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Paradigm Shifts in Intonational Phonology: A Critical Account

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Abstract:
The paper attempts to review how Intonational phonology as a field of study evolved. For that matter, works on intonation designated as significant milestones in the field undertaken by linguistics and phonologists have been reported and discussed. The present work discusses how initially diverged instrumental and impressionistic approaches to intonational studies subsequently came to be utilized by linguists and phonologists to develop phonological models. Before the 1970s, psychologists and phoneticians studied intonation to find acoustic cues to intonational phenomena, whereas linguists were interested in analyzing intonation in terms of pitch phonemes and nuclear tones. At a later stage, phonologists started to model their intonational studies based on the evidence they derived from their phonetic data and experiments. The paper ends with a discussion on the *autosegmental metrical theory* propagated in the works of Pierrehumbert (1980).

Keywords: intonation, intonational phonology, prosody, autosegmental metrical theory, pitch

Introduction

Pitch modulation is a universal linguistic feature, though languages may differ with respect to the level at which it is applied. The fundamental frequency contour physically represents the pitch modulation with which segmental strings are uttered. While tone languages like Mandarin (Xu, 1999) and Mambila (Connell, 1999) and pitch accent languages like Japanese (Haraguchi, 1977) and Swedish (Bruce, 1977) employ pitch movements phonemically at the lexical level, there are South Asian Languages like Bengali (Hayes & Lahiri, 1991; Khan et al., 2008), Hindi (Patil et al., 2008; Xu, 1999), and Tamil (Keane, 2014) and European languages like English (Pierrehumbert, 1980) and Italian (Grice M., 1995) that post-lexically assign tones to prosodic constituents. Intonation refers to this post-lexical utilization of tones in languages.

Intonation through history

Despite intonation being an integral part of languages, curiosity in the study of intonation started to grow only in the 20th century, and it was not until the 1970s that some momentous developments took place. Before the 1970s, there were no methods or frameworks to back a comprehensive intonational study. Until then, all the studies on intonation were undertaken with the inspiration of theorists, and scientific rigor was absent in them.

Ladd (2008) roughly categorized the approaches adopted in intonational studies before the 1970s into two separate groups – *instrumental* or *phonetic* and *impressionistic* or *proto-phonological* approaches. The former was adopted and developed by some experimental psychologists and phoneticians whose main objective was speech perception and to identify the acoustic cues to intonational phenomena such as syntactic-pragmatic notions like 'finality,' 'continuation' and 'interrogation' or emotional states such as anger, surprise, and boredom. The outcomes of these studies are some general findings, such as the fact that active emotions like anger or surprise coincide with higher overall pitch or that the duration of pauses at intonational breaks correlates with the syntactic strength of the boundary. On the other hand, the phonological approach assumes an abstract level of representation for intonational features. Linguists and language teachers mainly adopted this approach, and they had some practical and theoretical purpose behind it. The teachers were interested in improving the pronunciation of foreign speakers of a language, and the linguists' concern was a general development of phonemic theory. Here, we see a meaningful change in the treatment of intonation in terms of more minor categorically distinct elements such as pitch phonemes, nuclear tones, etc.

From a methodological point of view, the instrumental approach aimed at making measurements, whereas the goal of impressionistic tradition was to construct a model for intonation. The rivalry between the two approaches continued until the 1970s when linguists and scholars started to relate the phonological categories as described by impressionistic tradition to instrumentally validated acoustic or articulatory parameters.

Configurational vs. based models

Initially, intonation was thought and defined in terms of *tunes* or gestalts (Arvaniti, 2011a; 2011b): one pitch contour was interpreted as one tune without any internal structure; it is because linguists like Jones (1967) considered that there can be only two types of emphasis possible – contrastive and intensifying. Armstrong and Ward (1926) also proposed a similar two-tune system – *Tune-I* and *Tune-II*. This view of intonation contours as gestalt has also been supported by researchers like Bolinger (1951), Cooper and Sorensen (1981), and Xu (2005), among others.

Another group of researchers supporting the configurational model acknowledged that intonation contours are combinations of primitives such as rises and falls or dynamic tones. The supporters of this group, like Cohen and Hart (1968), Hart and Cohen (1973), and Hart and Collier (1975), observed that intonation contours cannot be represented as gestalts since they do not simply stretch out or shrink with the length of the segmental string they are associated with. Listeners perceive the difference among intonational contours not by considering the contour holistically but by perceiving the pitch movements in the contour. The model developed at the Institute of Perception Research (henceforth IPO) is one such model that describes intonational contours in terms of pitch movements (for details, see Hart, Collier, & Cohen (1990)). These pitch movements are categorized as *prominence lending* and *non-prominence lending* pitch movements; while the former co-occurs with stressed syllables, the latter does not designate any lexical prominence.

The British school, on the other hand, defined intonational contours as *tone groups*, which are analyzed further into smaller units, viz., the *pre-head, head, nucleus*, and *tail* (Crystal, 1972; O'Connor & Arnold, 1973). For them, a tone group must minimally contain the nucleus, which is realized on the most prominent syllable of the group. The head designates the contour stretch from the first stressed syllable to the nucleus, and the tail is the contour following the nucleus. The pre-head refers to any F_0 stretch preceding the head. The British school model, like the gestalt model, was interested in the global contour shapes of each constituent unit without acknowledging the existence of any possible local tone events.

This trend of postulating intonational melodies as gestalts or interpreting contours only in terms of dynamic tones was contradicted by the level-based model proposed by American structuralists like Pike (1945), Trager and Smith (1957), and Hockett (1955). They spoke about the internal structure of intonation and the role played by intonation in conveying meaning. Linguists like Pike (1945), Wells (1945), Trager, and Smith (1957) spoke about four-level tones or '*pitch phonemes*' – Low, Mid, High, and Overhigh, which occur at certain structurally salient points in the utterance. These phonemes are not representative of any inherent pitch range; they are defined in relation to one another. However, the contemporarily popular configurational model temporarily overshadowed the level model of intonation. Bolinger (1951) attacked the system of four-level tones for representing intonation by saying that the distinctive functional units of intonation were really 'configurations' like 'rise' and 'fall.' According to him, apart from the degree of emphasis, there is no difference between an utterance with an Overhigh-High-Mid tone pattern and an utterance with a High-Mid-Low tone pattern; as per the four-level tone system, the two contours are distinct.

Autosegmental-metrical model of intonational phonology

Bruce's study on Swedish word accent added a new dimension to the perception of tune text association. In his study (Bruce, 1977) on Swedish word accents, he showed that accent-I and accent-II are marked by an H(high) tone, i.e., the F_0 maximum, and they differ from each other with reference to the timing of the pitch peak (H). In accent-I, the pitch reaches the peak (F_0 maximum) before the start of the accented syllable, and in accent-II, the F_0 touches its highest value right after the onset of the accented vowel. Although there is normally a fall after the peak, he noticed that this fall, at times, gets shortened or even truncated. It is the high peak that is invariably precise in its alignment in time with the segmental element and not the fall of F_0 to the baseline height. Supporting the notion of alignment, Bruce proposed that in the Swedish accentual pattern, "reaching a certain pitch level at a particular point in time is the important thing, not the movement (rise or fall) itself" (Bruce, 1977, p. 132). Thus, he did not consider pitch movement to be the basic unit of analysis; rather, it is the alignment of pitch levels (either L or H) with structurally defined points on the segmental string between which the pitch interpolates. For Bruce, rises and falls of F_0 are only transitions between two phonetic alignments of tones: rising is a transition from an L tone-aligned tonal target to H, an aligned tonal target, and falling is a transition from an aligned to An aligned tonal target. The segment with which L is aligned gets the lowest local F_0 value, and the H-aligned segment, as can be predicted, gets the highest F_0 value; these points of alignment were defined by Bruce as "turning points" – in terms of the local F_0 maxima and minima. Further, he differentiated turning points co-occurring with lexically prominent syllables from those co-occurring with phrase boundaries, which is identical to the distinction made by the IPO model (Hart et al., 1990) between *prominence lending* and *non-prominence lending*. According to Bruce (1977), lexical tones and phrasal tones do not require separate representations; rather, they can be concatenated together in the same representation.

Bruce, however, did not attempt to phonologically represent the phenomena of alignment; for him, it is only the outcome of the phonetic realization. Pierrehumbert, in her dissertation (1980), proposed that in English, the alignment of a tone with a segment on the segmental string may serve as a cue to the difference between two categorically distinct phonological associations: pitch accents and boundary tones. She proposed that only two tones, high (H) and low (L), are sufficient for the phonological representation of English intonation. Ladd (2008) used the term *autosegmental-metrical model* (henceforth AM model) *of intonational phonology* to refer to Pierrehumbert's model, developed further in Beckman and Pierrehumbert (1986a) and Pierrehumbert and Beckman (1988) among others.

She related alignment with the concept of phonological prominence with the adoption of star notation (T*), which she borrowed from Goldsmith (1976/ 1979). She proposed that a prominent syllable in the segmental string gets a pitch accent[1], which is usually marked by local pitch change (often marked by either a local F_0 maximum or a local F_0 minimum) in the global F_0 contour. According to Pierrehumbert (1980), the tone, which is phonologically associated with the most prominent point on the segmental string, is marked by a star, and that star, apart from being a cue to prominence, would also mark the precise location of tune-text alignment.

Taking further the argument of Bruce (1977) regarding the alignment of pitch peaks in a Swedish accent, Pierrehumbert (1980) proposed bitonal pitch accents; in this view, rise and fall on an accented syllable are interpreted phonologically as L+H or H+L, respectively. Moreover, she explains that the early and late alignment of the peak or valley depends upon which tone of the bitonal combination is starred. If there is an early rise, the abstract phonological pitch accent would be L+H; however, only the H is associated with the accented syllable; the pitch accent, according to Pierrehumbert, is to be represented as L+H*.

The next tonal association Pierrehumbert talks about occurs on the boundary. The concept of boundary tone, which she presented in her work in 1980, was later on revised in her works with Beckman (Beckman & Pierrehumbert, 1986a; Pierrehumbert & Beckman, 1988). According to them, in the case of boundary tones, the association of tone is with the boundary and not with the prominence of any specific syllable; such tones are realized on the final syllable of a prosodic phrase. Pierrehumbert (1980) proposed that H and L tones are arranged linearly on an autosegmental tier and are associated with prominent nodes and boundaries of prosodic phrases, which are metrically arranged. Although these tones designate the targets for tone realization, they do not represent the phonological specification of the contour between them. The course of the intonational contour between two tonally specified targets is an interpolation, and it is tonally underspecified (Pierrehumbert & Beckman, 1988).

Prosodic phrasing

AM model, apart from discussing the intonational specification, proposes a hierarchically organized prosodic structure. Beckman and Pierrehumbert (1986a) put forth the prosodic hierarchy of English where the highest node is the *intonational*

[1] The term *pitch accent* was first used by Bolinger (1951). According to him, like it is in the IPO model (Hart et al., 1990), a prominent word in a sentence is assigned a pitch accent on its stressed syllable.

phrase (henceforth IP), which normally corresponds to the clause. An IP minimally must comprise an *intermediate phrase* (henceforth ip), which is a unit larger than a prosodic word and smaller than an IP. In English, such ips contain at least one pitch accent and a phrasal tone. Pierrehumbert and Beckman (1988) added another phrasal domain below the ip, i.e., accentual phrase (henceforth AP), while describing the prosodic hierarchy of Japanese. Variations in the prosodic tree have been reported cross-linguistically; for instance, in the prosodic hierarchy of Japanese (Venditti, 2005) and Korean (Jun 1993), IPs directly dominate APs. On the other hand, in Bengali, (Khan et al., 2008) and French (Jun & Fougeron, 2000), the existence of both IP and AP has been reported.

Another prosodic hierarchy was proposed by Prosodic Phonologists like Selkirk (1984), and Nespor and Vogel (1986), Hayes (1989b), Hayes and Lahiri (1991), among others, based on the syntactic information. In this hierarchy also, the highest node is the IP, which minimally dominates a Phonological phrase (henceforth P-phrase). The P-phrase is the immediately higher domain above the phonological word (henceforth P-word) node. P-phrases are comparable to ips in English (Beckman & Pierrehumbert, 1986a), APs in Korean (Jun 1993), and Bangladeshi Bengali (Khan et al., 2008). Irrespective of their origin, syntax, or intonation, both hierarchies obey the Strict Layer Hypothesis (Selkirk, 1984). According to this hypothesis, a non-terminal node in the hierarchy is exhaustively parsed into constituents from the level immediately below it. For instance, an IP must always contain P-phrases, and they, in turn, must contain only P-words.

ToBI transcription system

Based on the tonal representations proposed in the works by Liberman (1975), Bruce (1977), Pierrehumbert (1980), Beckman and Pierrehumbert (1986a), Pierrehumbert and Beckman (1988), Tone and Boundary Indices (ToBI) (Silverman, et al., 1992; Pitrelli et al., 1994; Beckman & Elam, 1997; Veilleux et al., 2006) transcription system was developed. The ToBI transcription system has been used to explicitly represent the intonational model proposed in the study. The labels used in the transcription are representative of phonological distinctions rather than being motivated by the phonetic realization (Pitrelli et al., 1994; Beckman et al., 2005). The ToBI system, apart from representing the phonologically contrastive tonal events, reports the hierarchically arranged prosodic structure.

Originally, the ToBI system was developed to label intonational and prosodic databases of Mainstream American English (MAE) (Pitrelli et al., 1994). This system is known as MAE_ToBI. Subsequently, studies on the intonation and prosody of other languages were conducted using the ToBI system. For instance, German (Grice,

Benzmüller, Mayer, & Batliner, 1996), Japanese (Venditti, 2005), French (Delais-Roussarie, et al., 2015), etc.

In To BI transcription, the F_0 contour of a recorded utterance is presented electronically or on paper, accompanied by four parallel tiers containing relevant information about transcription, tonal events, prosodic phrasing, segmental processes, etc. These four tiers are *tones*, *words*, *break*, and *miscellaneous* tiers from top to bottom. The tone tier contains information regarding the tonal specification of pitch accents and boundary tones. The word tier contains a transcription of orthographic words. In the third tier, which is the break indices tier, the prosodic boundaries are demarcated with the help of integer numbers from 0 to 4. In the final tier (miscellaneous), comments are given regarding any disjuncture marked in the above three tiers.

Conclusion

The present paper reviews the evolution of Intonational Phonology as a field of study. The paper shows how the study of intonation started with two contrasting approaches: instrumental and impressionistic. The objective of the former approach, sponsored by experimental psychologists and phoneticians, was to make measurements, whereas the latter approach, adopted by linguists and phonologists, aimed at constructing a model for intonation. However, in the subsequent studies, attempts were made to formulate phonological models backed up by phonetic evidence. After the development of configurational models and level-based models, we finally arrived at the AM model of intonational phonology. According to this model, at the phonological level, there are strings of tones - Low and High: these tones get associated with metrical heads and phrasal boundaries in a string of segments. AM model also postulates that segmental strings maintain a hierarchically arranged prosodic structure.

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