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Toward a Sequential Approach for Tonal Error Analysis

Qinghai Chen

Introduction

It is unanimously acknowledged that the lexical tones are one of the most difficult parts, if not the most difficult, for American learners of standard Chinese. Very often we come across students who are already at the advanced level but still agonizing over their tones. The problem is actually more than the lack of native-like accents. In a tone language like Chinese, tones are phonemic. Misuse of tones may cause difficulty in communication, and sometimes may even result in misunderstanding.

Why then does a good mastery of the Chinese tone system seem to be beyond the reach of so many of the American learners? The common stand is to attribute the problem to the interlanguage interference from the English intonation although some scholars also suggest the explanation in terms of intralanguage interference (White, 1981). A number of studies, although not very many, have been done in the past decades on standard Chinese tones in terms of contrastive analysis and error analysis in an attempt to facilitate Chinese instruction (Chiang, 1979; White, 1981; Shen, 1989a; Miracle, 1989). There have also been attempts to explain second language learners' difficulty in terms of observing the tonal development of first language Mandarin-speaking children (Li & Thompson, 1977; Yue-Hashimoto, 1980). Linguists tend to believe that a good command of Chinese tones is not impossible for American learners. Some suggest that the learner's tonal performance is related to his perceptual processing which is developed out of his language background (Hockett, 1951; White, 1981; Repp, 1990).

However, previous studies among American adult learners seem to have some limitations. First, almost all the tests used in the studies have been tonal production tests and seldom have accompanying perception tests been used. Second, in analysis of tonal production, errors used as data are typically collected by having students read aloud a familiar lesson or a number of specifically designed sentences. No natural speech is reported to have been used as data in published literature. Third, in order to avoid or reduce interaction of various factors, analysis has generally been restricted to syllables at a certain position in the utterance. Even when a whole sentence is examined, every tone is treated as if it were occurring by itself regardless of its context in the sequence. Thus, discussion largely remains syllabic, focusing on isolated tones. There is little possibility of identifying and analyzing systematic sequential patterns in the learner's interlanguage. It is hard to imagine that conclusions drawn within these limitations could be comprehensive enough.

The purpose of the study was, therefore, to try to analyze American adult learners' tonal errors with a different approach. Both natural oral data and data from perception tasks were used for analysis. More importantly, tentative efforts were made to analyze tonal errors in sequences as sequences. On such a basis, two systematic sequential patterns in the learner's tonal development were identified and a hierarchy of difficulty was suggested.

Review of Literature

Tonal Feature of Chinese

Chinese is not unique in being a tonal language. As far as it is known, tonal languages are found in Southeast Asia, Africa, and even in North America among Latin American Indians. However, looking specifically into the Chinese tonal system reveals that it has unique characteristics.

Almost every Chinese syllable must carry a tone. The tone is a suprasegmental phoneme which

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nantal and vocalic segments. Each tone represents a fixed pitch pattern, being either level or rising. These tones may serve to differentiate meaning just like the different pitches of a native speaker. The tones used in standard Mandarin Chinese can be depicted as follows:

- **Tone 1**: high level /55/
- **Tone 2**: high rising /35/
- **Tone 3**: low falling-rising /214/
- **Tone 4**: high falling /51/

These tones are not fixed on a scale but relative sounds or contours that vary according to the normal voice range of individual speakers (DeFrancis, 1984). There are, in addition, a neutral tone, which occurs when a syllable is unstressed. Unlike the four basic tones, a neutral tone cannot be pronounced in isolation. Its phonetic pitch, depending on the tone of the preceding syllable, is relatively low after the level, rising and falling tones. It is relatively high only after the falling-rising tone (Norman, 1988).

According to Chan (1987), there are only two basic oppositions in the tonal system of standard Chinese: (1) high versus low: for Tone 1 (/55/) versus Tone 3 (/214/) —in particular, the [21] variant, and (2) rising versus falling: for Tone 2 (/35/) versus Tone 4 (/51/). Even in slow speech, the pitch changes would be constant and at the extreme ends, hence a great deal of effort would be required from the speaker.

Tones contrast in contour, pitch height and duration. The traditional view holds that in standard Chinese, tonal contrasts are primarily realized by difference in contour. Some recent studies, however, suggest that it is the fundamental frequency (F<sub>0</sub>) or pitch level, that are most basic and salient (Yue-Hashimoto, 1980; Connell et al., 1983; Shen, 1989a). As Connell puts it, “relative pitch seemed to be the primary cue for tonal distinctions” (p. 339). However, he immediately adds that “in the cases of low tones there could well be other cues such as duration or subtle differences in the fundamental frequency contour” (p. 339). Blicher (1990), too, notices the relatively long duration of low and rising tones although, at the same time, he deliberately recognizes differences in both fundamental frequency (F<sub>0</sub>) height and contour as primary means of realization of tonal contours.

Tonal values can be affected by a number of factors although never by the segments which occur with the tones (Wang, 1967). In nonfinal position, tones in standard Chinese are subject to certain changes known in many languages as sandhi. Two of the three sandhi rules involve Tone 3. First, when a Tone 3 is immediately followed by another Tone 3, the first one is changed from /214/ to /35/ which is identical to a Tone 2. Li and Thompson (1977), referring to Wang and Li (1967), claim that the resulting Tone 2 by this rule “has been shown experimentally to be indistinguishable from an inherent rising tone” (p.189). Second, a Tone 3 in front of any other tone reduces to just /21/ without the following rise. The resulting tone may even be /11/ as is illustrated by Li and Thompson (1977), who, in their later publications, also adopt the /21/ interpretation. Either /21/ or /11/ reflects a low nonrising vocalic value. The third sandhi rule states that a Tone 2, preceded by a Tone 1 or Tone 2 and followed by another syllable of any tone, changes into Tone 1 in rapid speech (Norman, 1988). All these changes are results of tonal assimilation or dissimilation.

Another kind of tonal value change which is assimilative in nature is tonal coarticulation. It is manifested in terms of changes in fundamental frequency height, but not in the direction of fundamental frequency movement. For example, when two fourth tones (high falling) come together, the first one is pronounced shorter (Mao, 1987); meanwhile, the second one is lower in pitch than the first, and the first one does not drop as far as those spoken in isolation (Wu, 1988; referred to by Shen, 1990). Unlike tonal sandhi, tonal coarticulation does not affect tones very much so that the basic tonal contours remain relatively unchanged.

In standard Chinese, intonation also interacts with tones, i.e., lexical tones are influenced in their fundamental frequency movement by sentence intonation. But again the basic features of the four tones are left intact. Only in sentence-final position may intonation perturb tone contours in a significant manner to cause pitch-neutralization (Connell, 1983; Shen, 1989b). Connell points out the fact about the Chinese language that “recognition of tone is stable over a wide range of frequency changes” (p. 350). The wide range of tone stability, he claims, permits intonation to function in the same manner as it does in non-tonal languages.

There have also been studies on contextual effects examining the issue of the perception of lexical tone. Many of them claim that perception is affected by contextual circumstances. For example, Shigeno and Fujisaki (1979; referred to by Fox & Qi, 1990) point out that the effect is a product of auditory rather than phonetic processing. Speer, Shih, and Slowiaczek (1989) claim that phrasal prosodic structure influences auditory language comprehension processes. Fox and Qi (1990), when failing to provide adequate support for the hypothesis that context (in the form of F<sub>0</sub> rise rate) can significantly affect the lexical tone identification responses for either Chinese or English listeners, suggest more controlled experiments examining the influence of context (especially in the form of pitch variation) on the perception of lexical tone in particular.

**Acquisition of Chinese Tones by American Learners**

From the previous section, we know that the number of the Chinese tones is really not great, and the tones, even though their values may be affected by various factors, do not usually go beyond recognition. When we examine the tonal sandhi
phenomena, which seem to be the only factor to change the tone values substantially, there are only three rules for consideration, and they appear simple and easy. So, since the values themselves and the rules are not complicated, the tones should not theoretically be difficult for English-speaking learners. However, the difficulty experienced by American learners in their attempts to acquire good Chinese tones is widely witnessed. Chiang (1979) is certainly not alone when he states that the problem of learning the tones "needs to be tackled decisively and carefully right in the beginning of learning" (p.249).

It seems to be a common belief that it is not the phonological segments (i.e., consonants and vowels) of standard Chinese that present any articulation difficulty for American learners; rather, it is the tones that are difficult for them to acquire (Shen, 1989a). However, contrastive analyses of the phonetic tonal contours of English and standard Chinese have failed to reveal any major articulatory differences between the isolated tonal contours of the two languages. According to White (1981), the four tonal patterns in Chinese, namely high level, rising, low falling-rising and falling, are all available in English, which actually has at least one more, i.e., rising-falling. The primary difference between the tones of English and standard Chinese is the significantly wider domain of the English tone. While a Chinese tone falls on one syllable, an English tone may be spread across any number of syllables. However, this does not sound like an adequate and satisfying explanation of the difficulty encountered by American learners of Chinese as a second or foreign language.

If the process of second language acquisition in any sense and to any extent parallels the process of first language acquisition, it should be helpful to examine how the tones are acquired by native Chinese children in their language development. In a duration of over seven months, Li and Thompson (1977) did an "in-depth longitudinal study" in Taipei with 17 children from Mandarin-speaking families. The result of the study strongly supports the suggestion in the literature that suprasegmental aspects of language are acquired relatively early. They claim that when the child is still at the one-word stage and his utterances are "segmentally inaccurate or even incomprehensible", he already has the adult tone system almost completely under control and his utterances can be "tonally perfect" (p.190). In an article describing the tonal development of her daughter, Yue-Hashimoto (1980) claims that her baby "could distinguish all five tones in Mandarin" by the age of 20 months (at a stage of single-word utterance and with a very limited inventory of segmental sounds acquired), and that she "began an interesting play on tones" at age 2 (around the time when there is a sudden outburst of syntactic activity) (p.181). These two studies have apparently revealed the fact that the correct tone system is acquired by Chinese children with standard Chinese as their mother tongue well in advance of the segments. Both studies give credit to Van Lancker (1975; referred to by Li & Thompson, 1977) for his finding that features of pitch are stored and processed in the brain differently from segmental phonological features and that intonation is acquired before many segments in English.

A hierarchy of acquisition sequence for the Chinese tones has been suggested on the basis of first language empirical studies. Generally speaking, level tones are easier than contour tones, and falling tones are easier than rising tones. The specific order of ease of learning put forward by Li and Thompson (1977) based on the data from two small children is: Tone 1 (/55/), Tone 4 (/51/), Tones 2 and 3 (/35/ and /214/). It turns out that Tone 2 and Tone 3 are more difficult for the child to produce. Not only do they appear later in his speech, but they are also the only tones confused with each other throughout much of the early acquisition period. Li and Thompson attribute the difficulty and confusability of these two tones to the fact that, because they both have a rising end component, they are similar to each other and different from the high level and falling tones. Such an analysis can find abundant support in literature since it has already been proved that greater physiological effort is required to raise pitch (Ohala and Ewan, 1973; referred to by Li & Thompson, 1977), and that languages tend to try to reduce the occurrence of low-high sequences which involve rising pitch (Hyman, 1973; Hyman and Schuh, 1974; referred to by Li & Thompson, 1977). In spite of the difference in the level of difficulty in acquisition, what is significant here is that, for Chinese native speakers, once they have acquired the whole tonal system in their early childhood, it has become a matter of course that the tone pattern is an integral part of whatever character or word they learn. In their daily use of the spoken language, they no longer feel consciously that they are taking care of their tones. The close functional association between segmental structure and fundamental frequency contour gets intuitively rooted in their linguistic behaviors.

In a study in the integration of segmental and tonal information in speech perception, Repp and Lin (1990) compare two groups of subjects: speakers of a tone language (standard Chinese) and of a non-tone language (English). They find that Chinese and English listeners both show an underlying processing asymmetry between consonants and tones in consonant-vowel syllables, whereas only Chinese listeners show such an asymmetry between vowels and tones. Their study serves as evidence that English native speakers are less sensitive to tonal differences, tending to interpret them as pragmatic, affective, or merely auditory variations. White (1981), in his comprehensive analysis of tonal perception errors, mentions the fact that English speakers will hear the Chinese high tones as stressed and the low Tone 3 as unstressed or very weakly stressed although in standard Chinese the stress on a syllable is realized by amplitude (i.e., loudness) and duration (i.e., length) rather than F0 pitch.

In accordance with the finding that Tone 2 and Tone 3 are the last tone pairs to be reliably distin-
guished in production by first language learners of standard Chinese (Li and Thompson, 1977), and more confusable than other pairings to native Chinese-speaking listeners (Chuang, Hiki, and Nimmura, 1972; Ze, 1976; referred to by Blicher et al., 1990), an earlier suggestion is found that these are also the two tones which are more difficult for American learners (Kirilloff, 1969; referred to by Li & Thompson, 1977). Again, their confusability is attributed to the similar rise in fundamental frequency during their final portions (Blicher, Diehl and Cohen, 1990). There is no unanimous agreement in the ordering of the degrees of difficulty, however. Shen (1989a) argues that, for American learners, Tones 1 and 4 are more difficult to acquire than Tones 2 and 3 because Tones 1 and 4 are less marked according to Kellerman’s markedness theory (1979, 1983), and more likely to be receptive to first language transfer than the other tones. The underlying implication in the assertion, however, clearly excludes the possibility of any kind of positive first language transfer. Still another study finds that errors in the production of isolated tones do not occur consistently with one single tone (White, 1981). A similar stand is adopted by Miracle (1989), who finds that American learners make both tone contour errors and tone register errors fairly evenly across all the tones. If there is a particularly problematic tone, he states, it is the rising tone, but the difference is not significant. Taking Shen’s findings into consideration, Miracle suggests that while Tones 1 and 4 are initially troublesome, with further learning, the difficulties even out across all the tones. In addition, Miracle also finds that, in tone combination words, significantly more errors are found in the initial syllable than in the final syllable.

So far, basically three possible sources of difficulty have come under discussion as far as the learning of standard Chinese as a second language by American English native speakers is concerned.

The first possible source is seen as linguohabitual, and is denied by some researchers. The following quotation represents such an argument:

Though subject to small variations from language to language that have no cognitive import, the range of voice pitch remains remarkably uniform across languages. This is true regardless of how many tones a language has, or whether it has any at all. In general I find it extremely difficult to distinguish utterances in certain types of tone language (e.g., Mandarin) from those in a non-tone language (e.g., English) by just examining the pitch measurement of theses utterances.... No matter how many tones a language has, the voice pitch traverses approximately the same overall range (Wang, 1967; p. 100).

Some other linguists hold a different view, however. They find that the relative pitch range of Chinese speakers is 1.5 times wider than that of English speakers (Chen, 1974; referred to by White, 1981), and that it is 25% higher and 25% lower (White, 1981). The normal pitch range of American English speakers, even when they are speaking Chinese, is significantly smaller than that of native Chinese speakers. In other words, American learners of Chinese have considerable difficulty in making use of the 1 and 5 values on the 1-5 numerical scale for the normal Chinese pitch range. Therefore, their tonal misproduction centers on errors in tonal register (Chao, 1989; Zhao, 1987; referred to by Shen, 1989a). Specifically, their pitch height of high tones is relatively lower than that of native speakers of standard Chinese (Shen, 1989a). Going a step further, Shen suggests that “what American learners learn in tonal production is not tonal shape — such as level, rising, and falling — but tonal register such as high, low and mid” (p. 40). Regrettfully, this argument of difference in the fundamental frequency (F0) range is not always supported by empirical studies. Miracle (1989) claims that the subjects in his acoustic study do not show a narrower F0 range than native Chinese speakers.

The second possible source of difficulty, as is suggested, is interlingual by nature, which means that it is caused by interference from English prosodic features, most significantly from English intonation. We may feel more sure of this argument because there is a universal agreement. It is not only because learner errors in pronouncing the Chinese tones in terms of English intonations are widely observed in great quantity, but also because the consistency and systematicity of the errors can be convincingly explained by contrastive analysis, such as the one presented by White (1981). In his comprehensive study, White makes it clear that interference may come either from learners’ habitual use of intonation in English to differentiate sentence types, or from their less self-conscious use of English intonation to express emotion and attitude. His prediction is that the second kind of interference forms much more serious transfer problems and is much more difficult for learners to overcome since they may even not be aware of it. In what Chiang (1979) calls a contrastive study, which according to him includes both contrastive analysis and error analysis, he classifies learner errors attributing them to interference from various English intonations. Although the focus in Shen’s study (1989a) is on interference from another characteristic of English suprasegmental production — pitch range, as we have reviewed before, she also asserts that American learners, in producing Chinese tones, transfer the articulatory habits of the English prosody. On the basis of the studies cited above, one thing becomes apparent: that is, phonetic transfer from English in the learning of Chinese is considered totally negative. No such thing as positive transfer is considered by researchers.

In contrast to the second possible source of difficulty, the third one is said to be intralingual, i.e.,
dealing with inherent properties of the target language. This can partially be supported by the difficulty which Chinese children appear to have for the acquisition of some of the tonal features. What is unique is the claim that the Chinese tone "may violate some universal phonetic constraint in the syllable; and, because of this, the particular syllable-tone combination is difficult for speakers of most other languages, not just English, to pronounce" (White, 1981; p. 32). Starting from this assumption, the difficulty encountered by American learners, and probably by all learners of standard Chinese as a second language, becomes a matter of self-justification. However, no substantial research seems to have been reported so far. Far from having been justified, the claim only serves as a hypothesis at least for the time being.

Despite all these possible sources of difficulty, however, there should be no doubt that for an American learning standard Chinese as a second language, the mastering of the tone is not impossible. It has been pointed out that "any physiologically normal human being has all the necessary apparatus; Chinese has distinctive tones (contours of pitch), and even a person who thinks he is tone-deaf can learn them correctly" (Hockett, 1951; p. xi).

According to Hockett, the most efficient way for the learner to improve his Chinese pronunciation is to develop at once and the same time that ability to pronounce correctly and to hear correctly. He obviously implies that the learner's performance in tonal production is complemented by his tonal perception ability. Other linguists have also touched upon the perception side of tonal performance of American English speakers. White (1981), when he compared the mechanisms of stress in the two languages, discusses the fact that English learners of Chinese will hear the high tones as stress and the low Tone 3 as unstressed or very weakly stressed, and consequently, they may be heard to mispronounce certain tones. Repp (1990), too, claims that the difference between English speakers and Chinese speakers is in their tonal perceptual processing. It appears then that any study looking into learners' tonal errors in their oral production, should also refer to their auditory performance.

Research Methods

In the literature concerning the acquisition of standard Chinese by American English speakers, research data is usually gathered among college students taking elementary Chinese courses. A problem is that the number of subjects has always been small, often no more than 10. This should not be surprising, considering the fact that Chinese instruction in this country, overwhelmingly offered at the college level, is still small in scale.

And also, the production errors used in analysis sometimes do not carry explicit origins as if they were collected by teachers in daily instruction and should be commonly understood (White, 1981). Others are typically collected by having students read a familiar lesson (Shen, 1989a) or having them read a number of specifically-designed sentences in which all the possible tone combinations available in standard Chinese in monosyllabic or disyllabic words are included (Miracle, 1989).

The usual procedure for data processing is to have subjects' voices reading the test material recorded and then judged by native speakers of standard Chinese. In order to avoid or reduce interaction of various factors, the analysis may be restricted to syllables at a certain position in the utterance, e.g., the sentence-initial syllable, or the utterance-terminal syllable (Chiang, 1979). Due to the same concern, sometimes only the word (one or two syllables) in the topic position is analyzed (Miracle, 1989). Even when each syllable in a sentence is taken into consideration, analysis seems to remain on syllable level (Shen, 1989a). The underlying assumption seems to be that, by avoiding various interactional factors, the analysis of tonal errors could be less complicated and more accurate.

Previous studies, while constructive and valuable, seem to have the following limitations: (1) No perception tasks have been used in conjunction with production tasks. (2) No natural speech is seen to have been used as data in published literature. (3) More importantly, discussion appears to be only syllabic, taking tones in a sequence as isolated tones rather than as a sequence.

Efforts to try to avoid internal factors of interaction in tonal data analysis might have presented a picture which is at least incomplete for the acquisition of tones by American learners. As we have briefly reviewed, no factors other than sandhi rules have significant effects on tonal values. Even when tonal sandhi comes into play and changes a tone by nature, it can be predicted with rules, and the affected tone can then be analyzed for what it should be. The negative transfer of the prosodic features of the learner's first language comes up at the sentence level, rather than the syllable level. Therefore, interactional factors are really unavoidable in analysis of learners' errors. For new and more valid findings, it is necessary to analyze the tones in a sequence as a sequence.

Research Hypothesis

With a different approach, some systematic sequential tonal patterns in learners' interlanguage might be identified, which would add a somehow new look to analysis of tonal errors and facilitate the acquisition of Chinese tones by American learners.

Methods

Subjects

The eight students enrolled in Chinese 211, a conversational class, in the winter semester of 1992 at Brigham Young University all participated in the study. Since the two female students turned out to
be born and raised in Hong Kong and to have
Cantonese, a tonal dialect of Chinese, as their
mother tongue, they were excluded later and only
six subjects remained in the final analysis.

The remaining six male American students,
while they varied in their college majors, had all
studied standard Chinese formally for over a year.
Three had lived in Hong Kong for ten months to
two years with different levels of competence in
Cantonese. One was born in a Chinese American
family in California, had visited Taiwan once for
three months, but did not speak much Chinese.
The fifth had lived in Taiwan for over a year and
married a Chinese lady, but still needed to take
the conversational Chinese course to improve his oral
ability. The sixth and the last subject student was a
Chinese major who had not been previously ex­
posed to a Chinese-speaking community. All the
subjects were aged between 20 and 30.

Testing Materials

The tonal perception test consisted of five parts: (1) the same monosyllable ba repeated eight
times — two times in each of the four tones — in
a random order; (2) eight monosyllables — differ­
ing in segmental structure but representing the
same tone distribution as in (1) — given in a ran­
dom order; (3) ten disyllables and longer sequences
with only the first syllable being tested — the first
syllable occurring four times in Tone 2 and two
times in every other tone — given in a random
order; (4) ten disyllables and longer sequences with
only the last syllable being tested — the last syll­
able occurring one time in Tone 4, three times in
Tone 3, and 2 times in every other tone including
the neutral tone — given in a random order; and
(5) twenty disyllables representing all the possible
two-syllable combinations (the neutral tone can
only occur in the final position) — given in a ran­
dom order.

In the tonal production test, oral utterances
were elicited by words and phrases given in
English under two topics. The first topic required
"this week, cold, windy, weather report, tomorrow,
change, warm", while the second required "yester­
day, restaurant, friend, three dishes, beer, expen­
sive, good food." Each topic required "name, date,
day, and time" at the beginning. The two topics
with requirements were written on two sheets of
paper, and the subject randomly chose one at the
test.

Procedure

The subjects were first given the tonal percep­
tion test in the classroom. The test material was
read aloud by the researcher with an interval of
2-5 seconds between items depending on the com­
plexity of the task. The subjects were asked to give
the relevant tone number for each item on a printed
form. It was only a few minutes' work.

Then the subjects were given the elicited­
speech test as part of the course requirements for a
unit of three lessons. Every subject’s voice was
recorded, transcribed, and judged respectively by two
Chinese native speakers including the researcher
himself. Both are veteran language teachers and
presently instructors of Chinese at BYU. The re­
searcher himself did the transcription and had a
detailed analysis of the data. For the purpose of
verification, the other judge was asked to go over
the tape and mark out with different signs all the
syllables she regarded as incorrect and inappro­
priate. She was also required to underline all the se­
quences she found awkward, which could be part
of a sentence or a whole sentence.

With both the perception and production data
ready, the researcher did the rest of the work. The
final analysis of the production data was based on
the tonal errors identified by both the judges.

Results and Analysis

Distribution of Errors

Perception errors made by the subjects are sum­
marized in Table 1. The left column depicts errors
at the sequence-initial position in the various tones.
For Tone 2, e.g., its /35/ value was misperceived as
/55/ in four cases, which consisted of 25% of the
total sixteen errors, and it was mistaken for /21/ in
twelve cases, which made up of 75% of the total
errors. The right column in the table is for tonal
perception errors at the sequence-final position. It
is read the same way as is the left column. Tone 0
refers to the unstressed neutral tone, which is not
possible at the sequence-initial position.

It is obvious from the tables that Tones 2 and 3
were more likely to get confused with each other,
and the same for Tones 1 and 4. The Neutral Tone
was also problematic. Although there is the regret
of not being able to decide which tone or tones
are more problematic because the tones did not
occur evenly in the test, it is still found that the
final position attracts more errors than the initial
position.

Identifying and classifying tonal errors in the
production data turned out to be much more diffi­
cult. Distribution of the 35 problematic tones
agreed upon by both judges as either incorrect or
inappropriate is tabulated in Table 2. Whether a
syllable is Initial or Final depends on the way the
subject uttered it as well as on its semantic and syn­
tactic relationship with the neighboring syllables.
Generally speaking, a syllable which occurred af­
after a pause and/or took the lead in a compound or
phrase is considered Initial. A syllable which came
up before a pause and/or positioned last in a com­
 pound or phrase is regarded as Final. For reasons of
feasibility, factors like coarticulation, which do not
affect tones in a significant manner, were ignored.
The subjects' performance on the neutral tones was
Table 1 — Distribution of Tone Perception Errors

<table>
<thead>
<tr>
<th>INITIALS</th>
<th>FINALS</th>
</tr>
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<tbody>
<tr>
<td><strong>Tone</strong></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td>1</td>
<td>/55/</td>
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<tr>
<td>2</td>
<td>/35/</td>
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<tr>
<td></td>
<td>/21/</td>
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<td>3</td>
<td>/21/</td>
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<td></td>
<td>/214/</td>
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<tr>
<td></td>
<td>/51/</td>
</tr>
</tbody>
</table>

**#** — number of occurrences of a specific error for a certain tone

**%** — percentage of that specific error out of the total number of errors for a certain tone

Table 2 — Distribution of Tone Production Errors

<table>
<thead>
<tr>
<th>INITIALS</th>
<th>FINALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tone</strong></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td>1</td>
<td>/55/</td>
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<tr>
<td>2</td>
<td>/35/</td>
</tr>
<tr>
<td>3</td>
<td>/21/</td>
</tr>
<tr>
<td>4</td>
<td>/51/</td>
</tr>
</tbody>
</table>

also ignored so that the analysis could be focused on the four basic tones.

Only twelve out of the total of thirty-five syllables in the list could be said to have been misproduced as another existing tone in standard Chinese. In Table 2, the tonal values of these twelve syllables are presented numerically between two slashes, such as /51/. The other twenty-three errors, unidentifiable as a Chinese tone, are given out with bold, italicized and underlined double letters to represent their tonal shape, such as 22. Numbers of a bigger font size are syllables either at the beginning or at the end of a sentence. These values are decided according to the pitch range of every relevant subject. With no acoustic means available, the judgment was based on the musical and linguistic training I had received and on my past language instructional experience. If such judgment could be considered valid, it could very well be argued that the overwhelming majority of the tonal errors the subjects made in the elicited speech are level tones which do not exist in standard Chinese at all.

Examining these two tables, there seems to be no correlation between the distribution of tonal production errors and that of tonal perception errors. For example, in Table 2 we find Initial Tone 1 errors but in Table 1 the counterpart area is left blank. On the other hand, in Table 1 Final Tone 2 errors abound while in Table 2 we fail to find any. Also, Table 2 no longer shows the confusion between Tone 2 and Tone 3, which is so obvious in Table 1.

**Two Sequential Error Patterns**

In the production data, at least two sequential tonal patterns were found among the subjects. The first one which is observed in the elicited speeches
of five of the six subjects can be called a “55-33-22-53” pattern. In the following examples, sequential numbers between slashes represent correct tone values.

In Diagram 1, unmarked syllables all have level tones, underlined syllables share the same level value, italicized syllables are contoured tones. This is probably an ideal pattern to be found in a comparative phonological study. We can easily match it to English sequences such as “he is not here” and “we have many books”.

Another possible pattern is “high—low—high—low—(high)”. The two words “high” and “low” are used here in a figurative sense referring to the relative pitch heights of neighboring tones in a sequence. The “high” does not necessarily mean an absolute high pitch register, and the same is for

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Diagram 2 — Sequential Tonal Error Pattern Two

<table>
<thead>
<tr>
<th>Sub. 3</th>
<th>33</th>
<th>22</th>
<th>33</th>
<th>22</th>
<th>33</th>
</tr>
</thead>
<tbody>
<tr>
<td>ni</td>
<td>yu</td>
<td>mei</td>
<td>kou</td>
<td>/35-21-35-21-51/</td>
<td>(have seen)</td>
</tr>
<tr>
<td>Sub. 2</td>
<td>44</td>
<td>22</td>
<td>55</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>bu</td>
<td>shi</td>
<td>heng</td>
<td></td>
<td>/35-51-21-51/</td>
<td>(isn’t very hot)</td>
</tr>
<tr>
<td>55</td>
<td>33</td>
<td>55</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bu</td>
<td>shi</td>
<td>tai</td>
<td>leng</td>
<td>/35-51-214/</td>
<td>(isn’t too cold)</td>
</tr>
</tbody>
</table>

“low”. The following three examples were taken from the utterances of two subjects. The sequential numbers between slashes represent the correct tonal values.

All the syllables in this second pattern carry level tones. Here, again, influence from the familiar English rhythm can immediately be felt.

Discussion

In the previous section, negative transfer from the English intonation to American learners' Chinese tones is seen clearly first in Table 2 and then in the two sequential patterns. Table 2 convincingly highlights the fact that American learners' tonal errors are not caused by randomly replacing one tone with another. Sixty-six percent of the errors listed in the table are simply not Chinese tones at all. The great number of alien level tones might have been caused by the interaction of English prosodic features. Interference from the English intonation is more evident in the tendency that at the beginning of a sentence the low Tone 3 may get a higher fundamental frequency to resemble Tone 1 while at the end of a sentence the high level Tone 1 more or less attains the feature of the falling tone.

All the subjects seem to have demonstrated a 1-5 pitch range, i.e., everyone at one time or another did reach the two extremes in the scale which is used to depict the normal pitch range of Chinese native speakers. Their common erroneous tonal behavior can be generalized as shown in Table 3, where proper tone values are represented numerically between slashes such as /214/ while their deviant forms are seen as bold, italicized and underlined numbers such as 23.

Apparently, the subjects' performance was restricted by such tendencies for most of the time to a narrower pitch range of 2-4 and opportunities to extend the F0 to 1 or 5 on the scale were greatly reduced. A characteristic of this nature, unique for American learners speaking English as their mother tongue, could not possibly be matched in any way in a perception task in which a speaker of standard Chinese conducts the utterances. On the other hand, even though a learner can perceive the tones well, he may not be able to produce them correctly especially in a speech when he has little chance to attend to his own utterances and thus may unconsciously draw more on his native language. Considering that alien tones comprised the majority of the subjects' errors, it is not surprising that no correlation was found between Table 1 and Table 2.

When all the deviation forms from each and every tone in the data were listed out, there was a temptation to suggest a hierarchy of difficulty on the basis of the literature. The study could not have
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identified a particularly problematic tone or tones. However, it still seems that the findings of tonal error forms could support and help explain the following acquisition order suggested in the literature: Tone 1 (/55/) — Tone 4 (/51/) — Tone 2 (/35/) — Tone 3 (/214/). Based on the assumptions that in tonal development level tones are easier than contoured tones, mid register is easier than high and low registers and falling contour is easier than rising contours, Table 4 shows how all the deviant forms found in the study could possibly fit in the suggested order of development. Here, all the number combinations that are bold, italicized and underlined stand for an incorrect or inappropriate value of a specific tone. Every column shows what deviations the learners might undergo before they acquire the proper value represented numerically between slashes. The arrows help to explain how the total developmental process is realized.

Table 4 — Tonal Deviations in a Suggested Order of Development

<table>
<thead>
<tr>
<th>Tones</th>
<th>1</th>
<th>4</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>/55</td>
<td>/51</td>
<td>/35</td>
<td>/214</td>
</tr>
<tr>
<td>Development</td>
<td>22/22</td>
<td>/22/33</td>
<td>/22/33</td>
<td>22</td>
</tr>
</tbody>
</table>

*sequence-final

What is listed in Table 4 may further be interpreted into a hierarchy for Chinese tone acquisition, which is depicted in Table 5.

Table 5 — Hierarchy for Chinese Tone Acquisition

<table>
<thead>
<tr>
<th>Tones</th>
<th>1</th>
<th>4</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>low level</td>
<td>half falling</td>
<td>half rising</td>
<td>half falling-rising</td>
</tr>
<tr>
<td>Development</td>
<td>high level</td>
<td>full falling</td>
<td>full rising</td>
<td>full falling-rising</td>
</tr>
</tbody>
</table>

*sequence-final

In Table 5, while “full” means the realization of the full tonal value, “half” does not necessarily mean half of the value. Rather, it implies the non-realization of the full tonal value. Here, again, the columns show how every tone is acquired after a possible problematic stage, and the rows from top to bottom reflect degrees of increasing difficulty in articulation. The columns and rows join together to provide an explanation for the acquisition order of Chinese tones.

It should be noted, however, what is suggested by Table 4 and Table 5 is merely a hypothesis to be verified in future studies. It is not my intention to hold that every American learner of Chinese, in their actual learning practice, would have to go through all the deviant forms in a predictable order to reach tonal perfection. On the contrary, for reasons such as learner difference, instructional difference and environmental difference, things like a predictable acquisition order amenable to all the learners will not exist. But a hypothetical hierarchy would at least help us to explain the nature of tonal errors and the order of tonal acquisition as a general tendency.

Looking again at Table 3, it is obvious that contour tones are rarely distorted so much as to go to the opposite direction. The two cases found in the study might be accounted for as performance errors or individual style. If these errors are disregarded, the general trend stands further out: the majority of the errors appear to be either incorrect and alien level tones or improper contour tones which do not realize their full value. This adds support to the assertion in the literature that the primary cue for tonal distinctions is register (i.e., pitch height) rather than contour (i.e., tonal shape). This also implies that for American learners to have better Chinese tones the fundamental task is not to teach them how to produce these tones, nor is it to warn them of the possibility of mispronouncing a specific isolated tone as another specific isolated tone under certain conditions. Instead, a teacher’s primary responsibility is to present the real, complete picture of the learners’ tonal performance in sequences and help them to consciously get rid of the interference from their mother tongue. It would be of little value to work on isolated tones in the classroom.

A large number of alien level tones and non-fully-realized contour tones in the subjects’ production were neglected by the other judge. The fact seems to imply that, as long as a sequence appears as a number of level tones and non-fully-presented contour tones, even though produced in a narrowed pitch range of 2-4, it would still have a good chance to be recognized and accepted by native speakers. This may also suggest that the poor Chinese tonal performance of American learners is not simply due to linguo-habitual factors, nor simply due to interlanguage or intralanguage interference. The real problem may lie in socio-lingual fossilization out of lack of necessity and motivation to seek improvement! Now that they can already communicate, why must they have perfect tones!

Suggestions for Further Research

Although the study is not without findings, it has great limitations. First of all, the data base is far too small as in other studies. A much larger group of subjects is needed in further studies. Secondly, the subjects, mostly having had a long-term exposure to a native language environment, may not be typical American learners of Chinese. Learners with basically only classroom learning experience may
be needed as subjects, and preferably, they would be learners in several different levels. Thirdly, the judgment for errors in the study was overly subjective, largely depending on personal intuition. For more accurate and reliable assessment, acoustic approaches should be adopted. Fourthly, the definitions for "sequence" and for "initial" or "final" need to be elaborated on a solid theoretical basis. Fifthly, to generate more scientific and comprehensive outcomes, sophisticated statistical techniques are needed in data processing.

Even though there are serious limitations on this particular study, it has reviewed many issues that could be followed and should be followed in future studies. It can serve as an important step leading to a better understanding of Chinese tonal acquisition by American learners.

Conclusion

To collect data from learner's elicited speeches and analyze their tonal errors as sequences seems to be an effective way to reveal the genuine and complete picture of the acquisition of Chinese tones by American native speakers of English. The study has tentatively identified two tonal sequential patterns in American learners' interlanguage, which are characteristic of alien level tones and non-fully-realized contour tones. Both occur as a result of interference from the English prosodic features. Learners' oral production does not seem to correlate with their performance in tonal perception tasks, possibly because production errors result in tonal utterances that are largely incomparable with the standard Chinese tones, and therefore, the perception test does not relate to them at all.

Bibliography


