**Recursive Intonational Phrases in Urdu/Hindi**

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In Urdu/Hindi, a typical sentence consists of a sequence of rising F0 contours. Patil et al. (2008) analyzed these rising contours as low pitch accents (L*) followed by high phonological phrase (PhP) boundaries (H-). They also reported that the F0 peak in each subsequent rising contour is scaled lower than the preceding rise, thus claiming that intonational phrase (IP) is the domain of downstep. In their analysis of embedded relative clauses, Féry and Schubö (2010) found that the PhPs in Urdu/Hindi are iteratively organized as evident by the downstepped scaling of F0 peaks between clauses. To date, no analysis has been conducted to investigate recursivity in IPs in Urdu/Hindi. This research examines if the IPs are phrased iteratively or recursively in Urdu/Hindi utterances consisting of numeric sequences separated by hyphens.

To do that, I set up a production experiment. Participants were required to produce groups of numbers separated by hyphens. In total, 21 numeric sequences were used. In each sequence, digits were divided into three groups separated by two hyphens. The size of a group ranged from one to seven numbers. An example sequence is presented in (1). It was hypothesized that some participants will interpret the hyphens as indicating IP boundaries and produce a terminal or non-terminal boundary there. This would be comparable with the production of those speakers who will not produce a boundary before hyphens. It was also predicted that the non-terminal IP boundaries will differ phonetically from their terminal counterparts and they both will differ from the prosodic realization of digits where no boundary is marked before hyphens.

Eleven female undergraduates from Pakistan were recorded at the sampling frequency of 44.1 KHz. A Praat script was used to measure the duration of syllables immediately preceding the hyphens. The scaling of F0 peaks before the hyphen (peak2) was measured manually. In order to determine if this peak was upstepped, its F0 was subtracted from the F0 scaling of the immediately preceding peak (peak1). The presence or absence of a juncture before the hyphens was determined perceptually. The utterances with a pause to indicate the presence of a hyphen were labelled as boundary marking (BM). When the speakers produced no pause before the hyphens, the utterances were labelled as non-boundary marking (NBM). The prosodic difference between the BM and NBM utterances was analyzed using Linear Mixed Effects Regression (LMER). Separate models were run for syllable duration and difference in the scaling of peak 1 and peak 2. These were used as dependent variables and boundary (pause before hyphen or its lack) was used as a fixed factor. Items and speakers were used as crossed random factors.

The analysis showed that in the BM context, speakers produced the syllables before hyphens with significantly longer duration than their counterparts in the NBM context (Table 1). According to Moore (1965) and Puri (2013)'s claims regarding syllable lengthening before IP boundaries, this shows the presence of an IP boundary before hyphens in the BM utterances. Table 1 also shows that in the BM context, the difference between F0 peaks (peak2 - peak1) was significantly higher than the difference between these peaks in the NBM context. Thus the pattern of downstep was disturbed in the BM context by scaling peak 2 higher than the preceding F0 peak. Figure 1 presents the F0 contour of a string identical numeric sequence produced in the BM and NBM contexts. Figure 1a shows that while F0 peaks are upstepped before the hyphens, the overall pattern of downstep is maintained. As IP is the domain of downstep (Patil et al., 2008), I propose that the boundaries before hyphens in the BM context are non-terminal IP boundaries recursively organized within a larger IP. The formalism is presented in (2). This constitutes first evidence of recursive phrasing in Urdu/Hindi and opens up the avenue for further investigations of recursive IP phrasing in other contexts such as embedded syntactic clauses and variation in information structure.

| | | | |
|---|---|---|---|
| (1) | a. | $(2)_{PhP}$ $(13)_{PhP}$ - $(4)_{PhP}$ $(5)_{PhP}$ $(67)_{PhP}$ - $(76)_{PhP}$ | PhP phrasing |
| | b. | $(213$ - $4567$ - $76)_{IP}$ | IP phrasing |
| (2) | a. | $(2)_{PhP}$ $(13)_{PhP}$ - $(45)_{PhP}$ $(67)_{PhP}$ - $(76)_{PhP}$ | PhP phrasing |
| | b. | $((213)_{IP}$ - $(4567)_{IP}$ - $76)_{IP}$ | IP phrasing |

| **Variables** | **Hyphen 1** | **Hyphen 2** |
|---|---|---|
| Syllable duration | β: 48ms, SE = 0.016, p = 0.003 | β: 47ms, SE = 0.016, p = 0.003 |
| F0 scaling (peak2 - peak1) | β: 23Hz, SE = 11.2, p = 0.04 | β: 26Hz, SE = 9.3, p = 0.007 |

Table 1: Results of LMER analyses.

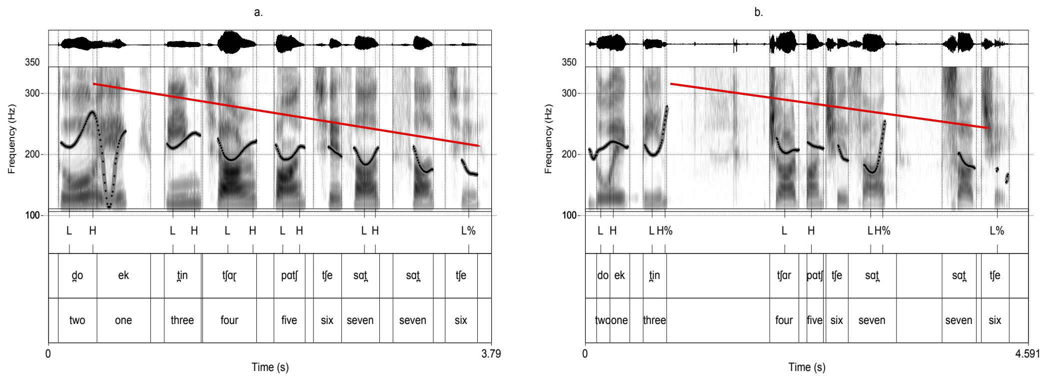


Figure 1: String identical numeric sequences produced as three IPs (a) with partial downstep and a single long IP (b) with complete downstep of F0 peaks.

# References

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