International teaching assistants' production of English focus marking

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International teaching assistants' production of English focus marking

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This study investigates the realization of English focus by 18 Mandarin-speaking International Teaching Assistants (ITAs). Participants read passages containing contrastive information (e.g., *The price of a train ticket is twenty dollars, while the price of a bus ticket is eleven dollars*), and then responded to the experimenter's questions (*Is the price of a bus ticket twenty dollars*?). ITAs were tested within a month of their arrival in the US, and again at the end of their first semester. Overall, the productions of ITAs at both points in time were judged as less natural by native English listeners than the productions of the native speakers of English, though the naturalness of some ITA productions improved at the second sampling. Acoustic analyses of the ITA productions and comparison with the productions of 18 native English speakers revealed a good deal of interspeaker variability in the ITA productions, with several different patterns associated with the 'unnatural' productions: (a) failure to accent the focused element; (b) failure to deaccent the word following the focused element; and (c) failure to align the accent with the stressed syllable of the focused word, with the entire focused word spoken on high pitch.

1. INTRODUCTION

English is generally described as a stress-timed language in which regular rhythmical beats of utterances coincide with stressed syllables of words carrying prominence in a sentence. Among the prominent syllables, the most prominent word receives what is called *sentence stress*. In general, the primary sentence stress falls on the rightmost content word (words of open categories such as nouns, verbs, and adjectives) unless another word in the sentence requires focus for pragmatic reasons, such as to signal new, contrastive, or corrective information. This primary sentence stress in an English declarative sentence is marked by expanded F0 and intensity and longer duration on the main-stressed syllable of the focused element (Cooper et al. 1985). Material following this stressed syllable exhibits post-focus compression (PFC), which is realized as a drop in F0 and intensity following the stressed syllable of the focused element.

At least some dialects of Mandarin have been found to realize sentence focus by in-focus expansion and post-focus compression (Jin 1996, Xu 1999, Xu, Chen, & Wang 2012). That is, a focused word within a sentence displays an expanded F0 range with a higher F0 peak than other words and optionally a longer duration as well. Post-focus elements, on the other hand, show a substantially reduced pitch range (while still maintaining the lexical tone identity) as well as lowered intensity. Mandarin and English differ, however, in the location of F0 expansion and subsequent post-focus compression. In English, the position of both in-focus expansion and post-focus compression are crucially dependent on word stress, with the syllable immediately following the stressed syllable of the focused word undergoing PFC. In contrast, in Mandarin, which unlike English is generally described as syllable-timed rather than stress-timed (Mok 2009), post-focus compression occurs following the entire focused constituent. Mandarin speakers' sentence focus production data from Xu (1999) illustrates this pattern (Figure 1). A sentence containing three words, *[māomī] (kitty) [mō] (touch) [māomī] (kitty)*, was produced by Mandarin speakers with varying sentence focus on Word 1, Word 2, and Word 3. As shown in Figure 1, even when every syllable in the Mandarin sentence has High tone, the focused word is realized with even higher pitch throughout the entire focused word, followed by F0 drop in the post-focus word.
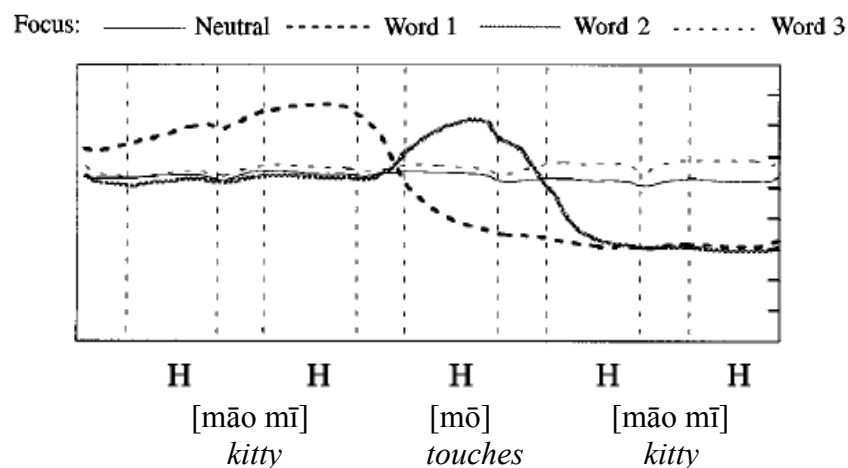

Figure 1. Pitch contours of a Mandarin sentence with different focus positions (Xu 1999).

Considering the above differences in the Mandarin and English implementations of focus intonation, we expect differences in the realization of English sentence focus by native speakers of Mandarin and of English. In fact, Mandarin speakers have been reported to have difficulty in producing native-like English focus intonation despite the presence of PFC in their L1 (Wu & Chung 2011, Chen, Xu, & Guion-Anderson 2014, Chen 2015, Chen, Robb, Gilbert, & Lerman 2011). Similar patterns have been reported for bilingual English-Cantonese speakers (Wu & Chung 2011) and bilingual Quanzhou Southern Min-Mandarin speakers (Chen, Xu, & Guion-Anderson 2014).

This study reports on an investigation of the production of English sentence focus by native speakers of Mandarin at two points during their first year as international teaching assistants (ITAs) in the US. The study addresses the three research questions below.

1. How do Mandarin-speaking ITAs produce corrective focus intonation in English?
2. What factors cause native speakers (NSs) of English to perceive ITA corrective focus as unnatural?
3. Does ITA focus production improve with residence in an English-speaking context?

These questions were addressed by two studies: a production task designed to elicit corrective focus prosody by both NSs and Mandarin-speaking ITAs, and a naturalness judgment task designed to examine the relationship between the acoustic correlates of focus prosody and naturalness judgments by English NSs. Based on the differences between realization of focus in English and Mandarin, we hypothesized that in our study, NSs would be more likely to exhibit PFC following the stressed syllable of the focused word than would the ITAs. Specifically, in terms of the target focus word in this study, we expected that the drop in F0 and intensity from the stressed syllable of the focused word to the following syllable would be greater for NSs than ITAs. However, for both groups, we expected to observe a drop of F0 and intensity from the stressed syllable of the focused word to the stressed syllable of the post-focus material word, consistent with PFC following the focused word.

The paper is organized as follows. Section 2 describes the first experiment, a production study, in which both Mandarin and English speakers participated in a task designed to elicit corrective focus. The second experiment, a naturalness rating study, in which undergraduate English speakers rated each group's productions as natural or unnatural, is described in Section 3. Section 4 summarizes the specific factors that contribute to perception of non-native focus as unnatural as well as the changes over time in Mandarin speakers' production. Section 5 concludes.

2. EXPERIMENT 1: PRODUCTION TASK

A. Methods and Materials

The production experiment was designed to elicit English focus intonation in order to compare the acoustic features associated with focus intonation displayed by the two groups of speakers, Mandarin-speaking ITAs and English NSs. Two groups participated in the production experiment: 18 Mandarin-speaking ITAs (11 male, 7 female), who were recorded within the first month of their arrival in the US (Month 1) and a second time 3 months later (Month 4), and 18 native speakers of English (7 male, 11 female), who participated in the experiment once, to

create a baseline for comparison. All participants were enrolled at Stony Brook University at the time of their participation. Approval of the project was obtained from Stony Brook University's Committee on Research Involving Human Subjects.

Participants took part in a number of different tasks. The task discussed in this study consisted of reading passages aloud and then answering questions. For this task, each participant was seated in front of a laptop computer with an experimenter in the same room. The participant was shown a slide such as the one given in Figure 2, and instructed to read the sentences aloud.

Figure 2. Slide 1 for production experiment.

When they finished reading, participants were shown the slide in Figure 3 and were first asked to confirm correct information (i.e., *You can take the bus to New York City, right?*). Then they were asked to confirm incorrect information, in order to elicit the target phrase with corrective focus (*The price of the bus ticket is twenty dollars, right?*). They were instructed to respond with a full sentence, correcting any erroneous information. The anticipated answer for the second question was *No, the price of the bus ticket is eleven dollars* with corrective focus on the word *eleven*. *Eleven* was chosen as the target item beforehand to avoid voiceless obstruents, to allow consistent tracking of the F0 contour.

Figure 3. Slide 2 for production experiment.

Both the reading of the passage and the question and answer responses were recorded. The recording was conducted in a quiet room on the Stony Brook University campus, using a Zoom H6 digital recorder.

B. Analysis

Although the task included several reading passages, only data from the passage illustrated above was analyzed. Each syllable in the target phrase *eleven dollars* was hand-segmented in Praat (Boersma 2001) by the first, the third, and the fourth authors. Since utterance-final lengthening was expected, the utterance-final fricative was excluded from the segmentation. For each syllable boundary, the nearest negative-to-positive zero crossing points to the onset and offset of the syllables were marked. For the onset of *ven*, we marked a point where the patterns of the complex waveform changed. The offset of *ven* was considered to be the point where two or more formants ended. The interval between the offset of /n/ (end point of the formants) and the release for /d/ was not included. For many speakers in both ITA and NS groups, it was difficult to determine the onset of the syllables *le* and *lar* since /l/ seemed to be treated as ambisyllabic, making the boundary unclear. For this reason, we marked the point at which the lowest F2 was identified (Figure 4 (1) and (2)). This method was applied consistently across all the speakers. An example of syllable segmentation is shown in Figure 4 below.
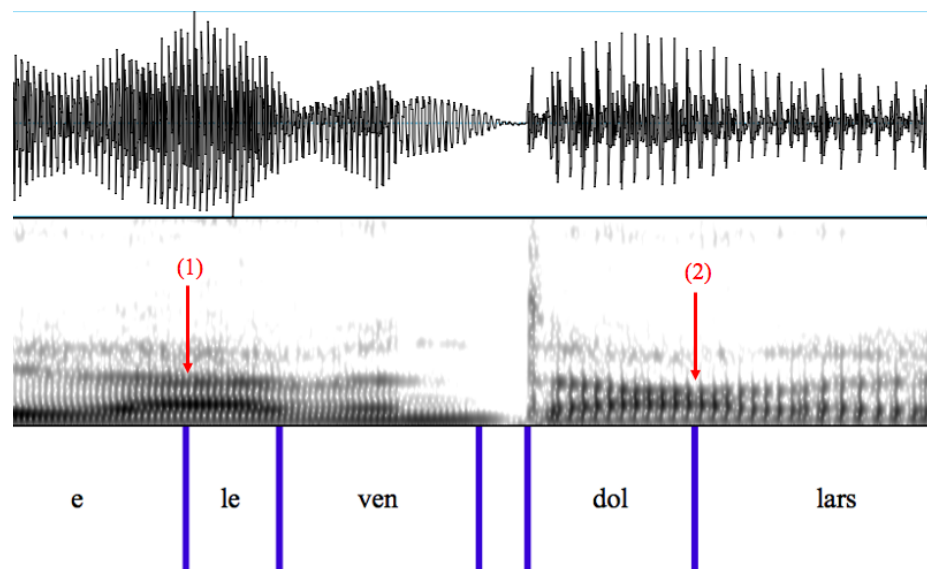

Figure 4. An example of syllable segmentation.

A Praat script, Prosody Pro (Xu 2005), was then used to extract the time-normalized F0 of the target phrase and to calculate the mean F0, mean intensity, and total duration for each syllable. Mean F0 values were converted to semitones ($12\log_2 F0/F_{ref}$, reference level = 1Hz) so that the differences in pitch range between female and male participants were eliminated. In order to determine whether PFC took place following the stressed syllable of the focused word, we compared the mean F0 values and mean intensity of the stressed syllable *le* and unstressed syllable *ven*. In order to rule out the possibility that any pitch and intensity changes from *le* to *ven* were simply due to differences between stressed vs. unstressed syllables, we compared the two lexically stressed syllables *le* and *dol*. Because the ambisyllabic nature of /l/ made it impossible to determine the precise location of the boundaries between syllables, duration data was not included in our analysis.

C. Results

The averaged time-normalized contour revealed several differences between ITAs and NSs, both males and females, as shown in Figure 5. While both ITAs and NSs exhibited falling intonation, the alignment of the onset of the fall differed for ITAs and NSs. As predicted, the beginning of the fall more often occurred during the end of the stressed syllable *le* for NS, but during the end of the word *eleven* for ITAs. Figure 5 also shows that the slope of the pitch drop for *ven* was steeper for NSs than for ITAs, indicating that NSs had a sharper decline in pitch after the stressed syllable of the focused word.
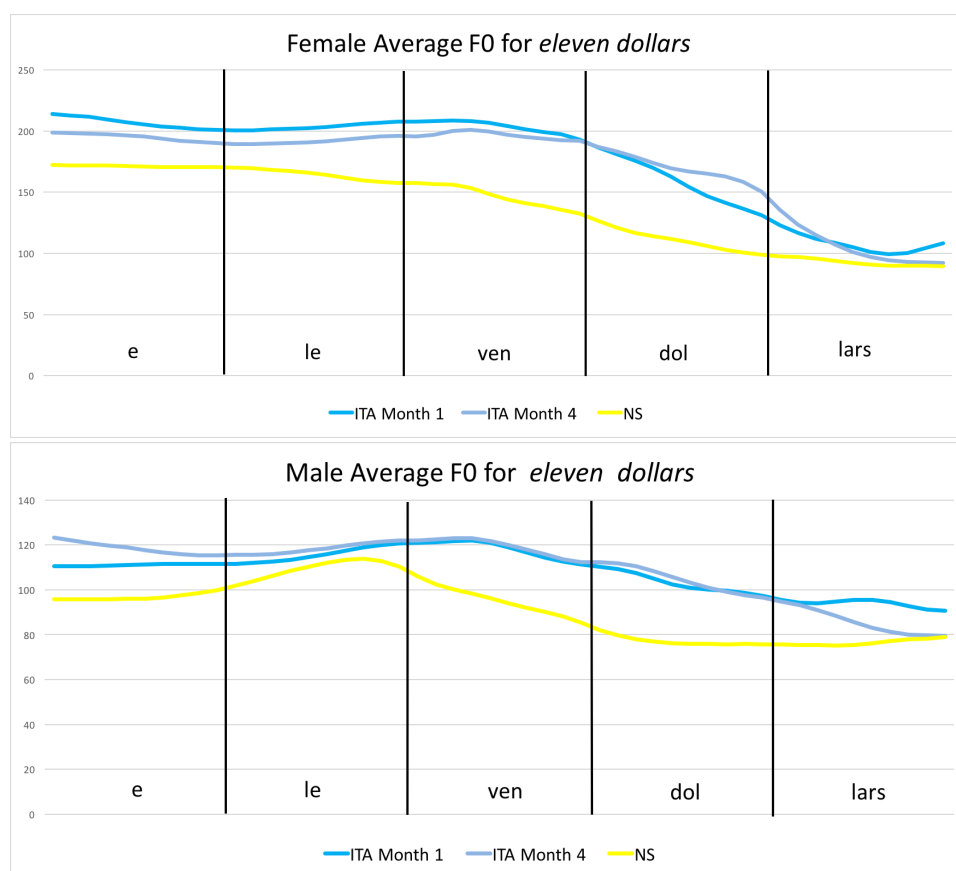

Figure 5. Time-normalized average F0 contours (Hz) for female (top) and male (bottom).

Figure 6 shows the average pitch of each syllable in *eleven dollars* for NSs and for ITAs at Month 1 and Month 4. NSs showed a much sharper decline in pitch from *le* (the main-stressed syllable of the focused word *eleven*) to *ven* (the post-stress syllable of that word) than did ITAs. Similarly, Figure 6 shows that the pitch decline from *le* (the main-stressed syllable of the focused word *eleven*) to *dol* (the main-stressed syllable of the post-focus word *dollars*) was greater for NSs than for ITAs.
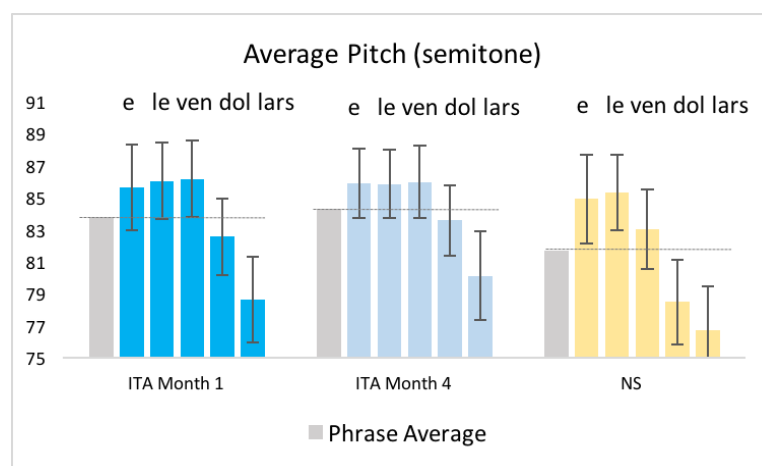
Figure 6. Average pitch for each syllable.
The horizontal lines indicate the average intensity across the syllables for each group.

Figure 7 compares the pitch differences between the stressed syllable *le* of the focused word *eleven* and the immediately following unstressed syllable *ven* as well as the main-stressed syllable *dol* of the post-focus word *dollars*. For statistical analyses of the F0 change across the two groups, the mean F0 of each syllable was converted from Hz to semitones and the difference value between *le* and *ven* and between *le* and *dol* was calculated for each subject. ANOVAs on mean F0 change (semitones) were performed separately with *Group* (ITAs Month 1 vs. NSs, ITAs Month 4 vs. NSs) as an independent variable using the statistical program R (R Core Team 2012) and the R package lme4 (Bates, Maechler, & Bolker 2012). As shown in Figure 7, the results reveal a significantly greater change in mean F0 (semitones) from *le* to *ven* for NSs than for ITAs at Month 1 [$F_{(1,34)}$ = 11.17, p = .002] and for ITAs at Month 4 [$F_{(1,34)}$ = 10.26, p = .003]. Similarly, F0 change from *le* to *dol* was greater for NSs than for ITAs at Month 1 [$F_{(1,34)}$ = 4.08, p = 0.052] and for ITAs at Month 4 [$F_{(1,34)}$ = 10.58, p = 0.003].
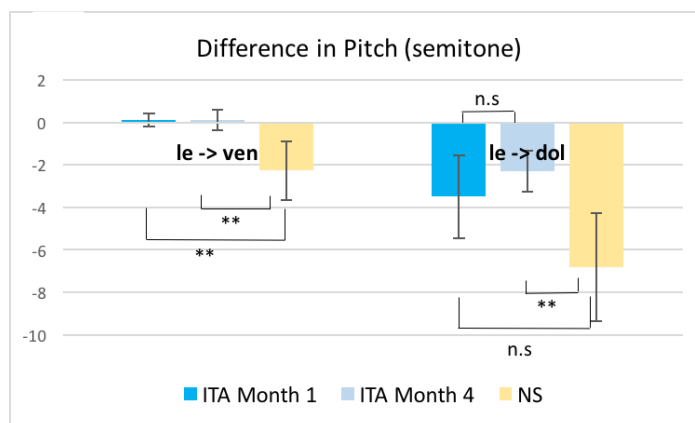

Figure 7. Differences in mean pitch between syllables.

Figure 8 shows the average intensity for the entire phrase (the first bar) and for each syllable. Intensity was lower for the post-focus unstressed syllable *ven* than for the stressed syllable *le* of the focused element, for both the NSs and the ITAs (at both time points). The intensity of *ven* was also lower than the average intensity across the phrase for all groups, although the intensity

increase from the unstressed syllable *ven* to the stressed syllable of the following word *dol* was much greater for NSs than for ITAs.
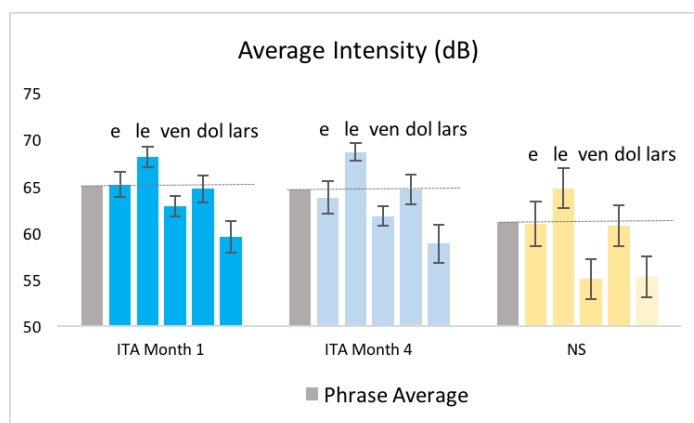

Figure 8. Average intensity for each syllable.
The horizontal lines indicate the average intensity across the syllables for each group.

Figure 9 shows the differences in intensity between the stressed syllable *le* and the unstressed syllable *ven* and between the stressed focused syllable *le* and the stressed post-focus syllable *dol*. The intensity drop from the stressed syllable *le* to the unstressed syllable *ven* was significantly greater for NSs than ITAs (ITAs at Month 1 vs. NSs: [$F_{(1,34)} = 27.15$, $p < 0.001$]; ITAs at Month 4 vs. NSs: [$F_{(1,34)} = 15.4$, $p < 0.001$]). In contrast, the intensity change from *le* to *dol* did not show any significant difference between the groups.
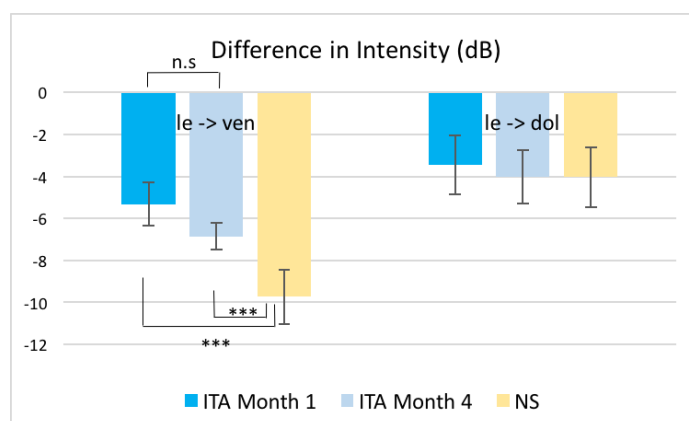

Figure 9. Differences in mean intensity between syllables.

In summary, the results showed that ITA focus production was different from that of NSs in terms of pitch contour and intensity. NSs' pitch contour showed a peak on the stressed syllable of the focused word and an immediate sharp decline on the following syllable. In contrast, in the ITAs' pitch contours, the pitch peak was aligned with the end of the focused word, with the decline beginning in the post-focus word. NSs also showed a significantly greater drop in intensity from the stressed syllable of the focused word to the following unstressed syllable than did ITAs. In contrast, there was no significant group difference in the intensity drop from the stressed syllable of the focused word to the stressed syllable of the post-focus word.

To determine whether these differences affect NS perceptions of ITA focus prosody, we carried out a second experiment, which was designed to investigate naturalness judgments of these productions by English NSs.

3. EXPERIMENT 2: NATURALNESS JUDGMENT TASK

A. Methods and Materials

The recorded sentences with corrective focus from Experiment 1 (*No, the price of the bus ticket is eleven dollars*) were used as stimuli in Experiment 2, in which native speakers of English judged the naturalness of the sentences containing corrective focus produced by English NSs and by ITAs at Month 1 and Month 4.

The target sentence (*No, the price of a bus ticket is eleven dollars*) was extracted from each recording sample and low-pass filtered at 400 Hz in order to minimize the influence of segmental information on judgments. Of 89 recording samples collected from the NSs (19) and from the ITAs (23 in Month 1 and 23 in Month 4), we excluded five ITAs whose productions of the target sentence at either Month 1 or Month 4 were assessed as problematic for any of the following reasons: extended pauses between syllables, stuttered target phrases, backtracking, and unclear extra information included in the response (although productions with minor wording changes such as addition of *only* were included). Additionally, one NS was excluded because of the speaker's unusually monotonic speech. This left 54 audio samples (from 18 ITAs at each of two time points and 18 NSs at a single time point). Fifty-four filtered audio samples were pseudo-randomized and divided into three blocks with a short break in between. Each sample was played twice.

Thirty-five students in an undergraduate phonetics class at Stony Brook University participated in this experiment as judges. Preceding their participation, their instructor had in an earlier class introduced the key elements involved in English emphatic sentence stress, so the students were familiar with the characteristics of focus intonation. For the naturalness judgment task, the experimenter explained the context in which the target sentence was produced by showing the undergraduate students the reading passage and questions. The students were then asked to listen to the sentence with corrective focus (low-pass filtered at 400 Hz) and to decide whether the intonation of *eleven dollars* sounded natural or unnatural. After the instructions were given, four example sentences were played in order to familiarize the judges with low-pass filtered speech samples. No feedback was given during either the practice or the experimental task. Only the judgments of the 28 students who had identified their first language as English were included in the results.

B. Analysis

The hypothesis underlying this experiment was that since NSs and ITAs differed in their realization of focus prosody, these differences would be reflected in the English-speaking students' judgments of the naturalness of NS and ITA focus prosody. The percentage of 'natural' judgments that each utterance received was calculated, and these percentages were compared across NS productions, ITA productions at Month 1, and ITA productions at Month 4, through independent sample *t*-tests. We also compared the naturalness judgments of ITA productions at Month 1 with those at Month 4 through a paired-sample *t*-test. For each ITA participant we also examined changes over time in naturalness percentages and compared these with changes in the pitch and intensity patterns of their productions.

C. Results

As illustrated in Figure 10, 71% of the NS productions were judged as natural (SD = 3.8), in contrast to 41.6% of ITA productions in Month 1 (SD = 5.4) and 43% in Month 4 (SD = 4.8).
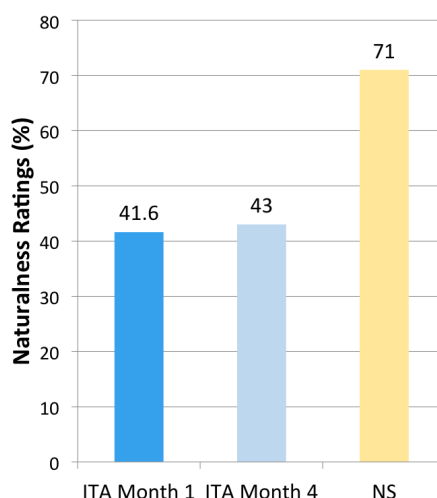

Figure 10. Percentages of naturalness ratings on ITA and NS focus prosody.

Independent sample *t*-tests revealed that the percentage of 'natural' judgments was significantly higher for NS productions than for both ITA Month 1 and ITA Month 4 productions (p < .001). However, a paired sample *t*-test did not show any significant differences between the judgments of ITA Month 1 and ITA Month 4 productions, indicating no significant group improvement in the naturalness of ITA focus production over the four months. These results confirm that the ITAs' patterns of realizing focus were not only different from NS patterns in acoustic measures but also in naturalness as perceived by native speakers.

4. DISCUSSION

Analysis of the pitch and intensity of English corrective focus in the phrase *eleven dollars* by native speakers of Mandarin and by native speakers of English revealed differences in both pitch and intensity, and these differences appear to have been associated with differences in the perceived naturalness of the productions by NSs and by ITAs.

The major difference in pitch contour between English speakers and Mandarin speakers was in the failure of the latter to manifest a drop in pitch directly following the stressed syllable in the focused word *eleven*, as in NS productions. Some ITAs failed to show a clear pattern of focus expansion and post-focus compression, and even those ITAs who exhibited a drop in pitch frequently aligned the pitch drop with the right edge of the unstressed syllable *ven*, one syllable later than the F0 drop in the productions of the NSs. Similarly, the Mandarin speakers showed a smaller drop in intensity than the English speakers from the stressed to the post-stress syllable. Together, these differences indicate that the non-native speakers showed different patterns than native speakers.

The relationship between the acoustic correlates of focus and the naturalness judgments can be illustrated by comparison of the F0 and intensity data from two individual ITAs: one whose

productions received a relatively high percentage (> 60%) of 'natural' judgments at both time points and one whose productions received relatively low (< 39%) 'natural' judgments. The target phrase pitch contours and average syllable intensity of the highly-rated ITA participant are shown in Figure 11, and those of the poorly-rated ITA participant are in Figure 12.
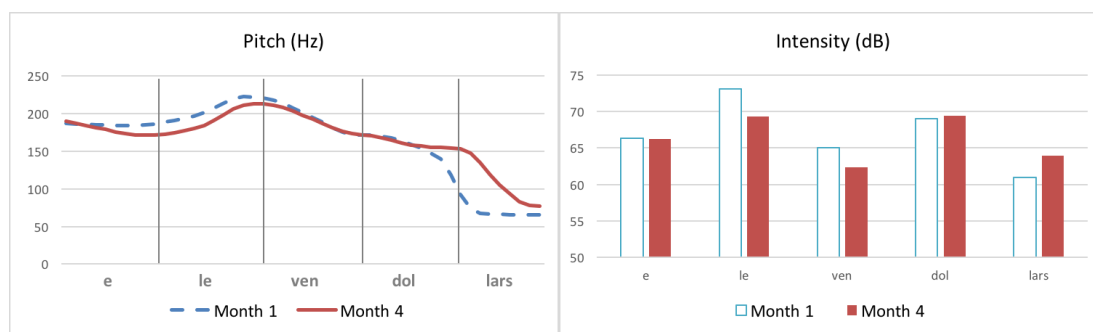

Figure 11. Pitch and intensity of each target syllable produced by a highly-rated ITA (who received 64% in Month 1 and 67% in Month 4).
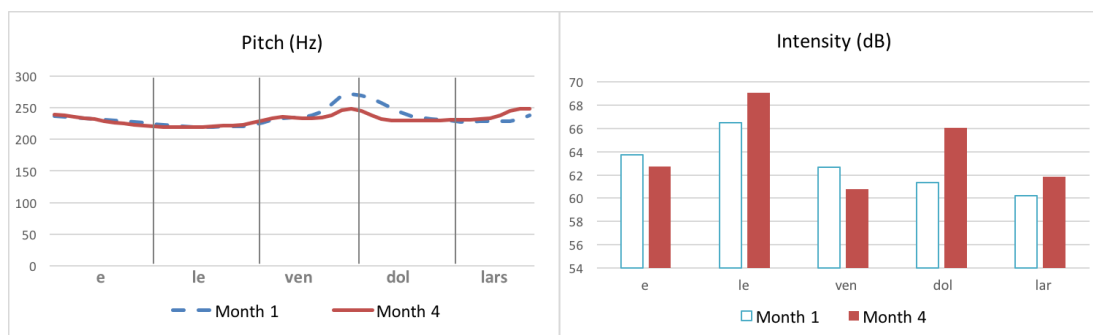

Figure 12. Pitch and intensity of each target syllable produced by a poorly-rated ITA (who received 19% in Month 1 and 29% in Month 4).

A noticeable difference between the productions of these two participants is in their pitch contours. The pitch contour in Figure 11 quite clearly shows that F0 rises on the stressed syllable *le* and begins to drop on the following syllable, similar to the pattern found in NS productions. In contrast, the pitch contour in Figure 12 is quite different from the average NS contour, showing a flat pitch throughout the phrase, with little hint of either in-focus expansion or post-focus compression. Thus, the difference in ratings of these two participants' productions seems to indicate that pitch contour played a crucial role in the NS judgments of naturalness.

The poorly-rated ITA showed a slight (10%) improvement from Month 1 to Month 4 despite the lack of noticeable change in pitch contour. Since pitch does not account for the improvement, it is possible that intensity played a role in this instance. The intensity drop from *le* to *ven* was larger in Month 4 than in Month 1, resulting in a pattern that was more similar to that of NSs' post-focus compression, illustrated in Figure 8.

Although there was no significant improvement for the ITA group as a whole, several ITAs did show an improvement in their naturalness ratings, with four showing improvement of 20-35 percentage points. Figure 13 shows the acoustic measures of one of the improved ITAs' focus production.
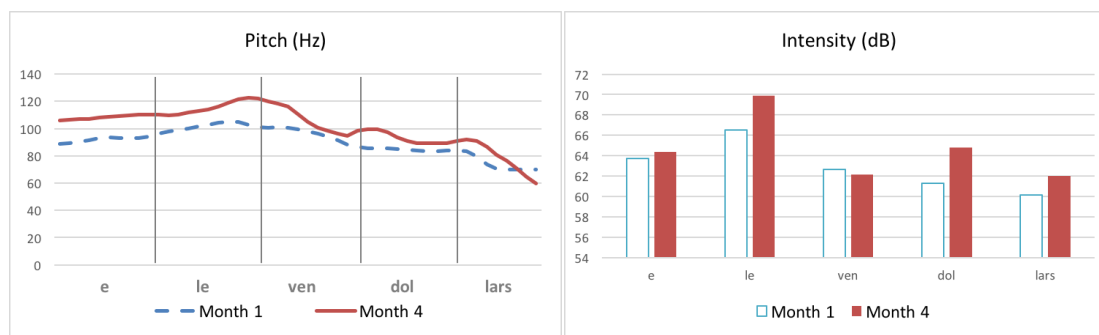
***Figure 13. Pitch and intensity of each target syllable produced by an improved ITA
(who received 29% in Month 1 and 50% in Month 4).***

The focus prosody of this participant shows more native-like patterns in Month 4 than in Month 1. Both pitch and intensity display a greater rise on *le* as well as a larger drop from *le* to *ven*, indicating clearer in-focus expansion and post-focus compression. This change in acoustic cues seems to account for the improvement in naturalness.

Comparison of these three speakers' productions suggests that not only the shape of the pitch contour but also the alignment of the pitch peak with the stressed syllable is an important factor in perceived naturalness. In addition, naturalness judgments seemed to be affected by the presence of an intensity drop from stressed to post-stress syllable, particularly in the absence of clear pitch cues, as shown by the improvement in naturalness judgments for the ITA whose pitch contour did not change but whose intensity pattern became more English-like. Further work is required to evaluate the relative importance of pitch and intensity differences in degree of perceived naturalness.

5. CONCLUSION

The results of this study are consistent with previous findings that even speakers whose native language uses post-focus compression are not necessarily successful in producing native-like English focus patterns (Wu & Chung 2011). ITA and NS productions differed in terms of the presence or the alignment of PFC, and the distance from NS patterns seems to be associated with perceived lack of naturalness. Given the importance of suprasegmentals in the intelligibility of non-native speech (Anderson-Hsieh & Koehler 1988, Hahn 2004, Munro & Derwing 1995, Sereno, Lammers, & Jongman 2016), it is encouraging that some ITAs did show improvement in their production of corrective focus, consistent with earlier studies showing effects of length of residence/L2 experience on L2 prosody (Chen 2015, Chen, Xu, & Guion-Anderson 2014). This paper reports on the initial phase of a longitudinal study that will track this group of ITAs over three years, providing information on long-term changes in L2 prosody.

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