Proceedings of the International Symposium on the Acquisition of Second Language Speech
Concordia Working Papers in Applied Linguistics, 5, 2014 © 2014 COPAL

An OT Account of the Second Language Acquisition of Mandarin Tone Pairs

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Abstract

This study examines the second language (L2) productions of Mandarin Chinese tone pairs made by learners with L1 backgrounds of American English, Tokyo Japanese, and Seoul Korean. Research data show that the Tonal Markedness Scale (TMS) and Obligatory Contour Principle (OCP) constrain L2 tone acquisition. The systematic error and substitution patterns (i.e., more T1-T1 productions than T4-T4, and in turn more than T2-T2) found in the word-level tonal productions are analyzed within the framework of Optimality Theory. The patterns are attributed to either a case of "emergence of the unmarked" due to interacting effects of the TMS and the OCP, or to local conjunction of the TMS.

The pitch of the voice plays a different role in tonal and non-tonal languages. While pitch patterns are specified mainly at the lexical level in tonal languages (such as Mandarin), in intonation languages, pitch gives meaning at post-lexical (phrase and sentence) levels, independent of the words' meanings (Gussenhoven, 2004). The more or less complicated tonal specifications in different types of languages pose difficulty in the second language acquisition (SLA) of Mandarin tones. This study

examines Mandarin tone acquisition by learners with L1 backgrounds of American English, Tokyo Japanese and Seoul Korean (henceforth English, Japanese and Korean). The present study examines the disyllabic tonal productions made by these learners and pays particular attention to the error and substitution patterns of tone pairs.

The Full Transfer/ Full Access model of SLA proposes that L1 and L2 acquisition differ with respect to starting point, but are similar with respect to Universal Grammar (UG) involvement (Schwartz & Sprouse, 1996). "Full Access" means that properties of UG not exemplified in the L1 are assumed still to be available to constrain interlanguage grammars. That is, when the L1 grammar is unable to accommodate the L2 input, the learner resorts to UG options. Following this model, the present study hypothesizes that some universal phonological constraints, such as the Tonal Markedness Scale (TMS) and Obligatory Contour Principle (OCP), constraint the SLA of Mandarin tones, although they may not have strong effects in L1s and L2. The present study tests for the evidence of TMS and OCP effects through a phonological experiment and analyze the data within the framework of Optimality Theory (OT, Prince and Smolensky, 1993; McCarthy and Prince, 1993).

The majority of SLA studies within OT focus on L2 syllable structures (e.g., Hancin-Bhatt & Bhatt, 1997, 2000; Broselow et al., 1998; Hayes, 1999). Broselow et al. (1998) introduce the notion of "the emergence of the unmarked" (TETU, McCarthy and Prince 1994) to the study of L2 syllable structures, but the situation of TETU in SLA and L2 learners' access to UG is still under investigation in the study of L2 phonology. This study extends the research of TETU in SLA to the topics of lexical tone acquisition and explores the tonal interlanguage properties. It is found that while some new tone structures are equally "bad" (not allowed) in L1s, the L2 tonal data demonstrate systematic error and substitution patterns reflecting the effects of universal phonological constraints outside the scope of L1 transfer. The asymmetry of high falling tone pairs (T4-T4) and rising tone pairs (T2-T2) found in this study provide evidence for the emergence of interacting effects of the TMS and the OCP.

BACKGROUND AND PREDICTIONS

A Brief Introduction of Prosodic Structures of the L2 and L1s

In Mandarin, morphemes are almost exclusively monosyllabic, and the pitch contour over a syllable can distinguish word meaning. There are

four types of tones on full syllables, namely, Tone 1 (T1, high level), Tone 2 (T2, rising), Tone 3 (T3, low) and Tone 4 (T4, falling). Following Yip (2002), this study assumes that the default form of Tone 3 is a low tone.[1] In disyllabic words, all tone types can be freely combined except for the T3-T3 sequence because of Tone 3 Sandhi. The Tone 3 sandhi states that when a T3 is followed by another T3, it will be changed into a rising tone.[2]

In English, the high tones and low tones (H and L) are loosely associated to tone-bearing units (TBU). Following Gussenhoven (2004), we assume English has both level tones and contour tone types, which means the HL (falling) or LH (rising) tones associated to one TBU can be found in English. The tone sequences H-H and L-L are not uncommon in English intonation, which means two adjacent TBUs bearing two identical H tones or L tones are allowed. However, two identical contour tones in a row within a word, such as rising-rising (LH-LH) or falling-falling (HL-HL), where the two identical contour tones are associated with adjacent TBUs, are rare in English intonation. English is known as a "stress-accent language" according to the characteristics of word prosody, and there are two kinds of stress patterns: weak-strong and strong-weak (Pierrehumbert, 1980). While the tones and TBUs are loosely associated in English, the correspondence between tones and TBUs is more stable in Japanese and Korean (Zhang, 2013). Following Venditti (2005) and Jun (1996, 2005), we assume the basic tone types in Japanese and Korean are H and L. Japanese is taken as a lexical pitch-accent language. A typical lexical pitch accent pattern in Japanese is described as "a drop from an H tone to an L," and the Accentual Phrase is tonally defined by a rise to a high tone around the second mora, and subsequent gradual fall to a low tone at the right edge of the phrase. Jun (1996, 2005) suggest that the F0 peaks and valleys of Korean intonation do not link to any specific syllable of a word, but instead to a certain location in the phrase, and Korean is thus taken as an non-stress non-pitch-accent language. The typical tonal pattern of the Korean Accentual Phrase is L-H-L-H or H-H-L-H, where the initial tone is determined by the laryngeal feature of the phrase-initial segment. In both Japanese and Korean, tone strings of H-H and L-L are

[1] Traditionally low dipping tone [214] (Full-T3) is taken as the default form of Tone 3, and the low tone [21] is an allophone. However, low tone [21]'s distribution is much wider than low dipping tone [214]. Since the default tone of Tone 3 is not the core issue in this study, we simply assume the low tone as the default form of Tone 3 here.

[2] This study calls this rising tone which results from the Sandhi T5 and the behavior of T5 was examined separately from T2.

common (Kubozono, 2011; Jun, 1996, 2005). Similar to English, two identical contour tones in a row are uncommon in Japanese and Korean.

To summarize, the target language, Mandarin, allows both level tones (high and low) and contour tones (rising and falling). In addition, the tone pairs, T1-T1 (H-H), T2-T2 (LH-LH) and T4-T4 (HL-HL), are equally good in the target language. In terms of basic tone types in the L1s, English allows both level and contour tones, but the basic tone types in Japanese and Korean are level tones, namely, H and L. As for tone strings in the intonation systems of the L1s, none of the L1s allow contour tone pairs, i.e., rising-rising or falling-falling sequences on adjacent TBUs. In other words, for all L1 speakers, contour tone pairs are new linguistic structures, and they are expected to be equally difficult for these L1 speakers. However, we predict that the interlanguage tonal grammars may demonstrate some effects of phonological universals, namely, the Tonal Markedness Scale (TMS) and Obligatory Contour Principle (OCP) because we believe SLA is constrained by UG.

Tonal Markedness Scale (TMS) and Obligatory Contour Principle (OCP)

The TMS is a universal and phonetically-grounded constraint scale usually presented as *Rising>>*Falling>>*Level (Ohala, 1978; Hyman & VanBik, 2004) which indicates rising tones are more complex (or, harder to produce) than falling tones, which in turn are more complex than level tones. Clearly, contour tones have greater complexity than level tones because contour tones contain more pitch targets within a TBU than level tones. According to Ohala (1978), falling tones are both easier to produce and perceive than rising tones. The tone complexity scale correctly predicts the order in which tones are acquired by Mandarin-speaking children (Li and Thompson 1977; Zhu and Dodd 2000). In this SLA study of Mandarin tones, we predict that the scale of *T2>>*T4>>*T1 is also at work. Since Tone 3 Sandhi occurs in connected speech, Tone 3 is not included in the scale. This prediction of *T2>>*T4>>*T1 means that although both T2 and T4 are allowed in English and not allowed in Japanese and Korean, the error rate of T2 would be significantly higher than T4, and in turn higher than T1 in the L2 tonal productions.

The OCP (Leben, 1973; Goldsmith, 1976; McCarthy, 1986) has played an important role in formal phonology and has been used to explain various dissimilation effects. The OCP states that "adjacent identical autosegments are prohibited" (McCarthy, 1986). Following Yip (2002), the OCP in this

study is referred to as OCP (whole tone), meaning two identical whole tones are prohibited, where the whole tone refers to an entire tone (either level or contour) borne by a TBU. It is supposed to govern tone behaviors universally. A strong case of the application of the OCP in the native Mandarin tonal system is the T3 Sandhi process wherein a T3 changes to T2 if placed before another T3. If the OCP is working in the interlanguage tonal grammars, the learners would disfavor all tone pairs, i.e., identical tone sequences, in favor of non-identical tone combinations. This may be manifested in both error and substitution patterns, i.e., tone pairs would have significantly higher error rates and lower substitution rates than expected in the L2 tonal productions.

This study hypothesizes that the L2 tonal productions are constrained by TMS and OCP and expects some similarities in the interlanguages of English, Japanese and Korean speakers. We may not see strong effects of these constraints in native L1s and L2, but we expect SLA error and substitution patterns, as part of the innovative interlanguage grammars, would demonstrate the effects of these constraints more clearly.

METHOD

In order to test for the evidence of the operative TMS and OCP in SLA, a phonological experiment was conducted. The test materials for the reading task are disyllabic words bearing 16 combinations of the four lexical tones. Two words (consisting of different morphemes) for each tone combination type are used, resulting in 32 distinct words. The 32 words are repeated once, resulting in 64 tokens collected per speaker per trial. The 64 test words are embedded in sentences. In order to avoid anticipatory and carry-over effects by neighboring tones (Xu, 1997), the tokens are embedded in sentences where the preceding and following morphemes are both bearing neutral tones.[3] Pinyin and English translation are provided in the reading list. The carrier sentence structure is displayed below.

Chinese character:	我 觉得	X X 的	东 西 很 好.
Pinyin:	Wǒ juéde	X X de	dōngxi hěn hǎo.

[3] Neutral tones also carry a pitch register which may be high or low depending on the preceding tones. However, all tokens in this study were embedded in the same sentence and the preceding tone to the first *de* is consistently Tone 2 (borne by *jue*). Thus we assume the neutral tones affect all of the tokens in the same way.

Gloss: I feel X X(particle) things very good
"I feel XX things are very good."

These 16 free combinations of the four tones are equally proportioned in the stimuli. We expect some tone types and tone combinations to be difficult to produce, while others may be easier to produce. So the occurrences of these 16 combinations may different from one another in actual L2 tonal productions.

Twenty English-speaking learners, twenty Japanese-speaking learners and twenty Korean-speaking learners were recruited for the experiment. All learners had been learning Mandarin for at least 6 months, but no more than 18 months, and Mandarin was the only tonal language any learner had studied. The learners' tonal productions were recorded by a microphone-headset from Radio Shack and a ThinkPad laptop computer with Windows XP. Version 5.2.17 of Praat (Boersma & Weenink, 2011) was used. Each learner produced 128 syllables, and the correctness of all L2 tonal productions was judged within sentences. Three native Mandarin speakers judged whether or not these test disyllabic words were the same as the target tone productions, and marked these as "correct" or "incorrect".[4] If the L2 tonal productions were incorrect the error tones (or substitute tones) substituted for the target tones were transcribed. To guarantee the reliability of the correctness judgments and transcriptions of incorrect tonal productions, both intra- and inter-rater agreement was calculated. The hypotheses regarding the universal constraints of TMS and OCP were tested using the SAS statistical package. The significance criterion adopted for declaring a significant difference was $p<.05$.

[4] The three judges have received training in linguistics, and have taught Mandarin (experience of judging non-native tone productions) as a L2 for 15, 4 and 19 years respectively. They were consistent in their judgments of some acoustically similar tones, such as T2 and low dipping tone (Full-T3). The acoustic measurements of the L2 productions of T2 and low dipping tones as judged by them conform to the acoustic differences described in previous studies (Jongman et al., 2006). For example, the turning points are earlier in the T2 productions than they are Full-T3; the $\Delta F0$ value is smaller and the duration is shorter in T2 than in those of Full-T3 productions.

EXPERIMENT RESULTS

TMS Test

The error rates and substitution rates for individual tones were examined. The error rates for each tone in the general data set ranged from 21.72% (for T1) to 56.61% (for T2). The rankings of the error rates for each tone within each L1 data set were very similar. Within each L1 data set, the error rate of T2 ranked the highest, all at or above 55%, with the T3 as the second highest, the T4 the third highest, and with T1 ranked the lowest. Figure 1 shows the error rates of each tone in the three L1 groups.

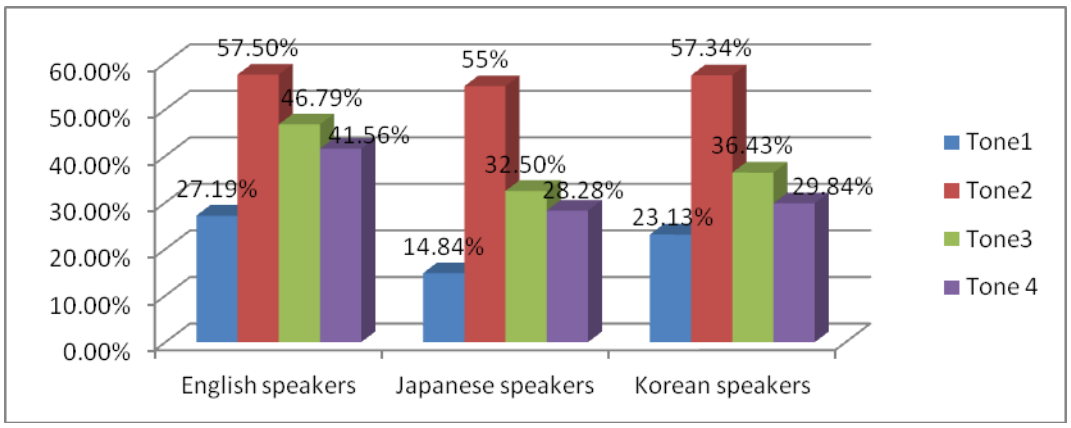

Figure 1. Error rates of each tone in the three L1 groups.

It is found that TMS is relevant in all L1 data sets, except for T1 vs. T4 in Korean speakers' productions, by comparing the error rates of T1, T2 and T4. The error rates of T2 are significantly higher than T4 throughout all L1 data sets. The error rates of T4 are higher than T1 in all data sets, but the case is supported by statistical analysis only in English and Japanese speakers' data. A statistical test of no association between tone and response using the Rao-Scott Chi-Square test was conducted to account for multiple observations within subjects. The final results of the statistical analysis, i.e. P values, are presented in Table 1.

Table 1. Rao-Scott Chi-Square Test Results for TMS Hypothesis

	Overall	English	Korean	Japanese
T4 vs. T1	<.0001	.0037	. 2780 (not significant)	.0004
T2 vs. T4	<.0001	.0044	<.0001	<.0001

The presence of TMS in L2 productions is confirmed by observing substitution patterns. The substitution rates of individual tones are negatively correlated to the error rates. It is evident in the overall data set and each L1 subset that the most often used substitute tone is T3, the second most used is T1, the third is T4, and the least frequently used substitute tone is T2. The substitution patterns in both the general data set and each L1 data set fully support the TMS constraint. To summarize, TMS is working in the present L2 data set.

OCP Test

The OCP Test focuses on the actual L2 tonal productions. The goal is to find out if the proportions of tone pairs match those of the stimuli in each sub-data set. The 16 free tone combinations of T1, T2, T3 and T4 are evenly proportioned in the stimuli, and the tone pairs (T1-T1, T2-T2, T4-T4) as a whole constitute 3 out of 16 portions in total.[5] Therefore, without OCP effects, we expect that the tone pair productions would also take 3/16 (about 20%) of the total productions in each data set. The test compares the observed tone pair percentages in the production with the expected percentages in the sub-data sets.

The tone pair occurrence rates were compared with their expected values using the binomial test. The tone pairs as a whole consist of 12.72% in English speakers' L2 tonal productions, which is significantly lower than expected ($P<.0001$); the tone pairs consist of 13.28% of the Japanese speakers' data set, which is significantly lower than expected ($P<.0001$). Korean speakers' tone pairs take 16.48%, the highest among the three groups ($P=0.0008$). Based on the statistical test results regarding the proportions of tone pairs in general, OCP effects are obvious in all three subsets. The Korean speakers produced the biggest number of tone pairs. This may be due to the L1 transfer of typical H-H pitch pattern (like T1-T1 sequence) from Korean.

We go a step further and look into the breakdowns of each tone pair and find that the individual tone pair proportions vary considerably, and the tone pair breakdowns demonstrate similar patterns across the three L1s (see Figure 2). All of them have T1-T1 (H-H) as the highest proportion, then T4-T4 (HL-HL), T2-T2 (LH-LH) and the T3-T3 (L-L) as the smallest proportion.

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[5] T3-T3 should be produced into T5-T3 due to Tone 3 Sandhi.

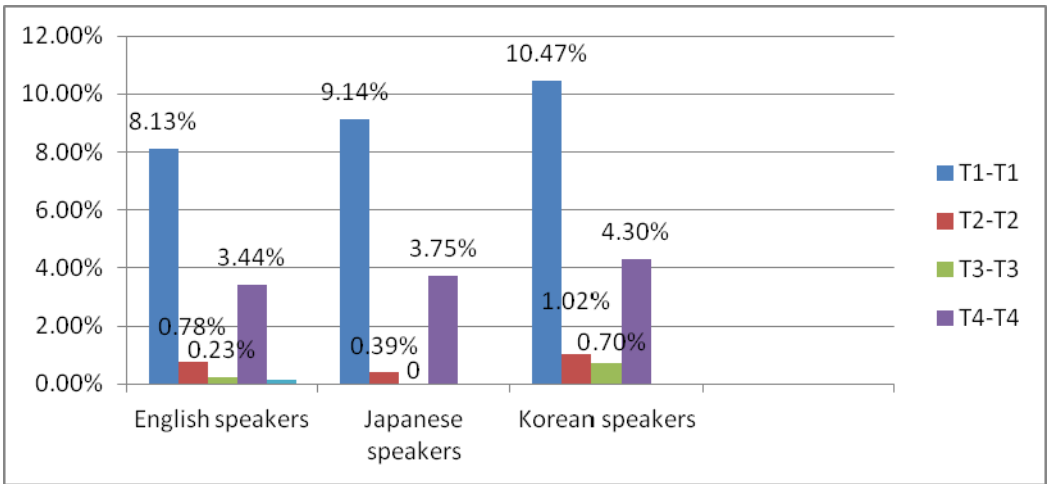

Figure 2. The occurrences of tone pairs in L2 productions for OCP test.

We also compare the individual tone pair rates with their expected values (1/16) using the binominal test. It is found that the occurrence rates of T1-T1 across all L1 data sets are significantly higher than the expected individual proportion, whereas the T2-T2 and T4-T4 rates are significantly lower than the expected proportion. The high occurrence of T1-T1 is an anti-OCP effect. It might be attributed to both L1 transfer and the universally preferred T1, an unmarked tone. H-H is a typical L1 tone sequence in Korean and Japanese, and H-H is allowed in English. There might be a transfer of this tone sequence into the L2 production. This also explains why the T1-T1 rates are higher in the Japanese and Korean speakers' data sets than in the English speakers' data, as T1-T1 is not a typical tone pattern in native English. In the data set, we also found many more T4-T4 than T2-T2, a pattern which is motivated by neither the L1 grammars nor the L2 grammar. We account for this pattern in next section.

The L2 Tone Production of Tone Pairs

Based on our observations of occurrence rates, we found that tone pairs (identical tone combination) are more disfavored by L2 learners than non-identical tone combinations. However, these tone pairs (T1-T1, T4-T4 and T2-T2) are found to be "disfavored" by L2 learners to varying degrees. We also noticed the accuracy rates of tone pairs (as target tone sequences) demonstrate the same tendency. As shown in Table 2, the accuracy of T1-T1 (high level tone pairs) is always significantly greater than T4-T4 (falling

tone pairs), and T4-T4 is more accurate than T2-T2 (rising tone pairs) across the three sub-datasets.

Table 2. Accuracy Rates of Target Tone Pairs

Target / L1	T1-T1	T4-T4	T2-T2
English speakers	56.25%	37.5%	12.5%
Japanese speakers	67.5%	52.5%	6.25%
Korean speakers	63.75%	48.75%	15%

This tendency appears to be independent of L1s and L2 to some degree. In native English, Japanese, and Korean, both two rising tones or two falling tones on adjacent TBUs are unusual. That is, T4-T4 and T2-T2 are equally "bad" in the L1s. The target language Mandarin, on the other hand, allows T4-T4 and T2-T2 so that they are equally "good" in L2. There is no reason for L2 learners to favor T4-T4 over T2-T2 if we only examine the prosodic structures of L1s and L2. Considering the tone types in the tone pair patterns in question, it seems the TMS, working with the OCP, plays a role here. In this section, I argue that this is a case of the "Emergence of Unmarked" reflecting a conjoint effect of the OCP and the TMS, or, a strengthened TMS effect by a process of Local Conjunction. To account for the Markedness effects residing in the OCP, a group of sub-OCP constraints is proposed. Below I provide the definitions of OCP constraints involved in the Mandarin tone acquisition:

- OCP (contour): no two contour tones (e.g., T2-T2, T4-T4) at adjacent TBUs.
- OCP (H): no two High tones (such as T1-T1) at adjacent TBUs.
- OCP (L): no two Low tones (such as T3-T3) at adjacent TBUs.
- OCP (LH): no two rising tones (such as T2-T2) at adjacent TBUs.

All these OCP constraints, except OCP (L), are ranked at the bottom of the Mandarin tonal grammar because all tone pairs except T3 pairs are allowed in Mandarin. Here we take the Korean speakers' case as an example L1. Korean allows H-H tone sequences, and the OCP (H) constraint is ranked at the bottom of the L1 grammar ranking. Because OCP (H) is also at the bottom of the ranking of L2 grammar, no re-ranking is required for OCP (H) during the course of SLA of Mandarin, which means OCP (H) may also rank high in the interlanguage grammar. So, it is not surprising that L2 learners perform T1-T1 very well and the

proportion of T1-T1 in L2 tonal production is high. So far we have accounted for what drives the highest frequency of T1-T1, and we are in a position to account for the asymmetry between T4-T4 and T2-T2.

Both LH-LH and HL-HL tone strings are new for L2 learners. This means the general OCP constraint, OCP (contour), is ranked high at the initial stage of SLA. The sub-OCP constraint OCP (LH), is actually masked by the general OCP (contour) because rising is a type of contour tone and is inactive in the native L1 ranking. OCP (LH) is also inactive in the L2 grammar because all contour pairs are allowed in Mandarin, and the general OCP (contour) is ranked low. The rankings of the OCP constraints in L1 and L2 grammars are shown below. OCP (LH) is dimmed in gray:

L1 (Korean), the initial state:
OCP (Contour), OCP (LH)>> Faithfulness>> OCP (H), OCP(L)

L2 (Mandarin), the target state:
OCP (L)>>Faithfulness >> OCP (contour), OCP (LH), OCP(H)

The grammar rankings above suggest that OCP (LH) and OCP (contour) are ranked high in L1, but should demote to lower ranks than Faithfulness constraints in L2. HL-HL and LH- LH are assumed to be equally difficult for L2 learners to acquire. However, according to the research data, it seems the L2 learners acquire HL-HL sequence earlier than LH-LH sequence since the error rates of T4-T4 are much lower than T2-T2 and the substitution rate of T4-T4 is much higher than T2-T2. Reflected in the SLA re-ranking, the general OCP (contour) is demoted to a low rank earlier than the specific OCP (LH), and the interlanguage may have the following ranking, where OCP (contour) moved to the bottom, but left OCP (LH) behind at the top:

Interlanguage grammar:
OCP (LH), OCP (L)>> Faithfulness>> OCP (contour), OCP (H)

This case of "general constraint demoted earlier than specific constraint" is very like the case devoicing in the L2 acquisition of syllable structures discussed in Broselow et al., (1998). Following this ranking, the H-H and HL-HL sequences are allowed, but LH-LH is not allowed at some specific point during the course of SLA, thus leading to higher frequency of HL-HL than LH-LH in L2 tonal productions. In this case, the demotion of a general OCP constraint activates a specific OCP constraint,

and some relatively unmarked structures are picked as the surface forms. Alternatively, the effects of the specific OCP (LH) are originally masked by other general OCP (contour) in the L1 grammar but become visible during the course of SLA. This represents the situation of the TETU. Table 3 sketches the grammar rankings of L1, interlanguage, and L2, as well as the consequences in the actual productions, with some example input tone pairs and output tone sequences (typical dissimilated tone sequences are cited from the most frequently produced tone sequences from the data).

Table 3. The Case of "Emergence of the Unmarked" Interacting TMS and OCP

L1 grammar:		
Input	OCP (contour), OCP (LH) >>Faith>>OCP(H)	Output
T1-T1/ T4-T4/ T2-T2/	→	**T1-T1**/ T3-T4/ T2-T3/
Interlanguage grammar		
Input	**OCP (LH)**>>Faith>>OCP (contour), OCP (H)	Output
T1-T1/ T4-T4/ T2-T2/	→	**T1-T1**/ **T4-T4**/ T2-T3/
L2 (Mandarin) grammar		
Input	Faith>>OCP (LH), OCP (contour), OCP (H)	Output
T1-T1/ T4-T4/ T2-T2/	→	**T1-T1**/ **T4-T4**/ **T2-T2**

In Table 3, we see the same group of input tone pairs surfacing with different outputs in L1, interlanguage, and L2. Only T1-T1 survived in L1 because OCP (contour) is at the top of the ranking, and no contour tone pairs are allowed in the output. In an intermediate stage of the SLA of Mandarin tones, T1-T1 and T4-T4 are in the outputs, because OCP (contour) was demoted, but OCP (LH) is still at the top of the ranking, which means LH-LH is not allowed in the L2 tonal productions. This leads to the asymmetry of rising tone pair and falling tone pair productions we discussed at the beginning of this section. In the L2 grammar and the grammar for L2 true productions, all contour tone pairs survived. This means learners who become proficient in Mandarin tones eventually will demote OCP (LH) below the Faithfulness constraints, thus allowing the full range of tone pairs in Mandarin. According to the data, very few subjects consistently made all tone pairs. This is very likely because of the instability of the constraint rankings in the developing interlanguage grammar.

The asymmetry in tone pairs in the three groups of leaners indicates a conjoined effect of OCP and TMS. The OCP constraints actually say nothing about the markedness of the elements involved. On the other hand, the TMS is only concerned with individual tone complexity and says nothing about tone pairs. They are two independent constraints, but it seems they jointly shape some properties of the interlanguage grammar with regards to tone pairs. This kind of situation can be modeled in terms of "Local Conjunction" of a constraint with itself, or, "self-conjunction" as in Smolensky (1993) (Alderete, 1997, Ito & Mester, 1996). Following Alderete (1997), OCP effects, broadly understood to encompass segmental processes of dissimilation and restrictions on segment co-occurrence, are the result of Markedness constraints strengthened by the operation of Local Conjunction. So, in this context of SLA of Mandarin tone pairs, I propose to deal with the TMS in the co-occurrence restrictions by extending the original TMS ranking to the locally-conjoined tone Markedness constraints, as shown below.

(*Rising) ^{2} >> (*Falling) ^{2} >> (*Level) ^{2}

This scale states that the local self-conjunction of rising tones is more disfavored than the local self-conjunction of falling tones, and in turn than the local conjunction of level tones. By doing local conjunction of the tone markedness scale, the greater number of T1-T1 sequences found than T4-T4 sequences, and the greater number of T4-T4 sequences found than T2-T2 sequences, can be explained by one general principle: two rising tones in a row are the hardest to produce, or most marked, two falling tones in a row are the second hardest, and two level tones in a row are the easiest. This markedness effect is not active in both the L1s and in the L2, but it emerges in the SLA data as a case of TETU and shapes the interlanguage tonal grammars.

CONCLUSION

Phonological universals are a major factor in L2 phonology, and an important corollary of universals is Markedness. Markedness concerns universal preferences in language for certain forms or features, and it is widely accepted that unmarked forms have a wider distribution, both within a given language and across languages. Markedness effects have long been recognized as playing a role in second language phonology (e.g., Eckman, 1977; 2008; Broselow et al., 1998; among others). The current

study extends the discussion of markedness effects to the topics of suprasegmental features in SLA. We examine the acquisition of new tonal structures by non-tonal language speakers, and the L2 tonal production data of tone pairs demonstrate interacting effects of the Tonal Markedness Scale and the Obligatory Contour Principle. This effect is also modeled as a strengthened effect of the Tonal Markedness Scale by a process of Local Conjunction (Smolensky, 1993).

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