Word melodies vs. pitch accents: A perceptual evaluation of terracing contours in British and Nigerian English

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Abstract

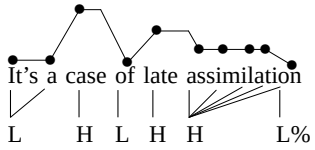
The results of a perception experiment in which Nigerian English listeners judged the well-formedness of Nigerian English intonation contours suggests that the language has tonal specifications for each syllable, including syllables that are unstressed in British English. The association of pitch accents to accented syllables in British English explains why British English listeners are relatively insensitive to deviations in the pitch of unstressed or unaccented syllables.

Index Terms: perception, intonation, word melody, pitch accent

I. Introduction

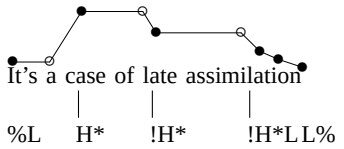
The terracing intonation pattern is given as the 'core [intonation] pattern' of Nigerian English by [1]. Descending series of pitch peaks were first described for African languages as 'downdrift'. Later, this concept was merged with what was then termed 'downstep', the lowered pronunciation of a H-tone relative to a preceding H-tone without an intervening pitch valley [2; 3]. The term 'downstep' is now applied to the 'staircase' type as well as to downstepping contours with low valleys between the steps. This is particularly appropriate for Nigerian English, where the descending steps may or may not be interrupted by low pitches due to function words intervening between the lexical words which form the steps. In our interpretation, the contour is due to a tone grammar as formulated in [4] according to which each lexical word receives a H-tone and each function word a L-tone. In terms of the typology in [5, ch. 3], in which tones come as (a) word melodies, (b) pitch accents, and (c) boundary tones, the Nigerian tones are monotonal word melodies, which spread through the words they come with. Since they are single tones, no direction or edge needs to be specified. The crucial aspect here is the word domain: the pitch will change at any boundary between a lexical word and a function word (from H to L) and between any two lexical words (from H to a lowered H). Graphically, the downstepping pattern is shown in (1). We assume that the syllable is the tone bearing unit, as it is in indigenous languages like Ibibio. The last target represents the merged pronunciation of spread H and the boundary L%, which marks declarative intonation.

(1)



In British English (BrE), terracing contours have been described as having the 'stressed syllable of each accented word a step lower in pitch' [6, p. 37] and as having 'inter-accent' descending level pitches [7, p. 160]. The insensitivity of the F0 contour to words boundaries was expressed in [8, p. 1] by the adoption of the 'foot' from David Abercrombie's work on rhythm [9], which consists of 'one salient syllable [plus any] non-salient or *weak* syllables' (where 'salient' can be interpreted as 'pitch accented'). In autosegmental phonology, the continuation of the pitch from initial boundaries or accented syllables to following accented syllables has been described as the simultaneous occurrence of a leftmost and a rightmost target ('double alignment' [5, p. 153; p. 302]).

(2)



The function words in (2) can alternatively be pronounced with low pitch in BrE. The variable here is phrasing: an intonational phrase (IP) boundary after *It's a case* will typically attract an initial %L boundary tone before unaccented *of*.

The purpose of the experiment was, first, to provide evidence for the word melody status of tones in the grammar of Nigerian English and of the specification of tone to every syllable, as shown in (1). A second purpose was to provide evidence for the typological difference between Nigerian English and British English, in which only accented syllables are specified for tone through pitch accents and intervening syllables remain unspecified for tone, resulting in a looser connection between f0 and stretches of unaccented syllables.

II. Experiment I: Nigerian English

II-A. Method

In order to test Nigerian listeners' sensitivity to (a) the L-toned status of function words and (b) the location of the pitch change at word boundaries rather than at specific syllables within words, a corpus of twelve sentences was composed with three naturally accentable words, referred to as W1, W2 and W3. One or two unaccented function words appear between W1 and W2. Words W1 and W2 had the word stress on the first syllable, while W3 had the word stress on a non-initial syllable. There were three conditions in the part of W3 before the non-initial main stress, each represented by four sentences. One set of four, set A, had a W3 with the main stress on the third or fourth syllable from the beginning and with secondary stress on the second syllable of the word (e.g. *consideration*). A second set, set B, had a word-initial closed syllable before the main stress, which syllable has secondary stress and therefore has an unreduced vowel in British English (e.g. *October*). A third set, set C, had a word-initial open syllable in the same position, which in southern British English is unstressed and typically reduced to schwa (e.g. *banana*). The three sets of sentences are given in Table I.

TABLE I

Sentences used in the perception experiment. The third lexical word (W3) has the prosodic structure [ws(w)S ..] (group A), [sS ..] (group B) and [wS ..] (group C).

A	1 He's a member of both associations
	2 Give it more consideration
	3 It's a case of late assimilation
	4 That's a strange interpretation
B	1 The ball was last September
	2 We start in late October
	3 The men will speak Ibibio
	4 She wants to sing cantatas
C	1 They grow the best bananas
	2 We need a new container
	3 He saw his old employer
	4 We'll wait for the new arrival

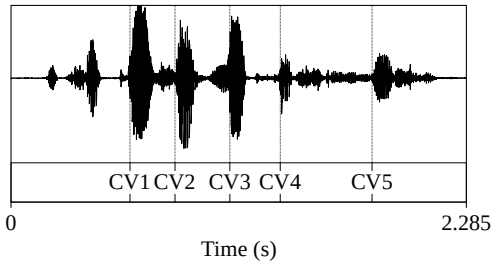


Fig. 1. CV-segmentations time stamps and speech wave form of *It's a case of late assimilation* (speaker NVO) CV: consonant-vowel boundary, or beginning of syllable rhyme; CV1: of first syllable of Word 1; CV2: of first syllable of (first) function word; CV3: of first syllable of Word 2; CV4: of first syllable of Word 3; CV5: of main stressed syllable of Word 3.

Five speakers of standard Nigerian English were asked to read out the corpus in a neutral and quiet voice at least twice. They were recorded using an Olympus VN-2100PC Digital voice recorder in the second author's office. From these recordings we selected two speakers, one male and one female, whose recordings were technically the best and contained complete sets of sentences. Subsequently, we selected one reading of each sentence from the recordings by each of these two speakers. In general, speakers read the sentences in a careful, deliberate style. In about a fifth of the cases we decided to shorten pauses between words. The resulting file always sounded more natural than the original to the second author, who is a speaker of Nigerian English. One third of the materials, sentences A3, B2 and C1, was additionally recorded by a 30-year-old English female speaker of English in the studio of the School of Languages, Linguistics and Film of Queen Mary, University of London, from which readings one utterances of each sentence was selected.

The selected readings were annotated with the help of Praat [10]. Employing conventional segmentation practice, we identified the CV-boundary of the first syllable of W1, the first function word, W2 and W3, as well as of the main stressed syllable of W3. (Recall that in the case of W1 and W2 the first syllable is also the syllable with word stress.) We also identified all word boundaries.

In order to test two specific aspects of the well-formedness of the NigE contour given in 1, we decided to produce four artificial f0 contours on each of the 24 selected utterances

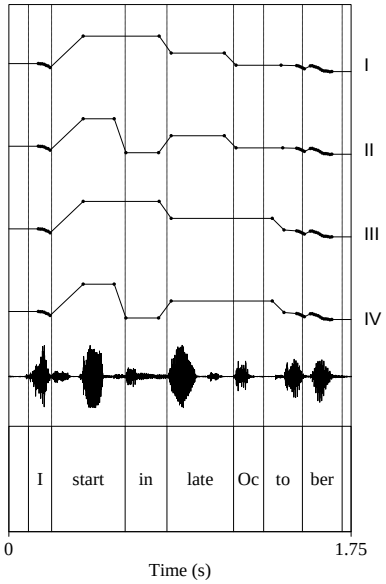


Fig. 2. Four artificial f0 contours of *It's a case of late assimilation* (speaker NVO) and word segmentations. I: low function word, low beginning of W3; II: high function words, low beginning of W3; III: low function word, high beginning of W3; IV: high function words, high beginning of W3.

produced by the two speakers of NigE and on each of the three selected utterances produced by the speaker of BrEng. Using the Psola resynthesis function in Praat, the f0 of the 'terrace steps' for W1, W2 and W3 was 270 Hz, 230 Hz and 200 Hz for the female speakers and 170 Hz, 135 Hz and 110 Hz for the male speaker, for all utterances. In versions (a) and (c), the f0 of W1 continued across the function word(s), while in versions b and d, the F0 dropped to 180 Hz at the CV boundary of the (first) function word, from where it continued to a point 60 ms to the left of beginning of the rhyme of W2. Versions (a) and (b) had a pitch drop after W2, causing the part before the main stress of W3 to be lower in pitch than W2, while versions c and d had this pitch drop at the main stress of W3, causing the pitch of the first part of W3 to be the same as W2. The f0 of the periphery of all sentences, i.e. everything to the left of CV1 minus 60 ms and everything to the right of CV5 plus 60 ms, was left unchanged. All pitch rises and falls were produced in 60 ms. Figure 2 shows the pitch contours used in the resynthesis of the four versions of *It's a case of late assimilation*. This procedure led to the generation of 4 $\times$ 12 (sentences) $\times$ 2 (speakers) or 96 stimuli produced from NigE source utterances, plus 4 $\times$ 3 (sentences) or 12 stimuli produced from the BrE source utterances, or 108 stimuli in all.

II-B. Procedure

An audio-cd was prepared containing the 108 stimuli is a random order. Each stimulus was preceded by a 200 ms bleep and an 800 ms pause, and followed by a 3.7 s response period. Four fillers occurred at the beginning of the test and two at the end. The audio-cd was played over loudspeakers in a large room in the Department of English at Uyo University. Judges were given the task to rate each stimulus for the degree to which it conformed to the speech of an educated speaker of Nigerian English when reading a sentence as a radio newsreader or university teacher. They gave their judgements on a printed answer sheet immediately after hearing the stimulus by ticking one of the five boxes numbered 1 to 5, where '5' represented

'very good' and '1' represented 'very poor'. On their answer sheets, each five-point scale was preceded by a written version of the corresponding sentence to help judges to keep the place. Twenty judges, twelve male and eight female, were recruited from the population of students and staff at the department. They had different language backgrounds, and their ages and their self-declared proficiency level in Nigerian English varied, as shown in II.

TABLE II
First language (L1), self-declared frequency of use of Nigerian English (NigE: 1=always, 2=often, 3=rarely), age group older) and gender of 20 Nigerian judges.

	L1	NigE	Age group	Gender
1	Annang	1	> 36	m
2	Annang	3	> 36	f
3	Ibibio	2	26-30	f
4	Ibibio	2	> 36	f
5	Ibibio	2	> 36	m
6	Ibibio	2	26-30	f
7	Ibibio	2	26-30	f
8	Ibibio	3	31-35	m
9	Ibibio	1	> 36	m
10	Ibibio	2	26-30	f
11	Igbo	1	26-30	m
12	Igbo	2	26-30	m
13	Igbo	2	31-35	f
14	Igbo	3	31-35	m
15	Igbo	2	31-35	f
16	Obolo	2	> 36	m
17	Ogoni	2	> 36	m
18	Pidgin English	1	> 36	m
19	Yoruba	1	21-25	m
20	Yoruba	1	26-30	m

II-C. Results

Out of the 20 $\times$ 108 judgement, 41, or 1.9%, were missing, due to unclear of absent choices on the answer sheets. Six speakers had one missing data point, one had two, one three, one 14 and one 16. We supplied the missing data by filling each empty cell with the mean of all scores given by that speaker. We then pooled the data across the four sentences in each group, and ran an Analysis of Variance (repeated measures) with acceptability as the dependent variable, Structure of W3 (A,B,C) and Contour (a,b,c,d) as factors, and speaker as a fixed variable. As we were not interested in possible interactions with and among listener properties, we ran this analysis separately with each of the four listener properties listed in Table I as a covariate. Language background was interpreted as binary variable, with Ibibio versus the other languages as values.

We found no effect of any of the four listener properties. Significant main effects were obtained for Speaker ($F(1,19)=17.34$, $p<.001$) and Contour, Huynh-Feldt corrected ($F(2.07,19)=14.63$, $p<.01$). There was an interaction between Syllable Type and Contour ($F(5.61,19)=2.99$, $p<.01$). Speaker NVO was 0.35 scale points more acceptable than speaker KE. The effect of contour is shown in Fig. 3, which presents acceptability scores pooled across speakers for each contour by syllable type of W3. The contour by W3-syllable-type interaction is due to the relatively low scores in W3-condition B (e.g. *September*) for contours I and III. Condition B appears to be the context in which the contours are maximally differentiated. The overall results are very regular: the best contour is II, with low function words and downstep at the word boundary, while the worst is III, which has the opposite f0 properties. Post-hoc comparisons show that contour II is

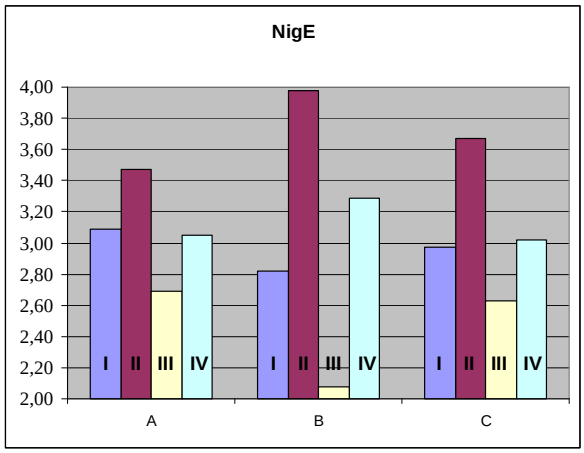


Fig. 3. *Acceptability scores by 20 Nigerian listeners for four artificial F0 contours (I: high function word, low first part of W3; II: low function word, low first part of W3; III: high function word, high first part of W3; IV: low function word, high first part of W3) for the three prosodic structure of the third word (A: unstressed first and stressed second syllable; B: stressed first syllable; C: unstressed first syllable).*

significantly different from each of the other three contours ($p<0.01$ for I and III and $p<0.05$ for contour IV), and that additionally contour III is significantly different from contour IV.

II-D. A speaker of British English

In order to see whether the preferences of the Nigerian listeners for the realization of Nigerian English intonation contours are exclusive to speech that is segmentally and rhythmically Nigerian English, a set of 12 stimuli was included which consisted of the four contours shown in Fig 1 superimposed on selected utterances of the sentences *He's a member of both associations*, *We start in late October* and *He saw his old employer* as spoken by a 30-year old female speaker of English from England. An analysis of variance on the scores by the Nigerian listeners with Contour and Syllable type as factors yielded no significant effects. This finding suggests that the Nigerian intonational preferences as apply to Nigerian English, not to British English. Rather, these stimuli are marked down regardless of contour(a mean score of 2.46, well below the mean score for the Nigerian English speakers, 3.13).

III. Experiment II: Nigerian vs British English

Phonologically, Nigerian English has syllabic tone: every syllable has a specification. There is no reason to assume that any syllables are phonologically privileged and thus phonetically more salient than others. British English, by contrast, has intonational pitch accents, which leave varying stretches of unaccented and/or unstressed syllables unspecified for tone. In this section, we consider the question whether Nigerian listeners show greater sensitivity to pitch on syllables which in British English are unaccented and/or unstressed than British English listeners. The hypothesis is that British English listeners will show little if any differentiation in their acceptability judgements of the four contours. To test this prediction, twenty-three judges were recruited from the student population of Queen Mary, University of London, 9 male and 14 female, 9 in the 18-20 age range and 14 in the 21-25 age range. They were told that they were going

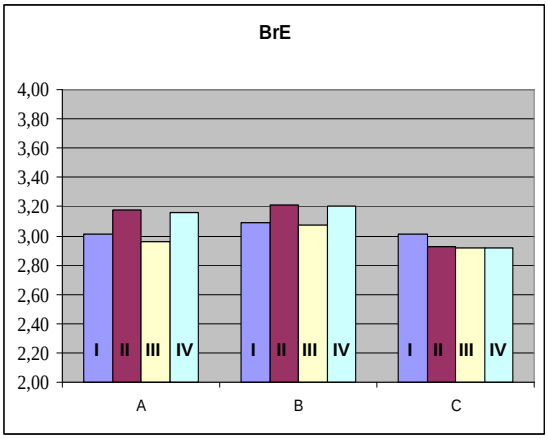


Fig. 4. *Acceptability scores by 23 British listeners for four artificial F0 contours (I: high function word, low first part of W3; II: low function word, low first part of W3; III: high function word, high first part of W3; IV: low function word, high first part of W3) for the three prosodic structure of the third word (A: unstressed first and stressed second syllable; B: stressed first syllable; C: unstressed first syllable).*

to listen to a number of Nigerian English speakers who had undergone a course in British English intonation, and who were trying their best to produce British English intonation patterns. Judges were asked to indicate on a 5-point scale how well the speaker had succeeded in producing an English intonation pattern in each case.

Out of the 23 $\times$ 108 judgements, two were missing. The scores were processed in the same way as in Experiment I. An analysis of variance (repeated measures) with Speaker, Syllable Type and Contour as factors yielded significant main effects for all three factors: Speaker ($F(1,22)=11.26$, $p<.01$), Syllable Type($F(2,22)=5.02$, $p<.05$) and Contour $F(3,22)=2.95$, $p<.05$). Speaker KE was judged to be 0.29 scale point more acceptable than speaker NVO, quite as was the case for the Nigerian judges. Post-hoc Sidak comparisons between syllable types showed that type B (e.g. *September* was significantly different from type C, e.g. *bananas*). Post-hoc Sidak comparisons for Contour showed no significant differences between any pairs, which means that two of the contours were together significantly different from the other two together (see Fig 4).
Syllable type C (*bananas* for W3) received lower scores that the other two syllable types, which we attribute to the unreduced nature of the word-initial syllable. Pronunciations like /bananas/, /arajval/ are apparently more disturbing to British English listeners than non-reduction in cases like /asosieʃan/. The differentiation among the contours is between those with low pitched function words (contours II and IV) and high-pitched function words (contours I and III. We explain this finding on the basis of the deliberate speech style conveyed by the Nigerian English read sentences. In this style, an intonational phrase break after W1 would appear to be marginally more natural than its absence. The more important finding, however, is the effect size, the poor discrimination among the contours relative to the Nigerian judgements. We see this as confirmation of the prosodic and tonal structure of English, which allows for a less precise realization of the contour in unstressed and unaccented syllables.

Understandably, given the task, the British listeners responded favorably to the British English speaker, who received a mean score of 4.38, as against 3.05 for the Nigerian speakers.

IV. Discussion

The results confirm the hypothesis that the tonal grammar of Nigerian English requires F0 lowering for function wordsand downstepping at the word boundary. The results therefore support the analysis of the declarative contour in (1). The significant difference between contour III and the less acceptable contour IV shows that failure to lower for the function words is a more salient deviation from the norm than failure to downstep at the word boundary; no significant difference was found between contours I and III, which only differed in the location of the downstep on W3.

V. Conclusions

Nigerian English intonation is to be described as a word tone system, in which the tones are predictable: H for lexical words, L for function words. Phonetic implementation requires consecutive H's to be downstepped, regardless of intervening Ls. Quite unlike British English, which places pitch accents on words as a function of a number of grammatical and pragmatic factors, Nigerian English word melodies are inherent components of lexical representations. The observation that Nigerian English does not 'deaccent' or has 'end stress' is inappropriate to the extent that the notions 'stress' and 'accent' are inapplicable to the language. Its word tones are not simply negotiable the way pitch accents are in English.

VI. Acknowledgements

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