Stress and accent

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Contents

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1. Introduction

In this article, I will discuss the phenomenon of (linguistic) stress as it applies to words. Units that are larger than words (such as phrases and sentences) can be said to have stress too, but I will not touch on these larger units here. Right away, in section 2, I propose to shift our attention to the notion of accent, which I define as more fundamental than stress. Stress, as we will see, can be seen as a phonetic manifestation of accent. I will provide a typology of the various ways in which accent is manifested besides through stress. In section 3, the question as to how accent is formally represented will be in focus. Section 4 argues that the set of accent-driven phenomena may be a reflection of lexical and post-lexical accentual structures that can sometimes be in conflict with each other. In section 5, I briefly discuss the relationship between accentuation and morphology, and 'stress shift' rules.

2. Manifestations of accent

It seems prudent to first make an attempt to define what stress is, or, at least, how I will use the term in this article. Starting with what most people who are able to read this article know (i.e. people who know English), let us consider the following pairs of English words:

(1)	convíct	cónvict
	protést	prótest
	pervért	pérvert

If one pronounces these words, pairwise, one will notice a difference that seems to involve the (relative) prominence of the syllables that the words are composed of. Let us capitalize the prominent syllables:

(2)

conVÍCT	CÓNvict
proTÉST	PRÓtest
perVÉRT	PÉRvert

Stress, as I will define it, is (relative) syllable prominence. It is now fair to ask what is meant by **prominence**. This brings us into the realm of phonetics, i.e. the study of the way speech is produced and perceived. Relative prominence corresponds, on the one hand, with greater articulatory effort in production and, on the other, with greater salience, or audibility, on the perceptual side. Stressed syllables, then, stand out and are easier to perceive than the unstressed, or lesser stressed syllables. Greater articulatory force can be the cause of several effects that can be measured by investigating the details of production, or the physical properties of the produced acoustic signal, e.g.:

(3) *Phonetic properties of stressed syllables*

a. The stressed syllable has greater duration
b. The stressed syllable is louder (greater amplitude)
c. The stressed syllable is pronounced at a higher pitch (higher fundamental frequency)
d. The segments are pronounced with greater precision

This list is not meant to be finite, nor is it couched in the latest language of the trained phonetician. Also, some or all of the phonetic properties may be exclusively or primarily manifested in only a part of the syllable such as its vowel, or its rhyme. Whatever the details, a stressed syllable will differ from unstressed syllables in having 'more' of whatever 'stretchable' property any syllable may have (such as duration, pitch, loudness, manner of articulation).

Following researchers such as Hyman (1977), I propose to reserve the term stress for 'prominence' as signaled by the above collection of cues. Then, I will also follow these researchers in saying that stress, in the sense just defined, is a phonetic manifestation or exponent of an abstract property **accent.**

Before we address the question of how accent is to be formally understood, let us include another language in the discussion, viz. Safwa (Bantu). Consider the following words or word combinations:

(4)

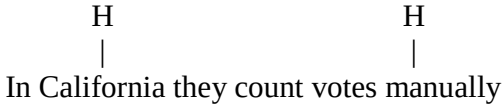
a'mi-ino	'teeth'
ga'mi-ino	'the very teeth'
mi-ino'	'it is teeth'
inko'ombe i'im-bisi	'uncooked beans'
inko'ombe m-bisi'	'the beans are uncooked'

Again, I have provided certain vowels with what is often (and appropriately) called an 'accent mark'. As in the case of English, speakers of Safwa perceive the syllables that contain these accented vowels as more prominent than the surrounding syllables. When we now look at the articulatory and acoustic properties of the vowels in question, it turns out that what distinguishes them from other vowels in the word is just

(or mainly) their relative higher pitch. Thus, the relevant vowels are singled out by only one of the properties that cue the presence of accent in English. But if 'stress' is the collection of all the properties in (3), we cannot say that Safwa has stress. So what *do* we say? The obvious answer may be that Safwa has **pitch.** We can now capture the difference between English and Safwa terminologically by referring to the former as a **stress-accent language** and the latter as a **pitch-accent language**, as proposed in Hyman (1977).

Before we discuss the matter of accent locations, it will also be important to see that the accents can be cued by phonological properties instead of, or in addition to non-distinctive phonetic cues, although the line between what is called phonetic and phonological lies in different places for different researchers. One important way in which word accents can reveal themselves is by function as anchoring points for some of the tones that make up the **intonation** melody. (Because these tones, being pitch events, link to word accents, researchers often refer to them as 'pitch-accents' not to be confused with Hyman's notion of pitch-accent introduced earlier.) An intonation melody in a language like English consists of one or more 'pitch-accents' (which can be H. L or a contour) and additional boundary tones coming at the beginning or the end of whatever word stretch of the sentence the melody is associated with (cf. Gussenhoven 1984). This word stretch is usually called the intonational phrase, a unit that need not coincide with a syntactic phrase. In the following example the 'pitch accent' is taken to be a high tone (H), and no boundary tones are assumed:

(5)



Both *California* and *manually* have several syllables, yet the H tone links to the one that we would call stressed or accented. I am not making a universal claim here on how intonation melodies are anchored to the 'text'. In other languages than English the tune-to-text rules may be different. In any event, in languages that work like English in this respect, 'pitch-accents' function as cues for word accent.

A second non-phonetic cue for accent lies in the notion of phonological **contrast**. Regularities in the phonological (or phonotactic) patterns of words can be broken down in statements about the inventory of phonological segments (or phonemes) and the possible combinations of these segments. It is not unusual to make statements about the segment combinations in terms of syllables, assuming that a well-formed word is a combination of wellformed syllables (plus, possibly, extra consonants at the beginning or end of the word). It is well-known, however, that some syllables allow more segment types and more combinations than others and at this point it will not come as a surprise to learn the syllables that allow 'more' are the ones that are accented.

Finally, we need to consider yet another type of cue. In English, the sound [p^h] (aspirated p) is restricted to initial position in accented syllables (if not preceded by an /s/). In unaccented syllables, instead, the sound [p] is found. In addition in syllable final position we always only find [p]. Traditionally, [p^h] and [p] are called **allophones** ('realizations') of one lexical phoneme /p/. The lexical representation of words only has a segment /p/. The aspirated segment is derived by an allophonic rule that forms part of the

mapping from the lexical into the post-lexical representation. Now, since [p^h] only occurs in accented syllables its presence is a cue of accent. Thus, one might say that English has a post-lexical constraint that bars the segment [p] from a stressed syllable onset. A process 'add aspiration' (called a repair rule in some frameworks) ensures that the lexical form /pin/ is rendered as [p^hin] at the post-lexical level. To account for the fact that English has no contrast between /p/ and /p^h/, we assume that the lexical phonology has a constraint that bars a phoneme /p^h/ altogether.

Both levels, then, are characterized by a set of wellformedness constraints, and both levels are served by repair rules that will change forms that violate these constraints before they can be accepted at that level. Lexical constraints can be violated by new words that are produced by the morphology or that enter the language through deliberate new formations or by loan words. Post-lexical constraints can be violated by the forms that are provided by the lexical phonology. Post-lexical constraints, unlike lexical constraints, are subject to variables that include style and rate of speech, as well as sociolinguistic variables.

All the differences between the contrastive options that can occur in accented syllables and in unaccented syllables, as well as the differences in syllable types that are allowed in these two circumstances are clear examples of phonological (or phonotactic) cues for accent.

Summing up, we have seen that the location of accent in English can be signaled by at least the following cues:

(6) *Cues for accent in English*

a. Inherent stretchable properties (duration, pitch, loudness, manner)
b. Anchoring of intonational tones
c. Lexical-phonotactic constraints
d. Post-lexical 'phonetic' constraints (and the processes that serve them)

All this undermines the term stress-accent because it shows that accent is manifested in much more than just stress, which only covers (6a). However, it strengthens the more important point that we must separate the notion of accent from the cues that signal its location. Large portions of the lexical and post-lexical phonology are determined by the difference between the presence or absence of accent.

3. Accentual representations

In the preceding discussion, we have been assuming that accent is a local property of one particular syllable in the word. If this where so, a proper and simple representation of accent would be to assign some sort of mark to the syllable in question (or its vowel), much as in done in dictionaries or transcriptions where accent is marked by an 'accent mark' (as in our example in 1). This practice, although tolerable for some purposes, is inadequate for two reasons, which will almost sound contradictory. Firstly, the use of a local accent mark fails to explain that accent is a 'once-per-word' property, i.e. only one syllable in the word can be accented. Accent is, as is often said, a culminative property. Thus, in order to represent accent formally in the phonological representation of words, it

must be so that there can be only one accent. The second reason for thinking that the accent mark is inadequate is that words apparently can have more than one accent. Consider the examples:

(7) an'tielope,
cro'codi,le

In English, if more than one syllable precedes the accent, a second accent is possible, often indicated by a second type of accent mark. The second mark is said to be a non-primary or secondary accent (or secondary stress), as opposed to the primary accent (stress). The reader will realize that the contradiction between the two inadequacies of the local accent mark is apparent: the potential presence of a secondary accent does not invalidate the claim that there can be only one primary accent. However, there can be more than one secondary accent:

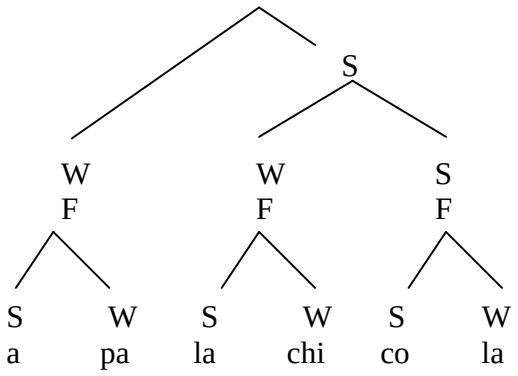
(8) a, pa la, chi co' la

Secondary accents clearly are a linguistic manifestation of **rhythm**. In some languages words can have an even greater length than 6 syllables, and in those cases words can have three rhythmic secondary accent or more. Hayes (1995) describes or refers to many cases of this type.

There are two views on the relationship between primary accent and secondary accent(s). In this section I will focus on one of these. The other view is discussed in the next section.

One view is that a primary accent is basically a promoted secondary accent. In this view, in other words, primary accent is determined on a foundation of secondary accents. A point in favor of this idea is that, in the examples in (7) and (8), the distribution of primary accents seems to follow the same rhythmic pattern that characterizes the secondary accents in that an accented syllable is typically followed by an unaccented syllable. Hence each accent seems to create a Strong - Weak domain. **Metrical Theory** formalizes this idea by assuming that the string of syllables of a word is organized in a sequence of binary trochaic (i.e. left-strong) feet. Essentially, a word is compared to a line of verse. The sequence of feet is then organized into a right-strong structure that designates the rightmost foot as the strongest foot in the word:

(9)



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*       *       *       *       *       *
*               *               *
                                *
                                *
```

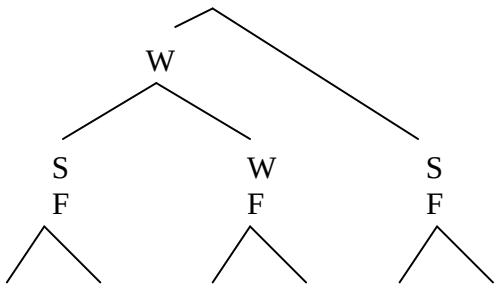
(Here, and in 10, ignore the 'grid' with asterisks, for a brief while.)

The terms strong and weak refer to the idea that accent is a relative notion. A syllable is said to be 'stressed' by virtue of being more prominent than a neighboring syllable. In later work, however, the idea has been expressed that a syllable by itself (e.g. in a monosyllabic word) can also be said to be stressed. In this way, one can make a difference between stressed monosyllabic words and unstressed monosyllabic words, the latter often called (phonological) clitics. In line with the second, non-relative view on stress/accent, it was also suggested to replace the term strong and weak by the terms **head** and **dependent**.

The feet are binary branching, headed constituent, restricted to two syllables (we call that **bounded**). The tree structure that organizes the feet is also thought of as binary branching, but not bounded because it can contain more than two feet. The idea that the phonological string of phonemes (just like the string of words that make up sentences, and the morphemes that make up words) is organized in a headed (most likely binary branching) structure has become widely acknowledged. A systematic account of this view on phonology can be found in the framework of **Dependency Phonology** (Anderson & Ewen 1987), that, in its earliest work, predates Metrical Phonology. (Below the level of the foot, we find that segments are organized into headed syllables consisting of binary headed syllabic constituents like onset and rhyme.)

Why is the structure in (9) adequate as a representation of the accentual structure of *apalachicola*? Notice, firstly, that only one syllable can be exclusively dominated by nodes labelled S, or head, (and the root node). This syllable, then, is the head of all heads, the ultimate head (UH), of the word and that seems an adequate formal representation of the notion of primary accent. Secondly, secondary accents are uniformly represented as heads of feet. The structure in (9) suggests that the two feet preceding the primary accent are not equal because they are structurally different within the word tree structure. Indeed, according to speakers of English, the non-primary accent on the first syllable is stronger than the non-primary accent on the third syllable (which is sometimes called a tertiary accent). Is (9) an adequate representation of that difference? It would be, if we posit the axiom that the more deeply embedded a weak foot is, the weaker it is. However, one might also wish to consider the structure in (10) that more directly shows that the second foot is subordinate to the first:

(10)



S	W	S	W	S	W
a	pa	la	chi	co	la
*	*	*	*	*	*
*		*		*	
*				*	
				*	

To date, it has been difficult to decide on such matters, which has seduced some researchers into using non-binary organization of feet resulting in a 'flat' structure.

The issue can be resolved quite easily, however. After the introduction of metrical theory, there have been a number of 'internal debates' on certain notational issues (cf. Halle and Vergnaud 1987, and van der Hulst 1999). Confusing to the relative outsider may be the use of so called metrical **grids**. Originally, Liberman and Prince (1977) introduced two simultaneous structures to account for the accentual structure of words, the tree and the grid. The grid consists of a series of columns, one for each syllable, the height of which indicates the degree of accent. The principle in (11) derives the grid from the tree:

(11) *Tree - grid correlation*
In any constituent the head has one more asterisk than its dependent

Notice, how in accordance with this principle, the grid in (10) nicely makes a three-way distinction between three degrees of accentual strength, whereas the grid in (9) does not have the same distinction.

Given that the grid is merely an interpretative device, one might argue that it is strictly speaking redundant. Realizing this, for a brief while, reseachers considered abandoning the tree rather than the grid, thus giving up on constituency. Others argued that grids had to be abandoned. Halle and Vergnaud (1987) argue that constituency should not be eliminated, but to please all parties they adopt a notation that uses the grid, enriched with brackets to indicate constituency, which is not different, of course, from using the headed tree structures (although it does have the typographical advantage of not having to draw tree structures).

English, apparently has left-headed feet, with the rightmost foot being the head foot (cf. Kager 1989 for many details and discussion):

(12) *English accent*
a. foot: left-headed (iterating through the word from right to left)
b. word: right-headed

The framework of metrical theory has shown to be very productive in accounting for cross-linguistic variation in accentual patterns by assuming that we can find variation along the two parameters in (13):

(13)

word \ foot	left-headed	right-headed

left-headed	initial syllable	second syllable
right-headed	penultimate syllable	final syllable

Feet must be assigned iteratively if the word has more than two syllables, and it must therefore also be specified whether this iteration works from right-to-left or from left-to-right, since that will make a difference in case the number of syllables in the word is uneven. For English, since the head foot is on the right, it can easily be shown that the iteration is from right-to-left. With the head foot being on the right, the location of primary accent would be dependent on the number of syllables in the word if the iteration was left-to-right, as shown in (14):

(14)

head right	*	*	2
left-to-right	(* *)	(* * *)	1
	(* *)(* *)	(* *)(* *)(*)	0
	1 2 3 4	1 2 3 4 5	

I used here the bracketed grid notation mentioned above. Level 0 represents al the stressable units (the rhymes). On level 1 we represent the foot heads and level 2 is for the word head. If a language would have a system as in (14), the location of primary accent would be penultimate in words that have an even number of syllables, and final in case the number of syllables is odd. This is certainly inadequate for English, which therefore must have right-to-left footing.

(Systems of the type in (14) have been claimed to exist, but I will argue below that metrical algorithms should not produce them directly. Thus, I will assume that the direction of footing is not independent from the edge choice for the head foot. Since in English the head foot is on the right, footing must be from right-to-left. I return to this issue in section 4.)

We now turn to a factor that may influence and interrupt the regular way in which syllables are gathered into feet. So far, we assumed that syllables are gathered in groups of two, monosyllabic feet arising only in case we can ran out of syllables. In some languages, however, certain types of syllables (called heavy) may not appear as the dependent in a foot. This is called **weight-sensitivity**. The 'weight' of a syllable is determined by its intrinsic, phonological properties. There are various types of intrinsic weight and weight is typically (perhaps exclusively, depending on the analysis) binary, i.e. languages will split the set of syllables in two sets, one called 'heavy', the other called 'light':

(15)

heavy	*light*
long vowel	short vowel
closed syllable	open syllable
checked vowel	unchecked vowel
low vowel	non-low vowel
high-toned vowel	low-toned vowel
full vowel	reduced vowel

The first three types have also been called moraic weight, assuming that in each of these cases the heavy syllables contains two units in its syllable rhyme; these units are called moras (or weight-units). In the remaining three cases (for which we might adopt the term 'sonority weight'), the heavy syllable is more salient by virtue of its greater aperture, its higher pitch, or its more complex articulation).

Intuitively it may be seem clear that the properties in the left-hand column give more prominence to a syllable (or its rhyme) in terms of duration (long vowel, checked vowels, closed syllables, full vowels), high pitch, loudness (open vowel), manner of articulation (full vowel), precisely those factors that can be found as phonetic cues of accent. It seems obvious that syllables that have more of those properties intrinsically (i.e. as distinctive properties), are reluctant to appear in positions that typically have less of them, i.e. unaccented positions. Conversely, syllables with such intrinsic properties will "attract" accent.

The assignment of feet can also be influenced by lexical irregularity. Thus for example in Polish which has weight-insensitive penultimate primary accent, some words have irregular final or antepenultimate accent. How can we account for that? The answer is that irregular final accent is achieved by assigning a lexical mark to the final syllable, and adding the convention that syllables with such marks may not appear in the dependent position of the foot. Elsewhere, I have referred to such marks as 'diacritic weight'. Such marks usually are historical residues of an earlier situation in which the relevant syllables had intrinsic weight. After a language has lost, e.g. a vowel length contrast, the accents can stay in the same position and thus, in a sense, become unpredictable. Thus, there are two types of weight:

(16) *Sensitivity of foot assignment: the dependent cannot dominate*
- a. a syllable having certain phonological properties (intrinsic weight)
- b. a lexically marked syllable (diacritic weight)

Lexical accent structure can be sensitive to both diacritic and intrinsic weight (Polish).

The antepenultimate exceptions require another type of lexical encoding, for example, encoding the final syllable as being disregarded by the metrical algorithm. This is called extrametricality.

4. Lexical and post-lexical structure

In the preceding section, I have proposed that the direction of footing and the edge choice of the head foot are correlated:

(17) Direction (left-to-right) = head foot left
Direction (right-to-left) = head foot right

Thus, with left-headed feet, we have assumed only two possible systems:

(18)a. *Initial accent*

left-headed	*	*

	left-to-right	(* *)	(* * *) 1
		(* *)(* *)	(* *)(* *)(*) 0
		1 2 3 4	1 2 3 4 5
b.	*Penultimate accent*		
	right-headed	*	*
	right-to-left	(* *)	(* * *) 1
		(* *)(* *)	(*)(* *)(* *) 0
		1 2 3 4	1 2 3 4 5

The English system presents a variety of (18b). If, however, the direction of foot assignment does not have to correlate with the choice of the head foot, two further systems can be produced:

(19)a.	right-headed	*	* 2
	left-to-right	(* *)	(* * *) 1
		(* *)(* *)	(* *)(* *)(*) 0
		1 2 3 4	1 2 3 4 5
b.	left-headed	*	*
	right-to-left	(* *)	(* * *) 1
		(* *)(* *)	(*)(* *)(* *) 0
		1 2 3 4	1 2 3 4 5

In (19a), which is identical to (14), where the direction is from the left, and the head is on the right (the parameters have opposite values, so to speak), we derive a system in which the location of primary accent is actually dependent on the number of syllables; in even numbered syllables primary accent is penultimate, while in odd-numbered words, it is final. (19b) would have initial accent in both cases, but the rhythmic structure would be odd. I am not aware of any such systems being reported in the literature. As I have mentioned in the previous section, system as in (19b) do seem to occur, but they are rare. In only a few cases do we find that primary accent is truly on dependent on rhythm. However, metrical theory with its bottom-up procedure of first building feet and than the word structure, predicts that the cases in (19) should be just as common as the ones in (18). Given their rarity, I would like to argue that we might want to exclude the possibility in (19) from our basic apparatus.

We can do this by somehow assigning primary accent first. With primary accent in place, we can then account for rhythmic structure in terms of the assignment of secondary accents that typically ‘ripple or echo away’ from the primary accent. Rather than stipulating the order in which primary accent and secondary accents are assigned in terms of rule ordering, it can be suggested to attribute the two aspects of the overall accentual pattern to the lexical and post-lexical phonology, respectively.

Lexical and post-lexical structure, which I will call here phonotactic and prosodic, respectively, may differ in a number of ways. This supports the idea that there are, in fact, two algorithms. In (20) I give a number of examples of such differences:

(20)		*Lexical*	*post-lexical*	
	Foot	weight-sensitive	weight-insensitive	(English)
		weight-insensitive	weight-sensitive	(Finnish)
		left-headed	right-headed	(BigNambas, Marind)
		right-headed	left-headed	(Taga, Dari, Uzbek)
	Word	right-headed	left-headed	(English)
		left-headed	right-headed	(Turkish)

In standard approaches to metrical structure, such mismatches are not interpreted as evidence for two structures, but rather as evidence for rules that transform an initial lexical structure into a later structure (not necessarily referred to as post-lexical). This is a typical derivational approach, stemming from the tradition of Generative Phonology. For example, Halle & Vergnaud (1987) propose that in English feet are assigned from right-to-left giving a right-headed tree and thus primary accent at the right edge. Then, to account for the fact that the secondary accents come from the left, they 'erase' all feet except the head foot and assign feet for a second time, now from left-to-right. In my approach, the apparent conflict between right-to-left and left-to-right footing is taken as evidence for a two-level analysis.

One might now ask how we can account for the cases in (19a) in which, contrary to the majority situation, primary accent does seem to be dependent on the prior existence of rhythmic structure. Space limitations prevent me from discussing this issue in detail. In this case, we need to say that the assignment of post-lexical structure is such that the dependent in the post-lexical feet cannot be rhythmically strong, while the distribution of rhythm is accounted for in terms of lexical footing. What remains to be explained is why in such cases the head of rightmost foot in the post-lexical structure prevails over the ultimate head of the lexical structure (which is on the first syllable).

5. Some further issues

This article has discussed issues of representation and typology. Certain important issues that involve accent/stress have not been dealt with. I will mention two issues briefly here.

This article has focused on word level accent. In this domain, it is relevant to consider the relationship between the accentual pattern and the morphological structure. One expects that only lexical metrification can be sensitive to morphological structure. Indeed, it has been argued that, for example, the English 'stress' rule is applied within domains that can be smaller than the word if the word is morphologically complex and either compounded or affixes with so called level 2 affixes. I have not discussed the phenomenon of accent at higher levels than the word, but it should be clear that

phonological structure is also relevant for the syntactic organization. Here, going beyond the domain of the lexicon, the distinction between phonotactic and prosodic organization no longer applies. A discussion of higher level prosodic structure and its relation to syntactic structure requires a separate article (cf. Nespor and Vogel 1986). I have also not discussed phenomena involving rules that 'shift' stress as in the famous pair (…) *thirteen'* vs. *thir'teen* (men), where the location of accent in *thirteen* differs depending on the syntactic or prosodic context. In line with the suggested analysis of English stress, the different locations correspond to the lexical primary accent (right edge) and the post-lexical primary accent (left edge). In the form *thir'teen* the post-lexical primary accent has taken over primacy from the lexical accent in order to avoid a stress clash between the accent on *teen* en *men*. Rhythm, then, is an important determinant of the distribution of post-lexical accents, not only at the foot level, but also at higher prosodic levels. A full discussion of such shifts is also beyond the scope of this article. A thorough discussion of many of the relevant facts and analyses can be found in Visch (1999).

Finally, one might ask whether all languages are accentual at the word level. I suspect that the answer is affirmative. We have seen that accent determines much more than pitch or stress. It seems almost inconceivable to me that we would come across languages that would lack all of the possible cues for accent. We have also seen that accents corresponds to the notion (ultimate) head, where this head is just a part of the overall structure that organizes the phonological structure of the word. Expecting to find languages that lack such hierarchical structure at the word level is like expecting to find a languages in which sentences are linear strings of words without any syntactic organization.

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