Pitch accent types and tonal alignment of the accentual rise in Indian English(es)

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Abstract

The paper presents an analysis of pitch accent inventory and tonal alignment of the accentual rise in the speech of university educated Indian English speakers from four L1 backgrounds (Hindi, Bengali, Tamil and Telugu). The results reveal that all speakers produced a high and a rising pitch accent, but with differences in the distribution of H* vs. L*+H among speakers. In addition, L1 speakers of Hindi and Bengali used L*+H in both nuclear and prenuclear contexts, contrary to the speech of L1 Telugu and Tamil speakers, who frequently produced the H* accent on nuclear accented words. An examination of peak alignment provides further evidence that the accentual rise corresponds to a bitonal pitch accent; the alignment of the H tone however shows a large degree of intra- and inter-speaker variation, and earlier timed peaks relative to the accented syllable offset for L1 Tamil speakers.

Index Terms: intonation, pitch accents, tonal alignment, Indian English

1. Introduction

'Indian English' (IndE) is a term commonly applied to the English language used by both, speakers in India and the Indian diaspora around the world. Despite the recognition of the term and its wide usage, the concept of IndE remains a complex notion due to vast linguistic diversity, multilingualism and rapidly changing socio-economic factors on the one hand, and 'areal' features in phonology [1] and intonation on the other [2]. This has generated an ongoing debate in the literature over the status of IndE [3,4,5] and the question whether we are dealing with a single pan-Indian variety or multiple sub-varieties [3,6,7,8,9]. While it has been established that IndE has some shared phonological features, irrespective of L1, more recent experimental research finds evidence for specific L1 influence [6,10,11], with the added complexity that the extent of L1 influence may also vary depending on the feature under investigation [10,6,8]. The present paper adds to the body of research and examines the effect of L1 on IndE intonation with a focus on pitch accent inventory and accentual rise alignment.

In contrast to the fairly large number of studies on the segmental phonology of IndE, little research has been conducted on its intonation. Earlier studies have been mostly descriptive, and more recent experimental studies within the Autosegmental-Metrical (AM) model [12] have often been preliminary or were based on a limited number of L1 backgrounds or/and speakers [6,10,11,13]. One of the well-documented features of IndE is higher accentual density compared to British and American English, whereby speakers of IndE accent a large number of words in an utterance [14,15,7]. Limited accounts are available about the types of pitch accents in this variety, with conclusions drawn on the basis of a small sample size or the limitation of one to two L1 backgrounds. The findings of [6, 10, 13,16], however, suggest potential differences in the use of pitch accent types across various L1 backgrounds or in their phonetic realisation. For example, [6] reported a more frequent use of rising pitch movements on accented words in English spoken by L1 Gujarati (Indo-Aryan) compared to the speakers whose L1 was Tamil (Dravidian). Similarly, speakers of Hindi and Bengali L1s, both Indo-Aryan, showed greater use of accentual rises compared to the speakers whose L1s belonged to a Dravidian language family, such as Telugu and Kannada [10,13]. [10] also reported L1 based differences in the distribution of accentual rises depending on the prosodic context, nuclear vs. prenuclear. Fewer pitch accents and a frequent use of nuclear rising accents in IndE spoken by L1 Bengali speakers compared to the nuclear high accents of L1 Kannada speakers contributed to the differences in nuclear tunes between the two L1 groups. Variation in pitch accent type has also been attributed to the age of L2 acquisition. [11] found that late Hindi-English bilinguals used rises on every non-final word, while simultaneous Hindi-English bilinguals used a wider pitch accent inventory in prenuclear contexts, including H* and H*+L accents.

Tonal alignment of the rising gesture, the temporal relationship of tonal targets (the L and the H) with the segmental material, is of particular interest in view of cross-linguistic and cross-dialectal variation [17,18,19,20], and the effect of L1 intonation on the alignment patterns of pitch accents [21,22], leading to phonological or phonetic differences in the same phonological categories. For example, [21]'s study on the intonational features in Greek L1 speakers of Dutch and in Dutch L1 speakers showed that most L2 speakers were unable to produce the typical L1 *f0* peak alignment pattern in L2 intonation, suggesting that it is difficult to realise the fine phonetic detail of intonational pitch accents even when phonological categories may be relatively similar.

In the descriptions of intonation in South Asian languages, a rising pitch movement on every accented word is generally modelled as an L* accent followed by a high phrase tone [23,24,25]. This is different to the "canonical" English intonation where the accentual rise often represents a rising pitch accent, L*+H or L+H*, with variability in the phonetic realisation in the dialects of American and British English, especially in relation to peak alignment [20,21]. So far, studies on IndE present an incomplete and mixed picture over the nature of the accentual rise. [10,16] posited an L+H* pitch accent for L1 Kannada speakers of English, and an L*+H and L+H* for Bengali English. [11] refrained from assigning a tonal category and referred to the rise produced by Hindi English speakers as an LH contour. [26] proposed the same analysis for Hindi and IndE spoken by L1 Hindi speakers, and treated both

the L and the H target as phrase tones that demarcate the edges of a minor prosodic unit. It is important to note that despite the presence of a "repetitive rising contour" in South Asian languages, tonal alignment of the rise is said to be a major source of cross-linguistic variation due to prominence patterns, segmental and lexical features across the languages spoken in the subcontinent [2]. This could potentially account for phonetic differences in the L and H alignment across IndE speakers with different L1 backgrounds.

The present study is a preliminary investigation into the possible influence of L1 on IndE pitch accent types/inventory and the alignment of the accentual rise. The study addresses the following questions related to these two intonational phenomena:

1. What types of pitch accents are observed in IndE for the speakers in this study?
2. What are the alignment characteristics of the tonal targets associated with the accentual rise? Is the H tone part of the bitonal rising pitch accent or a phrase tone?
3. Are there any differences in pitch accents use and /or tonal alignment of the accentual rise based on the speakers' L1?

2. Method

2.1. Speakers

Six female and two male speakers of Indian English were recorded at the University of Hyderabad, India. All speakers were enrolled in a university degree at the time of data collection, had started learning English at the age of 4-7 years, identified as bi- or multilingual, and were aged 22 to 30. Participants represented four L1 backgrounds (2 speakers each): Tamil, Telugu (Dravidian), Hindi and Bengali (Indo-Aryan). Participants for each L1 spoke the same dialect, with the exception of Bengali. One L1 Bengali speaker (DS) grew up in Guwahati, Assam, and acquired an Eastern variety of Bengali (she also lived in various places in India), while speaker SP came from West Bengal and acquired the Kolkata dialect.

2.2. Materials and analysis

The speakers were asked to read "The North Wind and the Sun" passage three times in a neutral voice, as if telling a story. They were recorded in a quiet room using a Zoom H4nSP audio recorder with an external lapel microphone. The recordings were made at a sampling rate of 44.1 kHz. For each speaker, the sound file deemed to have the most natural reading was selected for further analysis and converted into mono .wav files. The selected recordings were segmented and annotated using the WebMAUS services, Munich Automated Segmentation web platform [27]. The segmentation was manually corrected and annotated in Praat [28]. Additional Praat annotation included the following tiers: syllable boundaries, intonational phrases (IPs), accents, and tones. The tonal tier was used for intonational analysis, following the AM framework [12]. The number of IPs for each speaker varied, ranging from 32 (SP – L1 Bengali) to 45 (BH - L1 Telugu). Auditory and visual analyses were performed to identify pitch movements corresponding to pitch accents, phrase accents and boundary tones. On the tonal tier, the following additional acoustic landmarks were identified for each accentual rise: syllable onset, syllable offset, low (L) and high (H) turning points associated with the accented syllable, and word offset. The H target was identified as the first highest peak in the vicinity of the accented syllable. The L target was labelled just before the

elbow of the rising gesture, located either in the onset and or the vowel of the accented syllable.

The digitised files were processed using the online EMU Speech Database Management System [29] to create additional files for building hierarchies in order to query the database and further manipulate the data using the R statistical package [30]. The first set of analyses included an examination of $f0$ movements on accented words to determine pitch accent types and their proportional distribution for each speaker. The second set of analyses focussed on the rising gesture associated with the accented word. In order to examine the tonal alignment of the accentual rise, several temporal distances were obtained relative to syllable and word boundaries. These measurements are illustrated in Figure 1 below.
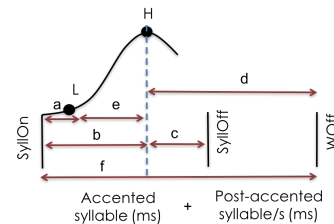

Figure 1: *Schematic representation of durational measurements relative to syllable onset, syllable and word offset.*

Temporal intervals (ms):
(a) between the L and the accented syllable onset (SyllOn);
(b) between the H and the accented syllable onset (SyllOn);
(c) between the H and the accented syllable offset (SyllOff);
(d) between the H and the accented word offset (WOff);
(e) between the L and the H targets (rise duration);
(f) combining the duration of the accented syllable and post-accented syllable/s.

Five linear mixed effects models (LMM) were used to predict the location of the tone targets in relation to the segmental landmarks (a-e). We used lme4 package [31] with the fixed variables for L1 and WORD TYPE (number of post-accented syllables, from 0 to 2), and random variables for TARGET WORD and SPEAKER. Except for the measurement of $f0$ peak alignment relative to word offset, likelihood ratio test showed that the interaction between L1 and WORD TYPE could be dropped without loss of fit. In addition, the fixed variable of WORD TYPE was not included when modelling the L timing relative to syllable onset (not relevant).

3. Results

3.1. Pitch accents

3.1.1. Overview of pitch accent types

Four types of pitch accent have been observed in the data, two of which are monotonal (low and high) and two bitonal (rising and falling). Additionally, the rising and high pitch accents include downstepped realisations, where the H tone target is lowered relative to the preceding H tone within the intonational phrase. One of the most common pitch accents produced by all speakers is a rising one, analysed as L*+H on the basis of the alignment of tonal targets. Phonetically, the L*+H accent is realised as a gradual rise from a low tone (L) to a peak (H), as

illustrated in Figure 2. The L is generally aligned within the accented syllable onset or the accented vowel, depending on the number of segments in the onset (C vs. CC and CCC). The H tone shows greater variability across the speakers with the alignment varying from the right edge of accented syllable to the post-accented rhyme. See Section 3.2 for more details on peak alignment.
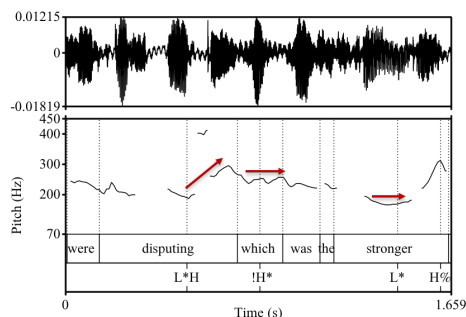

Figure 2: *Illustration of the rising (L*+H), downstepped high (!H*) and low (L*) pitch accents produced by an L1 Hindi speaker.*

Another pitch accent commonly observed in the data is H* and its downstepped realisation !H*. The tone target of the high and downstepped high pitch accents is generally scaled within the mid-upper range of the speaker's range and is characterised by a shallow rise from the onset to a peak of the accented syllable. This type of pitch accent can also be realised as a plateau, a stretch of sustained high pitch, as shown in Figure 2.

The H*+L and L* pitch accents occur less frequently in the data, with the L* often restricted to a nuclear position (Figure 2). The falling pitch accent H*+L is distinguished from the H*/!H* on the basis of an early peak, timed within the onset of the accented syllable onset, and a sharp fall in *f0* throughout the accented vowel. The L* accent in nuclear position will be examined further to determine whether this is indeed a low pitch accents and not an L*+H followed by a high boundary tone.

3.1.2. Pitch accents distribution and inventory

Figure 3 presents the distribution of nuclear and prenuclear pitch accent types for each speaker, grouped by L1. The categories for high and rising pitch accents include downstepped realisations.

As shown in the figure, all speakers produce the L*+H and H* accents. The proportion of high pitch accents, however, is higher for both L1 Tamil speakers (DN – 49%, KR – 52%) and one L1 Telugu speaker (BN – 62%), in comparison to L1 Bengali and L1 Hindi speakers (SP – 30%, GN – 16%, and HM – 45%). The most frequent use of the L*+H accent is observed for L1 Bengali speaker SP (61%) and L1 Hindi speaker GN (68%). Differences in pitch accent types and distribution between the two L1 Bengali speakers could be due to sociolinguistic factors. A further examination of distributional differences in prenuclear versus nuclear positions reveals a much more consistent pattern across the L1 groups. The results reveal that L1 speakers of Hindi and Bengali use the rising pitch accent in both prenuclear and nuclear positions, while for the L1 speakers of Dravidian languages, especially DN and KR (Tamil L1) and BR (Telugu L1), the L*+H is mostly restricted to prenuclear positions, with a predominant use of high pitch accent on nuclear accented words.

The findings also suggest differences in pitch accent inventory across the speakers and potentially L1s. Five of the speakers (L1 Telugu and L1 Tamil English speakers as well as speaker HM) do not produce a low pitch accent, and as a result have a smaller inventory of pitch accents. One of these (speaker BN, L1 Telugu) produced only two types of pitch accent: high and rising. Further analysis based on more speakers and different speaking registers is needed before drawing anything other than tentative conclusions at this stage.
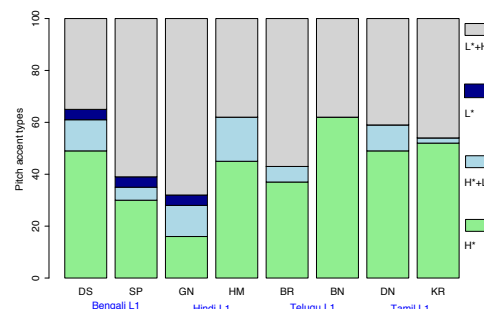

Figure 3: *Proportional distribution of pitch accents by speaker and L1.*

3.2. Tonal alignment of the accentual rise

The LMM analysis showed a positive effect of L1 on the alignment of the L tone target relative to the accented syllable onset (Figure 4). The likelihood ratio test between the full and null models predicting the effect of L1 on L alignment has reached significance ($\chi^2(3)=12.19$, p<0.001). Post-hoc Tukey Test showed that the difference was significant for two L1 groups only: Hindi and Tamil (z=-2.598, p<0.01). The L tone targets produced by L1 Tamil speakers timed earlier in relation to the syllable onset, often realised with the first consonant in the accented syllable onset.
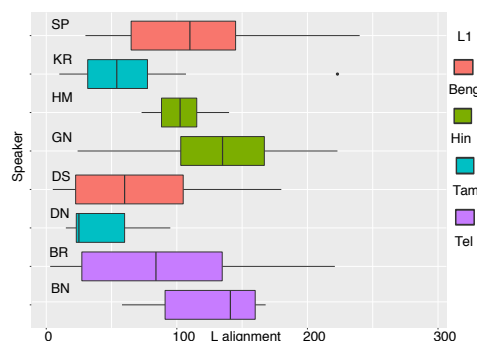

Figure 4: *Boxplot for the distribution of the L tone target relative to syllable onset (ms) presented by speaker and L1 (colour-coded).*

Despite some observable patterning of speakers according to L1, the results for peak alignment relative to syllable onset show no significant effect of L1 and WORD TYPE. This could be the reflection of interspeaker variation in the duration of segmental intervals, and the syllabic structure of the accented syllables. Similar to peak alignment relative to the accented syllable onset, there is no effect of L1 or WORD TYPE on rise duration (L to H target distance), and a lack of clear pattern based on L1. In addition, there is a large degree of variation for speakers DS (L1 Bengali) and GN (L1 Hindi).

The temporal interval between the *f0* peak and the accented syllable offset (Figure 5) showed a more distinctive pattern. The likelihood ratio test between the full and null models predicting the effect of L1 and WORD TYPE (number of post-accented syllables) on peak alignment has reached significance ($\chi^2(2)$=23.59, p<0.001). Post-hoc Tukey Test shows that L1 Tamil speakers produced earlier peaks. Differences in peak alignment were significant between Bengali and Tamil L1 groups (z=3.387, p=0.004), and Telugu and Tamil L1 groups (z=3.15, p=0.009). The boxplot in Figure 5 below also shows variation across the speakers and repetitions. Positive effect of WORD TYPE on peak alignment indicates later alignment of the H tone target when the accented syllable is followed by one or two syllables (1 syllable – 0 syllables: z=5.004, p<0.001; 2 syllables – 0 syllables: z=5.52, p<0.001). Lack of significant differences between the alignment of the peak in words with one and two post-accented syllables indicates that the H tone target does not move towards the word edge as the number of post-accented syllables increase and the word lengthens.
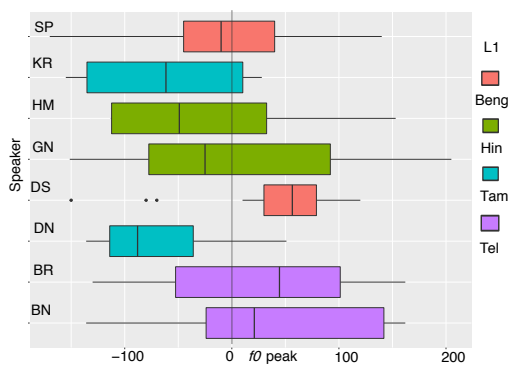

Figure 5: *Boxplot for the distribution of the H tone target relative to syllable offset (ms), presented by speaker and L1 (colour-coded). Zero mark (vertical line) on the x-axis represents syllable offset; negative values correspond to f0 peaks values within the target syllable.*
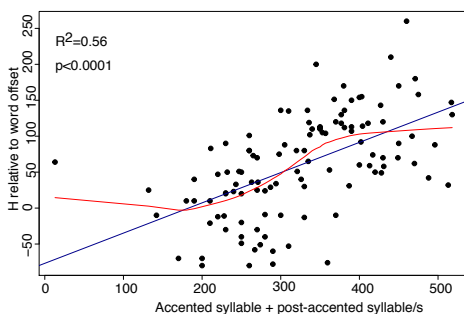

Figure 6: *Scatterplot for mean f0 peak relative to word offset (ms) and mean duration of accented syllable combined with post-accented syllable/s (ms). Blue colour - regression line; red colour - lowess smooth fitted line.*

This is further supported by the analysis of the *f0* peak relative to the word offset. As shown in Figure 6, the interval between H alignment and word offset strongly correlates with the combined length of accented and post-accented syllable/s (R^2=0.56, p<0.0001), demonstrating that the longer the post-accented material is, the greater the difference is between the H

timing and the word offset. The LMM analysis report that the likelihood ratio test between the full and null models predicts a significant effect of L1 and WORD TYPE on peak alignment in relation to the word offset ($\chi^2(8)$=21.29, p<0.005), with an interaction between L1 and WORD TYPE. L1 Hindi and L1 Tamil speakers produced earlier peaks in monosyllabic words compared to the peaks produced by L1 Bengali speakers (L1 Hindi – L1 Bengali: p<0.05; L1 Tamil – L1 Bengali: p<0.001).

4. Discussion and conclusion

Consistent with recent experimental research on IndE [6,10,13], the speakers in this study produce different types of accents, including a bitonal rising pitch accent. Based on the analysis of pitch movements on accented words, IndE bears greater resemblance to the intonation of well-documented Englishes (i.e., British or American varieties) than to the intonational phonologies of South Asian languages [23,24,25]. The findings give sufficient evidence that the *f0* peak of the accentual rise is part of the rising pitch accent and does not demarcate a minor phrase similar to the H tone at the edge of a phonological phrase reported for Hindi, Tamil and Bengali.

The presence of a rising accent seems to be a characteristic feature of IndE [6,10,11,13,16], and is produced by all speakers in this study. The findings, however, show variation in its use and distribution across the speakers. There is emerging evidence that speakers of L1 Tamil and Telugu, both Dravidian languages, use H* accents more frequently, similar to the findings of [6,10,13]. The results further reveal that speakers of Indo-Aryan languages use the L*+H accent in both nuclear and prenuclear positions, while speakers of Dravidian languages have a preference for the H* or, at times, H*+L accent.

The investigation of the accentual rise alignment shows a large degree of inter and intra-speaker variation, with some emerging patterns based on L1. Compared to Bengali and Telugu L1 groups, L1 Tamil speakers produce earlier peaks relative to the accented syllable offset, and earlier L tone targets in comparison to L1 Hindi speakers. Earlier peaks have previously been reported for Kannada English [10,16]. The results for the two L1 Bengali speakers do not pair together and highlight potential differences within the Bengali dialects. Based on the alignment of the tonal targets, an L*+H accent has been posited for the speakers of IndE in this study, with a view to conduct a follow up experiment that will control for syllabic structure, vowel type and prosodic position of the target words.

The present study has investigated pitch accent inventory and tonal alignment of the accentual rise in IndE, thus contributing to intonation research in varieties of English. The next steps include a comparison with associated phenomena in the L1s of the speakers; examination of conversational speech between the speakers of the same L1s; a closer look at phrasing and the prosodic hierarchy; and an investigation of pitch accents, their distribution and rise alignment for IndE speakers from other L1s, registers, and sociolinguistic backgrounds. The speech of speakers from a lower socio-economic status may show stronger L1 influence, namely more rises and a different phonological representation of the accentual rise.

5. Acknowledgements

6. References

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