Moroccan Arabic, relative to the other two focus conditions.

Moroccan Arabic thus uses phrasing and duration to mark focus in the noun phrase: in the Noun Phrase Focus condition, nouns and adjectives are lengthened and the noun phrases are also more likely to be followed by a phrase break, lending prosodic prominence to the entire noun phrase.

4.4. K'iche'

Like Moroccan Arabic, K'iche' does not exhibit post-lexical pitch accents in our analysis and we therefore examined only phrasing and duration as cues to focus. As shown in the last section of Table 4, prosodic phrase breaks (i.e., intonational phrase breaks) before, within, and after the target noun phrase occurred at roughly the same rate (12%, 18%, and 22%, respectively). As shown in Table 8, the mixed-effects models revealed no significant effects of focus condition on the observed phrasing patterns.

As shown in the last section of Table 5, in K'iche', where the noun follows the adjective, the nouns were, on average, longer than the adjectives, reflecting noun-phrase-final lengthening. Both adjectives ($\chi^2 = 20.71$, $p < .001$) and nouns ($\chi^2 = 7.96$, $p = .005$) were longer when they were followed by a prosodic phrase break ($M_{adj} = 457$ ms, $M_{noun} = 487$ ms) than when they were not ($M_{adj} = 334$ ms, $M_{noun} = 402$ ms). There were no significant effects of focus condition on word duration in K'iche', meaning that K'iche' showed no prosodic effects of focus in the noun phrase for any of the variables examined. This null result suggests that K'iche' may employ other cues to focus that were not examined here (including

Table 9
Prosodic cues to focus in the noun phrase in the head- and head/edge-prominence languages in the current study.

	Head-prominence		Head/edge-prominence	
	English	Guaraní	Arabic	K'iche'
Deaccenting	✓	✓	(n/a)	(n/a)
Pitch accent type	✓		(n/a)	(n/a)
Phrasing	✓		✓	
Duration	✓	✓	✓	

syntactic ones, see also Genzel et al. (2015) on Hungarian),[16] or, alternatively, that K'iche', like Italian, prosodically marks focus only on entire utterances, and not within the noun phrase (Swerts et al., 2002). This result is also compatible with the hypothesis that K'iche' does not employ prosody for focus marking in general (see also e.g. Hartmann and Zimmermann (2007) on in situ focus in Hausa (Chadic) and Kügler and Skopeteas (2007) on in situ focus in Yucatec (Mayan)).

4.5. Prosodic marking of focus summary

Table 9 summarizes the results of the analysis presented in Sections 4.1–4.4. American English is the only language to make use of pitch accent type to realize focus in the noun phrase; however, both American English and Paraguayan Guaraní make use of deaccenting for the realization of focus in the noun phrase. American English, Paraguayan Guaraní, and Moroccan Arabic use duration and Moroccan Arabic and American English also make use of phrasing. K'iche' showed no use of any of the prosodic cues studied in this experiment to realize focus in the noun phrase. Finally, apart from the prosodic marking of focus, three of the four languages—all except Moroccan Arabic—showed noun-phrase-final lengthening. A detailed comparison of the prosodic marking of focus in the noun phrase on the four languages follows in Section 5.

5. Cross-linguistic comparisons of the prosodic marking of focus

The previous section demonstrated that focus in the noun phrase is marked prosodically in three out of the four languages under investigation. The results obtained about the individual languages provide the basis for cross-linguistic comparison, with the ultimate goal of identifying the nature and extent of variation exhibited by human languages in the way in which focus is marked prosodically. The four languages in our data set are typologically unrelated and thereby ideally suited to identifying how languages may or may not vary in this domain. At the same time, the fact that the four languages are typologically unrelated and, in fact, instantiate different language types in Jun's (2005, 2014) prosodic typology, means that comparison must proceed cautiously, with consideration of the ways in which these languages can and cannot be compared. With this caveat in mind, we will compare the four languages on each of the three dimensions that were found to mark focus in the noun phrase in the languages individually: duration, phrasing, and pitch accenting.

For word duration, the main concern when comparing both within and across languages is variability in word length. To control for this source of variability, the same words were used in all focus conditions in each language, making it possible to compare e.g., the average durations of the words *orange*, *green*, *brown*, *yellow*, and *blue* across the three focus conditions in American English. In addition, the variation in word length was statistically controlled through the use of random intercepts for word in the mixed-effects models. Thus, the comparison across languages explores whether or not the duration of a word changes in each individual language as a function of the different focus conditions, rather than a comparison of absolute word durations across languages.

In both Moroccan Arabic and Paraguayan Guaraní, adjectives were longer in the Noun Phrase Focus condition than in the Adjective and Noun Focus conditions. However, in American English and Paraguayan Guaraní, nouns were longer in both the Noun and Noun Phrase Focus conditions than in the Adjective Focus condition; in Moroccan Arabic, nouns were only significantly longer in the Noun Phrase Focus condition than in the Adjective Focus condition. In Paraguayan Guaraní, focused expressions are lengthened: nouns are lengthened in the Noun Focus condition and both nouns and adjectives are lengthened in the Noun Phrase Focus condition. This result is consistent with the findings reported by Clopper and Tonhauser (2013). American English similarly exhibited lengthening of the focused expressions, but only for

[16] This possibility, of course, holds for the other languages in the study as well.

nouns. Adjective duration was not affected by focus condition, contrary to previous research, such as Eady and Cooper (1986), who observed lengthening of focused expressions regardless of word class.[17] Moroccan Arabic, on the other hand, only showed a lengthening effect in the Noun Phrase Focus condition, in which both the adjective and the noun were lengthened. No differences in noun or adjective duration were observed across the Noun or Adjective Focus conditions in Moroccan Arabic. These results suggest a combination of similarities and differences in the prosodic marking of focus in American English and Paraguayan Guaraní, head-prominence languages, and Moroccan Arabic, a head/edge-prominence language: although all three languages make use of duration to mark focus, they do so differently, with Moroccan Arabic only exhibiting lengthening in the Noun Phrase Focus condition, Paraguayan Guaraní using duration to mark both Noun and Noun Phrase Focus, and American English using noun duration only to mark both Noun and Noun Phrase Focus. K'iche', a head/edge-prominence language, showed no effect of focus condition on word duration, which further suggests variability among both head- and head/edge-prominence languages in the use of word duration to mark focus prosodically.

As discussed in Section 4, three of the four languages use phrasing to mark focus in the noun phrase. However, direct comparison on the basis of phrasing is challenging because the languages differ in their levels of prosodic phrasing. American English, Moroccan Arabic, and K'iche' all exhibit two levels of prosodic phrasing, but they differ in the size of the level of phrasing below the intonational phrase: whereas American English and Moroccan Arabic have intermediate phrases, K'iche' has accentual phrases. Further, Paraguayan Guaraní has only one level of phrasing (intonational phrases); no intermediate phrases or accentual phrases were observed in Paraguayan Guaraní. While these differences in the number and size of the prosodic phrases may affect the prosodic realization of focus, we are interested in a more basic question of whether or not these languages make use of phrasing at any level above the prosodic word to mark focus in the noun phrase. For each language, we have therefore only examined the use of intermediate and intonational phrase boundaries across focus conditions; that is, our analysis is limited to levels of phrasing that are larger than the prosodic word.[18]

Further complicating a potential cross-linguistic comparison is the fact that, as can be seen in Table 4, the languages differ in how often phrase breaks occurred before, within, and after the target noun phrase. Paraguayan Guaraní and K'iche' exhibited more prosodic phrase breaks before the noun phrase than Moroccan Arabic or American English; Moroccan Arabic and K'iche' exhibited more phrase breaks within the noun phrase than American English or Paraguayan Guaraní; and Moroccan Arabic and American English exhibited more prosodic phrase breaks after the target noun phrase than Paraguayan Guaraní or K'iche'. These patterns suggest that the two head-prominence languages, American English and Paraguayan Guaraní, may disprefer a phrase break in the middle of a noun phrase. In addition, the languages with weaker macro-rhythm, American English and Moroccan Arabic, show a large degree of asymmetry between phrase breaks before and after the noun phrase (5% vs. 54%, and 1% vs. 50%, respectively, for American English and Moroccan Arabic). The two languages with stronger macro-rhythm, while having fewer phrase breaks after the target noun phrase, did not show this same asymmetry, and exhibited phrase breaks before and after the noun phrase at similar rates (12% vs. 22% for K'iche', 19% vs. 22% for Paraguayan Guaraní). It is clear that, independent of focus marking, these languages have different patterns of phrasing, which is perhaps connected with their prosodic structure, particularly their macro-rhythm.

The languages with weaker macro-rhythm, Moroccan Arabic and American English, showed significant effects of focus condition on phrasing patterns, whereas the languages with stronger macro-rhythm, Paraguayan Guaraní and K'iche', did not. Because regular phrasing can create regular f0 alternations which contribute to strong macro-rhythm, dephrasing in these languages would disrupt these regular alternations. A language with strong macro-rhythm may therefore be less likely, overall, to make use of dephrasing to mark focus.[19]

Given that only two of the languages, Paraguayan Guaraní and American English, showed evidence of post-lexical pitch accents, only they will be compared on this dimension. As expected, both languages make use of post-lexical pitch accents to mark focus in the noun phrase, but they do so in different ways. In American English, significant effects of both pitch accent type and deaccenting were found for both nouns and adjectives. Adjectives were more likely to receive rising pitch accents in the Adjective Focus condition, and nouns were more likely to receive rising pitch accents in the Noun Focus condition. Nouns were more likely to be unaccented in the Adjective Focus condition than in the Noun and Noun Phrase Focus conditions, and adjectives were less likely to be unaccented in the Noun Phrase Focus condition compared to the Noun Focus condition, and were never unaccented in the Adjective Focus condition. Thus, in English, the head of the focused expression was likely to be accented, and to receive a rising pitch accent.

[17] An inspection of Table 5 suggests that the relative duration of the adjective and the noun may reflect focus condition (Katz and Selkirk, 2011), but the differences in relative duration are driven by the significant effect of focus on noun duration.

[18] We therefore do not explore effects of focus on accentual phrases in K'iche', which, as noted in Section 2.4, were produced on nearly all of the adjectives and nouns.

[19] The causal relationship between these two observations cannot be determined.

In Paraguayan Guaraní, while focus condition was a significant predictor of the presence of a pitch accent on the noun, with nouns being more likely to be unaccented in the Adjective Focus condition than in the Noun or Noun Phrase Focus conditions, focus condition was not a significant predictor of adjective pitch accenting. In addition, Paraguayan Guaraní showed no effect of focus condition on pitch accent type. These patterns suggest variability among head-prominence languages in the use of pitch accents to mark focus. This difference may be partially attributable to the fact that the annotation system for American English has been more extensively developed. Distinctions in f0 scaling that are phonological[20] in American English might also be phonological in Paraguayan Guaraní, but further study of Paraguayan Guaraní prosody is necessary to determine if additional pitch accent types that vary in f0 scaling occur in the language. However, the current research on Paraguayan Guaraní provides evidence for only two pitch accent categories. Given our current understanding of the prosodic structure of these languages, the observed differences in the pitch accent cues to focus across American English and Paraguayan Guaraní can be attributed to differences in prosodic typology, specifically, macro-rhythm. American English has a much larger inventory of pitch accents than Paraguayan Guaraní, and thus, has weaker macro-rhythm. It is therefore less disruptive to overall macro-rhythm for English to use pitch accent type to mark focus than it would be for Paraguayan Guaraní because the f0 alternations are already irregular. In addition, since Paraguayan Guaraní has a stronger macro-rhythm than American English, it makes less use of deaccenting to mark focus compared to English: as macro-rhythm is realized through regular f0 alternations, deaccenting, particularly of the phrasal head (in this case, the adjective) would disrupt these alternations. Paraguayan Guaraní thus employs other strategies for marking focus—duration—that do not disrupt f0 alternations, but still lend prosodic prominence to the focused expression.

We can thus consider two dimensions for the prosodic marking of focus. The first dimension relates to the prosodic resources that are available in the language for marking focus, i.e., whether it has pitch accents, accentual phrase tones, etc., which is partially captured by Jun's (2014) head- vs. head/edge- vs. edge-prominence distinction. With respect to comparisons within and across head- and head/edge-prominence languages, we observed that the prosodic realization of focus is not directly predictable from this dimension alone. In particular, we did not observe a one-to-one mapping between head- vs. head/edge-prominence and the production of prominence to mark focus. The head-prominence languages do not rely exclusively on pitch accenting to mark focused expressions as the prominent head of their prosodic unit and the head/edge-prominence languages do not rely exclusively on phrasing to mark focused expressions as the prominent edge of their prosodic unit. Whereas deaccenting is used in both head-prominence languages (American English and Paraguayan Guaraní), we only found evidence for pitch accent type as a cue to focus in one of the head-prominence languages (American English). Similarly, we only found evidence for phrasing as a cue to focus in one of the head/edge-prominence languages (Moroccan Arabic). However, phrasing also emerges as a cue to focus in American English, a head-prominence language. Similarly, duration is used to mark focused expressions in both head-prominence languages (American English and Paraguayan Guaraní) and one head/edge-prominence language (Moroccan Arabic), but not the other head/edge-prominence language (K'iche').

These differences within the head- and head/edge-prominence languages might be due to their differences in macro-rhythm, which is the second dimension in Jun's (2014) typology. The languages with weaker macro-rhythm, American English and Moroccan Arabic, make more use of prosodic properties which disrupt regular f0 peaks and valleys than the languages with stronger macro-rhythm, K'iche' and Paraguayan Guaraní: for American English, using a wide variety of pitch accent types, and for American English and Moroccan Arabic, using phrasing. The languages with strong macro-rhythm do not use these cues, thereby maintaining their regular f0 alternations to a greater degree by making use of other strategies: deaccenting and duration for Guaraní, and possibly, other prosodic factors not considered in this study for K'iche'.

Despite these differences, we also observed similarities across all three of the languages that used prosodic factors to mark focus. Specifically, the cues associated with focus in all of the languages serve to increase the prosodic prominence of the focused expressions, including both the adjective and the noun in Noun Phrase Focus, relative to the non-focused expressions, through increased f0 movement, increased duration, or enhanced temporal grouping through phrasing (see also Calhoun (2015) on Samoan).

6. Conclusion

A strong theory of the prosodic realization of focus must be able to account for cross-linguistic variation in prosodic focus marking. The current study contributes novel data on how focus in the noun phrase is marked prosodically in Paraguayan Guaraní, Moroccan Arabic, and K'iche', three typologically diverse languages that are comparatively understudied in the literature on prosody. The results reveal variability across languages in the specific phonetic and phonological prosodic properties that are used to mark focus in the noun phrase. Duration and deaccenting were used to

[20] Not uncontroversially, see for example, Ladd and Schepman (2003) and Calhoun (2012) who dispute the L+H*/H* distinction in English.

mark focus in Paraguayan Guaraní, duration and phrasing were used to mark focus in Moroccan Arabic, and none of the examined cues were used to mark focus in the noun phrase in K'iche'. This variability is partially due to these languages' status as either head-prominence vs. head/edge-prominence languages, and partially due to the languages' level of macro-rhythm, with the languages with weaker macro-rhythm being more likely to make use of focus-marking strategies that disrupt regular f0 alternations than the languages with stronger macro-rhythm. In addition, all of the significant effects of focus condition on the prosodic realization of utterances produced in this study reflect increased prosodic prominence for focused expressions relative to non-focused expressions. These results are consistent with previous research on the prosody of focus in better-studied languages, such as English, German, and Japanese, and suggest that prosodic prominence relations may be an important component of the realization of focus across languages.

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