An Analysis of the Pitch Contour of an English Declarative Question Read Aloud by Chinese EFL Learners

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Abstract

The pitch contour of an English declarative question read aloud by 12 Chinese EFL learners is labeled and analyzed by means of the phonetic software “praat” on the basis of the English intonation grammar proposed by Pierrehumbert. The careful study yields to two findings. 1) Most Chinese EFL learners can locate correctly the stresses of the target sentence and attach legal tonal events to the pitch accents and edge tones, but they prefer to employ non-monotonies for the pitch accents. 2) They are unable to manage the tone scaling of the pitch accents according to their strength in an IP or the proper combination of the tonal events into a pitch contour. Learners’ improper management of the tonal events for the pitch accents of the target sentence, their tone scaling and the pitch transition between two starred tones probably arises from the negative transfer of Chinese lexical tones and intonation, the severe shortage of input on English intonation grammar and their low-level skills in tone management at the declarative stage in English intonation learning. The results provide some inspiration for English intonation teaching and learning.

Index Terms: pitch contour, pitch accent, phrase accent, boundary tone

1. Introduction


2. English intonation grammar

Pierrehumbert[14] poses English tonal inventory in her PhD dissertation. Later, Beckman and Pierrehumbert[15], Silverman et al. [16] undertake some revision in the problematic pitch accents. In this study, Pierrehumbert’s tonal inventory is employed for analysis because the revised version of English tonal inventory is not enough for the description of learners’ irregular and complex intonation. The finite-state grammar of English intonational phrase is shown in Figure 1 below.

The English tonal inventory shown in Figure 1 demonstrates 4 points. First, there are three types of tonal events for the tonal inventory of English intonation, namely, seven pitch accents, two boundary tones and two phrase accents, which are made of two primitive tones H and L.
Second, well-formed tunes for an IP consist of one or more pitch accents followed by an edge tone (phrase accent and a boundary tone), as well as an optional initial boundary tone. This implies that a) “all possible combinations of pitch accents and edge tones are legal; b) there is no constituent structure within an English tune. This means that prenucleus accents and nucleus accents are the same except for their position: according to Pierrehumbert, the latter is the last accent of an IP. Third, the starred tone of the pitch accents is associated with the strongest syllable of the metrical feet, however, not all metrical feet necessarily receive a pitch accent. Fourth, the various tonal targets are mapped to Fo contour through two tone mapping rules, the metrical-context-sensitive rule and the tonal-context-sensitive rule. The metrical-context-sensitive rule, which scales tone phonetically, has three stipulations: a) the lowest Fo values corresponding to L%, remains stable for each speaker; b) the stress subordination between accents in an IP is reflected in their phonetic values: as prominence increases, the phonetic value of L* decreases while the value of H* increases; c) the lowering of the L* under prominence is prone to saturation towards the baseline. For the tonal-context-sensitive rule, which constructs the Fo contour between one target value and the next, there are mainly a downstep rule and an upstep one. The downstep rule postulates that each second H in a tonal context of H+L H or H L+H is lowered to the preceding H by certain ratio. The upstep rule postulates that the boundary tone (H% or L%) is raised after the phrase accent H regardless of what type of nucleus accent precedes. Fifth, the pitch transitions between the tonal targets are realized through some interpolation rules and a tone spreading rule. The former indicates that the interpolation between two H*s may be non-monotonic whereas the interpolation between all L tones and an adjacent tone is monotonic. The latter spreads L\^ or H\^ rightward over a cluster of unstressed syllables given that the next tone is phonetically equal or higher.

3. Methodology

3.1. Participants and the target sentence

The participants in our study are 30 English majors from a university of foreign study in Guangzhou. They are required to read a 130-word dialogue with moderate difficulty. The recording is made in a quiet language lab with professional recording equipment. For comparison, we invite 4 native speakers from the USA to read the same dialogue. The reading material is stored in a computer for analysis. The target sentence clipped from the dialogue is a declarative question “You mean you are not confident that you can pass them?”.

3.2. Data processing

The recording material is processed in the following steps. First of all, the material is played over and over again. Only the clear and complete objects are selected. Second, the target sentence is clipped from the dialogue by means of the software “cooledit”. Third, the 26 high-quality objects read aloud by the Chinese EFL learners and 4 by the native speakers are presented to a college English teacher majoring in linguistics, who has stayed in America for 12 years’ education from junior middle school to postgraduate education, for identification of nuclei and nuclear tones. Fourth, the phonetic software “praat” is employed to check the results. The 12 objects which have similar nuclei and nuclear tones to those of the 4 native speakers are singled out for the core of our research. After that, the 16 objects are labelled by a college English teacher, who majors in phonetics and phonology in her postgraduate study and teaches English pronunciation and English phonetics for 12 years. The labelled material is revised over and over again for correctness.

4. Data analysis and results

As to the labeling of the objects, according to Pierrehumbert[14], the starred/unstarred relation in pitch accents may be compared to the stressed/unstressed
relationship within the metrical foot which is comprised of a
stressed syllable and associated unstressed syllables
organized hierarchically. The bitonal accents resemble
bisyllabic feet, the starred tone being the stronger one
(marked as “s”) and the unstarred tone the weaker one
(marked as “w”). The metrical feet of the target sentence is
shown in Figure 2.

You mean you are not confident that you can pass them?

Figure 2: The metrical feet of the target sentence.

The target sentence is analyzed according its syntactic
structure. The metrical grid shows the relation among the
four stresses. It is evident that there are four pitch accents in
this sentence, “pass” which is controlled by three “s” is the
strongest syllable, namely the nucleus, “confident” which is
controlled by two “s” is the second strongest,
“not”controlled by one “s” is the third strongest, and “mean”
controlled by only “w” is the weak one. According to the
tone mapping rules, the stress subordination between accents
in an IP is reflected in their phonetic values: as prominence
increases, the phonetic value of L* decreases while the value
of H* increases. Therefore, the phonetic value of “pass” is
either the highest or the lowest.

The 4 objects read aloud by the Native speakers (as “NSs” below) and the 12 ones read aloud by the Chinese
EFL learners (as “Learners” below) are labelled with H and
L on the basis of Pierrehumbert’s English tonal inventory
according to the waveform and pitch tiers of each object
obtained from “praat”, take the objects of NS1 and Learner1
for example (as shown in Figure 3 and Figure 4).

In Figure 3 and Figure 4, the target sentence is labelled
in four parts according to its syntactic structure. The pitch
accents are labelled according to the feet structure. But it is
difficult to put each syllable in alignment with their
waveform and tone events. Due to the space, the labelling
graphs of other objects are not presented here. The labeling
of the tonal events of all objects are collected in Table 1 (for
NSs) and Table 2 (for Learners).

From Table 1, it is evident that all the tonal events of
the pitch accents and edge tones are all available in the tonal
inventory of English intonation. In addition, the combination
of the tonal targets is in line with the metrical-context-sensitive rule, namely, the stress
subordination of these objects is correctly reflected in their
phonetic values: as prominence increases, the H* values in
NS1 and NS4 increase, and the L* values in NS2 and NS3
decrease. It is also in line with the tonal-context-sensitive rule: the boundary tones H% in NS1,NS2 and NS3 are raised
after the phrase accents H+. Finally, the pitch transitions in
these objects are managed properly. The rightward spreading
available in NS1 and NS4 over several unstressed syllables
occurs only when the next pitch accent is equal to or higher
than the previous one.

From Table 2, we observe that 1) most of the pitch
accents, all the phrase accents and boundary tones are legal
except for the three underlined pitch accents of “L+H*+H+L” in Learner 2, “L*+H+H+L” in Learner 4 and
Learner 8. These three tones are not available in the tonal
inventory of English intonation.They all fall on the same
word “confident”, all with and “L*+H” on the stressed
syllable “con-“, a higher “H” on the unstressed “-fi-“ and a
“L” on “-dent”. 2) The pitch accents in the object of Learner
6 are more than expected. According to the syntactic analysis,
there are 4 pitch accents at most for the target sentence.
However, we find 5 pitch accents in the object of Learner 6,
with a “L+H*” on the second “you”. Compare the pitch
accents in Table 2 with those in Table 1, the NSs employ
more monotonies (H* and L*, which take up 43%) than the
Learners (which take up 26%). Among 12 Learners’
monotonies, 11 are H*s and only 1 is L*. For non-metony,
the NSs adopt L+H*, L*+H, H*+H and H*+L, altogether
take up 57%, while the Learners adopt the same tonal events
as well as two illegal ones, L+H*+H+L and L*+H+H+L,
altogether take up 74%. This indicates that the tonal events
Learners employ are more complex than the NSs’. Among
the non-motononies, the flat tone H*+H the Learners use
takes up 39% in all non-monotonies, much more than the
NSs, which takes up only 12.5%. As for the edge tones, ten
out of 12 are rising tones for the declarative question, six
high rise and four low rise. The rest two are low fall. Most of
these edge tones are wide-pitch-ranged.

As far as the organization of the tonal targets (pitch
accents) is concerned, none of the objects conforms to the
metrical-context-sensitive rule. The stress subordination
between pitch accents of each object is not reflected in their
phonetic values. In other words, the phonetic values of L* or
H* do not decrease or increase as prominence increases.
Among the eight objects with all pitch accents marked with
H*, only one object has the highest phonetic value for the last pitch accent, and very similar values for the other three accents. Three of them have the lowest phonetic value for the last pitch accent. Aother three objects have the last phonetic value higher than two pitch accents but lower than another one accent. One object is attached very similar phonetic values to four pitch accents. Four objects out of 12 have both H* and L* for the pitch accents. Two of them have two H*s for the first two pitch accents and two L*s for the second two ones with either the same phonetic values for two H*s or the first H* higher than second H*, the first L* lower than the second L*. One has three H*s for the first three pitch accents with properly scaled phonetic values but with a L* for the most strongest pitch accent. The last object has L* tone for the third pitch accents and H* tones for the rest three accents with the lowest phonetic value for the most strongest accent.

With regard to the pitch transitions between the tonal targets, the interpolation between H*s and L*s is in line with the interpolation rule. In most objects, the interpolation between H*s is non-monotonic, while the interpolation
between L*s and their adjacent tones is monotonic. As for the tone spreading rule, Pierrehumbert mentions, the leftward spreading is in fact the rightward spreading of the previous pitch accents[14], we leave it out for discussion. Among the twelve objects, nine are correct in the first half with the rightward spreading occurring when the next tone is equal or higher than the previous one, and incorrect in the second half with the rightward spreading available when the next tone is lower. Two of them are in line with the rule and one in breach of it.

5. Discussion

The findings above indicates: first, most Learners are able to locate correctly the stresses of the target sentence in the specific context and attach legal tonal events to them. But they tend to use non-monotonies for pitch accents, in particular the flat tone. They are also capable of employing proper edge tones for the declarative question. These are more or less similar to Chen’s[11] findings that Chinese learners employ similar nuclear tone for different types of sentences, and have better command of falling tones and rising tone. As for the latter, we observe that the Learners in our study prefer rising-falling tone to falling tone, and falling-rising to rising, particularly those on multi-syllable words. Chen also shows that the Chinese learners apply more level tones to reading than the native speakers do. It is the same case in the present study. This suggests that Learners are apt to use flat tone in English reading.

Second, most Learners are apt to adhere to the interpolation rule that the interpolation between H*s may be non-monotonic, most probably for the following reasons: a) Learners show a tendency to employ non-monotonic tonal events for pitch accents and edge tones as well as the unstressed syllables between pitch accents; b) most of the pitch accents are marked with H* instead of L*, so Learners’ tendency is in accordance with the interpolation rule. It suggests that Learners do not necessarily master the interpolation management between two H*s and two L*s.

Third, it is also obvious that Learners have not built any awareness of tone scaling of pitch accents according to their strength in an IP or of proper combination of the tonal events into a pitch contour, such as how to spread the tone rightward correctly and how to bring about smooth pitch transition. This is different from Chen’s proposal that the Chinese EFL learners do not have the awareness of choosing secondary tones according to the feeling and attitude implied in the sentence in different perspectives. With the same concept “awareness”, the present study focuses on the management of tones events according to English intonation grammar, in other words, the scaled phonetic values of the pitch accents in an IP with different strength based on syntactic analysis, while Chen’s centers on the relation between the nuclear tone patterns and the feeling and attitude embedded in the target sentence.

The possible reasons of Learners’ tonal behaviors are investigated in different perspectives. Firstly, from the contrastive linguistics point of view, English and Chinese intonation have some differences[17]. Chinese intonation exerts effect on pitch range and register rather than the contour of the lexical tones. Learners’ preference to wide-pitch-range edge tones probably results from the transfer from Chinese intonation, since Chinese intonation is mainly represented by the final syllable of an IP. In addition, the complex non-monotones Learners adopt for pitch accents as well as for the unstressed syllables between pitch accents, such as the flat tones, falling-rising tones, are similar in contour to the Chinese lexical tones.

Secondly, in Interlanguage perspective, according to Si Lianhe[18], at the first stage learning, Learners prefer to use their native language system for reference in their foreign language use when they do not obtain enough information necessary. Such case occurs to the Learners in the present study. When they are in want of the information for the management of pitch accents, the combination of tonal events, the interpolation between two starred tones and pitch transition, they apply the Chinese tone system to English and base tone events more on syllables than on metrical feet. Learners’ tone behaviors embedded in the management of pitch contour for the target sentence reveal the transitivity, permeability and native language dependency of Interlanguage.

Thirdly, from the standpoint of second language acquisition, Learners in the present study have acquainted the basic information of English intonation like the function and use of intonation patterns, the structure of an intonation phrase (tone unit). Nevertheless, they are not acquainted with the information of the combination of tonal events for a well-formed pitch contour of an IP, let alone internalize or automatize it. Their intonation learning is still at the declarative stage[19] (or controlled processing, the first stage
of information processing), pre-systematic by Corder or random errors by Brown[18]. In short, most Learners’ tone scaling of pitch accents and the management of pitch transition between two starred tones violate the stipulation of the English intonation grammar.

6. Conclusion

In a word, Learners’ improper management of the tonal events for the pitch accents of the target sentence, their tone scaling and the pitch transition between two starred tones probably arises from the negative transfer of Chinese lexical tones and intonation, the severe shortage of Learners’ input on English intonation grammar and Learners’ low-level skills in tone management at the declarative stage in English intonation learning. The results provide some inspiration for English intonation teaching and learning: 1) Chinese EFL learners should learn English intonation as early as possible for kids’ good imitation and thorough understanding of native-like English intonation in contexts; 2) in the course of English intonation teaching and learning, teachers should reveal to the learners the similarities and differences of intonation between English and Chinese; 3) the Chinese EFL learners should attach great importance to the relation between the tonal events for pitch accents and their stress structure based on syntactic analysis as well as the right combination of the pitch accents and edge tones.

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8. References


