名古屋外国語大学論集　第8号　2021年2月

Research Note

The Effect of a One-Month Study Abroad Program on Japanese Students' Perception of Prosody of Spoken English

Michiko NAKAKITA

Abstract

Prosody is an indispensable element for understanding the meanings conveyed by the speech stream. The F_0 contour and durational patterns, which comprise the prosodic properties of a speech signal most relevant to disambiguation, can be separately manipulated in resynthesized speech to investigate the manner in which these prosodic cues are used by listeners to disambiguate lexical/syntactic units. The existing literature has suggested that the weighting schema of prosodic cues changes over the course of the development of a native language. In the meantime, it remains unknown whether the same mechanism applies to the development of a second language. This study adapted the method of a previous study to the speech perception of non-native speakers with the aim of examining the hypothesis of EFL learners' cue-weighting shift as a function of intensive exposure to English. To investigate whether intensive exposure to an English-speaking environment changes Japanese students' perceptual prosodic cue weighting, a set of data was collected from 10 participants using a prosodic disambiguation task before and after a one-month study abroad program in Australia. The participants' task was to listen to a set of ambiguous speech

samples resynthesized by decoupling, creating three levels of F_0 contour patterns and five levels of durational patterns of two variations, *sunflower, pot* and *sun, flowerpot*, and crossing them. Each participant selected either a picture card with a sunflower and a pot or a picture card with a sun and a flowerpot. The results suggest that a cue-weighting shift has occurred for these EFL learners with the F_0 contour pattern cue becoming weighted heavier after the one-month study abroad program. Together with the existing literature, this study's findings support the hypothesis that a developmental cue-weighting shift can apply for both native and non-native English developments.

INTRODUCTION

Prosody refers to the rhythmic and melodic properties of spoken language. Just as written language requires spaces and punctuation to mark syntactic boundaries, prosody is an indispensable element for understanding the meanings conveyed by the speech stream. Previous studies have demonstrated that structural boundaries (lexical and syntactic) in English usually correlate with prosodic markers (e.g., Cooper & Paccia-Cooper, 1980; Shattuck-Hufnagel & Turk, 1996).

The role of prosody as a boundary marker for lexical/syntactic units is highlighted when one hears an ambiguous sentence. For instance, *Steve or Pam and Bob will come* has two possible meanings, depending on the placement of the phrasal boundaries (i.e., [[Steve or Pam] and Bob] or [Steve or [Pam and Bob]]). Research has shown that adult speakers produce reliable prosodic patterns that correlate with the intended phrasal structures, leading listeners to correctly identify the intended meanings (e.g., Lehiste, 1973; Price, Ostendorf, Shattuck-Hufnagel, & Fong, 1991; Scott, 1982). This phenomenon is known as *prosodic disambiguation*.

The prosodic properties of a speech signal most relevant to disambiguation are the fall-rise patterns of fundamental frequency (F_0) contour and the durational

patterns of syllables and pauses (Lehiste, 1973; Lehiste, Olive, & Streeter, 1976; Price et al., 1991; Streeter, 1978)[1]. F_0 and duration are distinct acoustic properties described by different measures. F_0 is measured in Hertz (Hz), and the patterns of change in Hz over time are visually observable in the rising and falling patterns of the F_0 contour. F_0 exists only in the voiced portion of the speech stream. Duration is measured in milliseconds (ms), and is represented in the waveform on the *x*-axis; it deals with the amount of time from the onset to the end of a sequence of phones and silences.

The F_0 contour and durational patterns can be separately manipulated in resynthesized speech – a method employed to investigate the manner in which these prosodic cues are used by listeners to disambiguate lexical/syntactic units (Beach, 1991; Beach al., 1996; Yoshida & Katz, 2004; Yoshida 2007). By separating the F_0 contour pattern and the durational pattern cues, it becomes possible to investigate (1) whether both the F_0 contour and the durational patterns are used as cues for disambiguation and (2) what is the weighting schema between these cues. Research has suggested that there is a trading relationship between the F_0 contour pattern and the durational pattern cue.

Yoshida and colleagues examined age-related changes in cue trading by conducting a perception experiment using parametrically resynthesized ambiguous variations of compound nouns between *sunflower, pot* and *sun, flowerpot* with groups of five-year-old, seven-year-old, and adult native speakers of English (Yoshida & Katz, 2004; Yoshida, 2007; Yoshida, Katz, Henley, & Golden 2007). The results suggested that a developmental cue-weighting shift with a durational pattern being the primary cue for the group of five-year-olds and the F_0 contour cue becomes increasingly stronger (therefore, the durational pattern cue becomes gradually weaker) with age. This is analogous to the findings from studies on developmental cue-weighting shift in phonemic categorization (e.g., Jusczyk, 1993; Mayo & Turk, 2004; Nittrouer & Miller, 1997; Sussman, 2001), which further suggests a more general pattern of development across segmental

and suprasegmental levels.

Whereas the main focus of the existing literature has been on cue processing among native speakers, this study adapted the method of a previous study to the speech perception of non-native speakers. More specifically, this study used the same audio stimuli described in Yoshida (2007) – the ambiguous variations between *sunflower, pot* and *sun, flowerpot* – in a prosodic disambiguation experiment with Japanese learners of English (EFL learners).

Direct comparison using the same material will be useful for a better understanding of the similarities and differences between native and second language developments. The central question of this study is not whether exposure to a language plays an important role in its development, but rather what changes with such exposure. Furthermore, it remains unknown whether the mechanisms of both native and second language are essentially the same or qualitatively different. Given the evidence found by previous studies that support a hypothesis of developmental cue-weighting shift for children, an investigation of EFL learners would be highly beneficial.

This research aimed to examine the hypothesis of EFL learners' cue-weighting shift as a function of intensive exposure to English. Specifically, it hypothesized that there would be differences in the EFL learners' response patterns when comparing pre- and post-exposure data. The durational pattern was expected to be the primary cue, while F_0 would be the secondary cue (e.g., Lehiste, 1973; Yoshida, 2007). The durational pattern cue and F_0 were expected to play a larger and a smaller role, respectively, in perceptual decision making during the pre-exposure session rather than during the post-exposure session.

METHOD

Participants

Participants were 10 college students who signed up for a one-month study abroad program in Australia offered by Nagoya University of Foreign Studies

(NUFS). All participants were either at the end of the freshman year or at the junior year (age range 19–20, $n = 10$) and were monolingual native speakers of Japanese with limited exposure to other languages. None of the participants had gone abroad before participating in this program.

Intensive Exposure to English During the One-Month Study Abroad Program

In this study, the participation of the EFL learners in the one-month study abroad program served as the phase of exposure to an English-speaking environment. The program was intended for relatively less experienced EFL learners. The learners were assigned to homestays and attended English classes at the college language center. The EFL classes were designed specifically for the NUFS group to ensure the learning of general English skills and did not include classes focused on listening skills. There were limited opportunities for them to join English-speaking college students and other groups of EFL learners, since the college was on a summer break. Because of this, many extra-curricular activities were included in the program to enable the EFL learners to experience various situations in which they could communicate with people in English. While there is no doubt that this entire experience must have had a major impact on these learners' English skills, it remains unclear what can change and how it can change for EFL learners through intensive exposure to English.

Choice of Ambiguous Materials

Speech materials included an ambiguous set of compound nouns *sun/flower/pot* that could be interpreted as *sunflower, pot* or *sun, flowerpot*. Yoshida (2007) selected these stimuli to ensure that each interpretation would be comprehensible to young children to investigate children's language development. These objects were also easily portrayed in pictures.

This research adopted the combination of *sun/flower/pot* so that its results

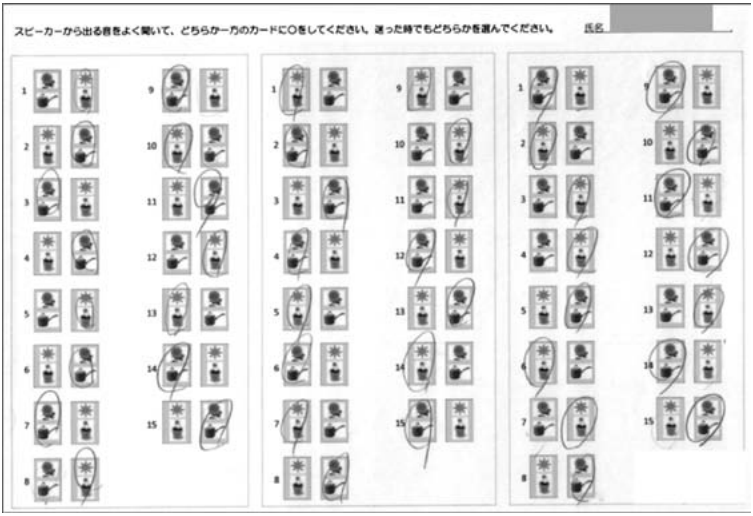


Figure 1. Sample of the response sheet used in a two-alternative forced-choice task.

were comparable to those of Yoshida's (2007) study on children's language development. While Yoshida used picture cards to collect data in the form of a card game, this research used a response sheet with such pictures to register each EFL learner's responses to the auditory stimuli (Figure 1).

Audio Stimuli

Audio stimuli were also adopted from Yoshida (2007). As described in Yoshida (2007), the audio stimuli were ambiguous variations of *sunflower, pot* and *sun, flowerpot*. Five levels of durational pattern and three levels of F_0 contour pattern were resynthesized from recorded speech samples by a male native speaker of general American English (PRAAT; Boersma & Weenink, 2004). When crossed, the materials yielded 15 stimulus variations. The durational pattern levels are shown in Figure 2, and the F0 contour pattern levels are shown in Figure 3.

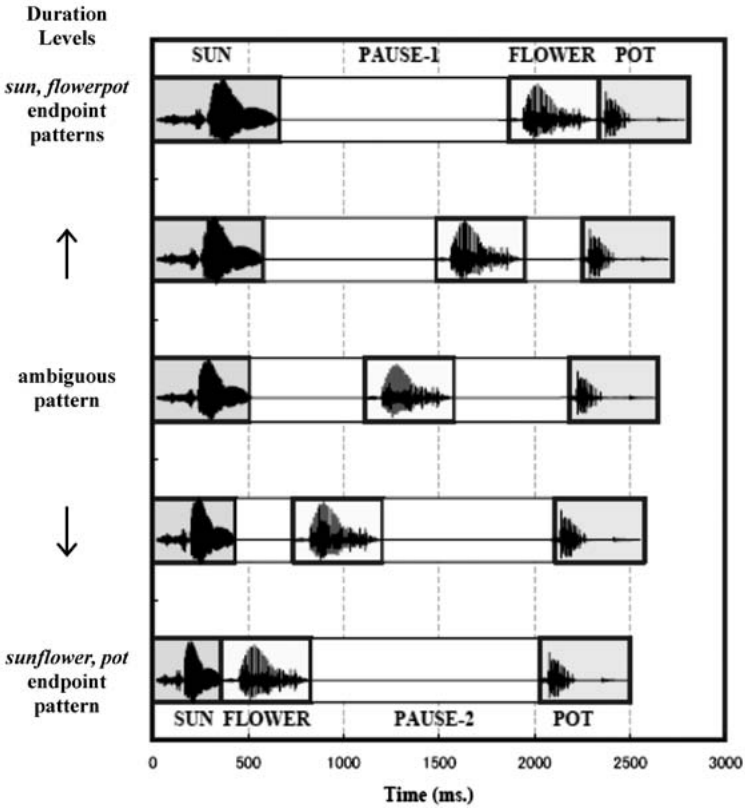
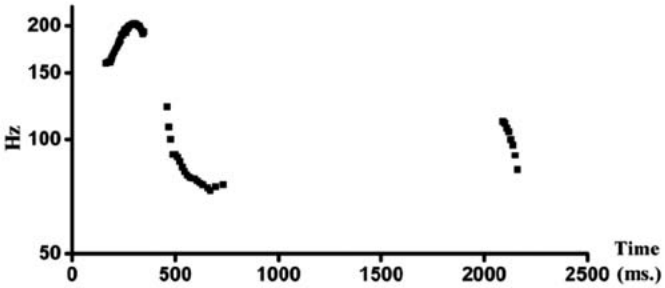
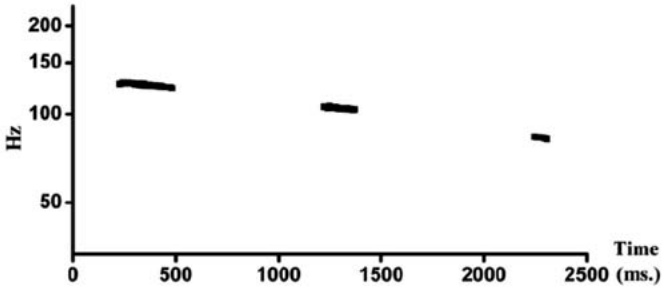


Figure 2. Example of the five levels of segmental duration pattern used to create auditory Stimuli. The five levels of duration were created by computer-editing the durations of sun and the two inter-word pauses (P1, P2). The waveforms shown here are from the sun, *flowerpot* stimulus series (Yoshida, 2007, p. 32).

A. The *sun, flowerpot* F_0 pattern



B. The ambiguous F_0 pattern



C. The *sunflower, pot* F_0 pattern

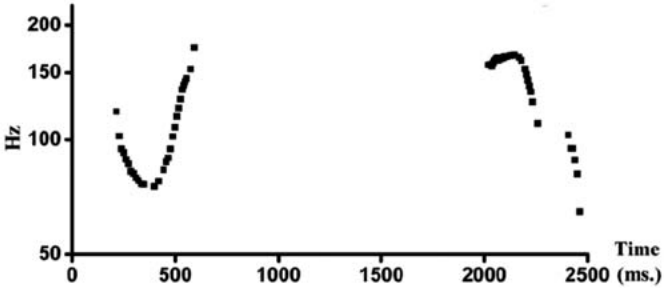


Figure 3. The three levels of F_0 pattern used to create auditory stimuli (Yoshida, 2007, p. 33).

Procedures

Each EFL learner attended a set of two sessions, with one session 10 days prior to the departure to the study abroad program and the other one month after the return to Japan. In both sessions, the learners sat separately from each other in front of a meeting table.

The experiment was conducted in the form of a two-alternative, forced-choice, picture-selecting task. The experimenter played audio stimuli using a computer connected to a set of loudspeakers at a comfortably high sound level. The learners were informed that they would hear a phrase played on the loudspeakers and that they would need to respond, even when they were unsure, by circling one of the two picture cards (*sunflower, pot or sun, flowerpot*) printed on the response sheet (Figure 1).

The learners were presented with 15 variations of the *sun-flower-pot* three times (15 variations × three sets = 45 total trials) in quasi-randomized orders. The experimenter did not provide feedback on the correctness of the learners' choices of cards, as such a feedback could have unexpected training effects on the learners' behaviors. The learners took a short break after completing each set of 15 stimulus variations. The entire session of 45 trials was completed in approximately 20 minutes.

Data Coding

Each listening trial yielded either a *sun, flowerpot* or a *sunflower, pot* response. The raw responses were coded as binary values (1 for *sun, flowerpot*, and 0 for *sunflower, pot*). Then, for each learner, the proportion of *sun, flowerpot* responses were computed over the repetitions of each of the 15 stimulus variations.

RESULTS

Table 1 presents the mean proportions of *sun and flowerpot* responses (ranging from 0.0 to 1.0) as a function of stimulus variations for pre- and post-exposure data (i.e., participating in the study abroad program) (panels A and B).

Similar response patterns were apparent in both pre- and post-exposure datasets. The proportions of *sun and flowerpot* responses were quite low (0.00 and 0.13) at the endpoint, when both the durational pattern and F_0 contour pattern cues indicated the other interpretation (*sunflower, pot*). This proportion increases monotonically toward the *sun, flowerpot* interpretation as the durational pattern and F_0 contour pattern cues are increasingly congruent. The proportions of *sun*

Table 1. Proportion of *sun, flowerpot* responses as a function of stimulus variation.

A. Pre-Exposure

	F_0 contour pattern			
Durational pattern	*sunflower, pot*	Ambiguous	*sun, flowerpot*	M
sunflower, pot	0.00	0.03	0.03	0.02
↑	0.00	0.13	0.43	0.19
Ambiguous	0.30	0.43	0.57	0.43
↓	0.83	0.77	0.90	0.83
sun, flowerpot	1.00	0.97	0.97	0.98
M	0.43	0.47	0.58	0.49

B. Post-Exposure

	F_0 contour pattern			
Durational pattern	*sunflower, pot*	Ambiguous	*sun, flowerpot*	M
sunflower, pot	0.13	0.03	0.10	0.09
↑	0.13	0.07	0.60	0.27
Ambiguous	0.50	0.40	0.87	0.59
↓	0.80	0.63	0.83	0.76
sun, flowerpot	0.83	0.93	1.00	0.92
M	0.48	0.41	0.68	0.52

and flowerpot responses were 0.97 and 1.00 when both the durational and F_0 contour patterns were at the *sun and flowerpot* endpoint. In sum, the stepwise manipulation of the durational pattern and F_0 contour pattern cues seems to have influenced the learners' response patterns in the intended manner.

A series of three-way (exposure × durational pattern × F_0 contour pattern) analyses of variance (ANOVA) was performed on the proportion of the *sun and flowerpot* responses. The results were consistent with the general patterns seen in Figure 4, which depicts a scatter plot of the data shown in Table 1. In Figure

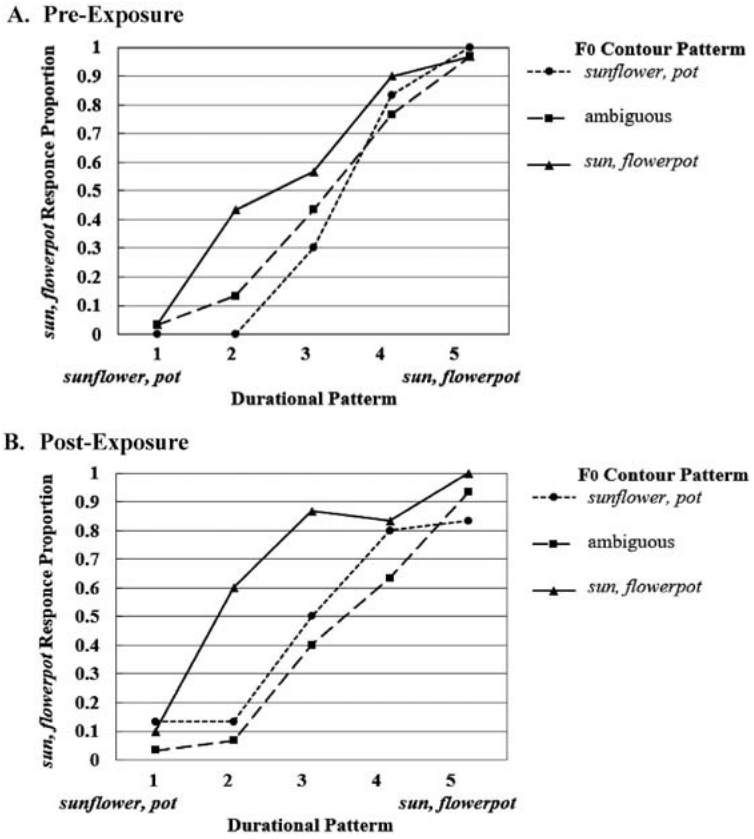


Figure 4. Proportion of sun, *flowerpot* responses as a function of the durational and F_0 contour patterns grouped by exposure.

4, the three lines represent the effects of the three F_0 contour patterns, while the slopes of the lines represent the effects of the durational pattern.

There were significant main effects of both the durational ($F(4, 36) = 125.49$, $p < .001$) and the F_0 contour ($F(2, 18) = 20.50$, $p < .001$) patterns. Changes in the durational pattern (or F_0 contour pattern) levels towards the endpoints resulted in a decrease in perceptual ambiguity (the *sun, flowerpot* response proportions became close to either 1.0 or 0.0). There was also a two-way interaction between the durational and F_0 contour patterns ($F(8, 72) = 4.43$, $p < .001$). The interaction between the two types of cues suggests that the relative importance of each cue was influenced by the other cue, which is consistent with the cue trading behavior reported in previous literature (e.g., Beach, 1991; Beach al., 1996; Yoshida & Katz, 2004; Yoshida 2007). Although there appeared to be some differences between panels A and B in Figure 4, the durational pattern × F_0 contour pattern did not further interact with exposure ($F(8, 72) = 1.26$, *ns*), neither was the main effect of exposure ($F(1, 9) = 2.45$, *ns*).

Concerning the question of whether cue strengths change with intensive exposure to English (cue-weighting shift), the two-way interaction between durational pattern and exposure ($F(4, 36) = 2.71$, $p < .05$) and the two-way interaction between F_0 contour pattern and exposure ($F(2, 36) = 2.90$, *ns*, $p = .08$) were of key significance to this study. Although the F_0 contour pattern did not reach significance for interaction with the exposure, it was visually notable that the F_0 contour pattern of *sun and flowerpot* became distinctive among the three lines after exposure. Based on previous findings on American children's English development by Yoshida (2007), it was predicted that the F_0 contour cue would become stronger for the EFL learners after intensive exposure to English. The wider distance between the *sun, flowerpot* line and the other lines after exposure is consistent with this prediction. Therefore, the simple effects on these two-way interactions between each cue and exposure were further examined.

Figure 5 shows the effect of the durational pattern cues for pre-exposure

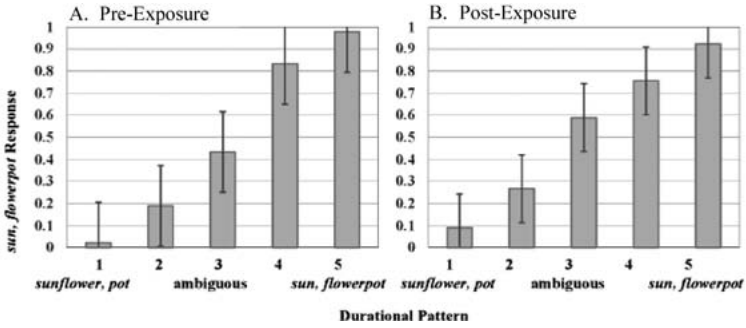


Figure 5. Proportion of *sun, flowerpot* responses as a function of the durational pattern grouped by exposure.

(panel A) and post-exposure (panel B). Although the interaction between the durational pattern and the exposure interaction was significant ($p < .05$), post-analysis of the simple effects for exposure at each level of the durational pattern indicated that pre- and post-exposure differences were significant, ($F(1, 9) = 7.88$, *Scheffé*, $p < .05$) only at the middle level of the durational pattern (which was designed to be the most ambiguous durational pattern among the five levels). On the basis of the visual examination in Figure 5, there are large overlaps of the error bars and no particular difference between the pre- and post-exposure panels, except for the slight difference in the slope of the three lines. The slope is steeper in the pre-exposure data plot (panel A) than in the post-exposure data plots (panel B), possibly suggesting a decreased cue strength of the durational pattern after exposure. This needs to be determined by future investigations.

Figure 6 shows the effect of the F_0 contour pattern cue for pre-exposure (panel A) and post-exposure (panel B). Although the interaction between the F_0 contour pattern and the exposure did not reach significance ($p = .08$), post-analysis of the simple effects for exposure at each level of the F_0 contour pattern indicated that the effect of exposure was significant ($F(1, 9) = 8.27$, *Scheffé*, $p < .05$) when the F_0 contour pattern was at the endpoint of *the sun flower*. Taken together with the notable change in the *sun, flowerpot* F_0 contour pattern after exposure in Figures

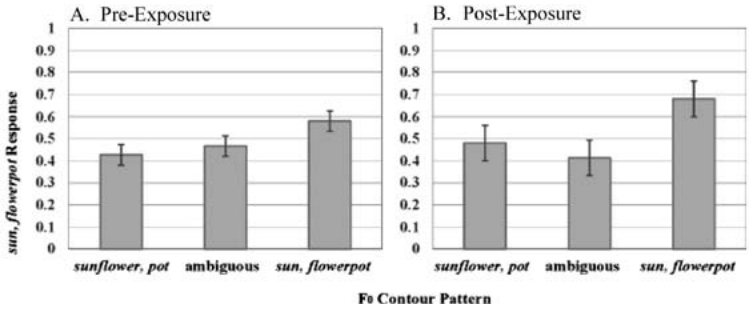


Figure 6. Proportion of *sun, flowerpot* responses as a function of the F_0 contour pattern grouped by exposure.

6 and 4, it is suggested that the EFL learners tended to weigh the F_0 contour pattern of *sun, flowerpot* heavier than the durational pattern unless the durational pattern clearly indicated the opposite (i.e., *sunflower, pot* interpretation).

In sum, these results are consistent with the hypothesized cue-weighting shift by the EFL learners as a function of the intensive exposure to the English-speaking environment during the one-month study abroad program. That is, the degree of the F_0 contour pattern effect increased after exposure, whereas the durational pattern effect remained fairly stable before and after exposure.

DISCUSSION

An important assumption behind the notion of cue-weighting shift is that the speech signal and its linguistic context provide redundant cues for a participant (e.g., Lieberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). This does not imply that all the available cues play equally significant roles in the listener's perception. Rather, to maximize communication efficiency, it is necessary for the listener to pay attention to the most critical cues and assign appropriate weights to each cue. These weighting assignments need to be flexible so that the listener can cope with the variability of listening conditions. In this sense, several studies (including studies of speech perception in the presence of background noise and

hearing impairment) have suggested the possibility of a cue-weighting shift (for an extensive review of the available data, see Assmann & Summerfield, 2004).

In contrast to the types of cue-weighting shift involved in interpreting variability in listening conditions, there is another type of cue-weighting shift that specifically hypothesizes the shift as a function of development. The existing literature on phoneme discrimination has suggested that child participants are capable of attending to multiple acoustic cues simultaneously, and that children weigh cues differently from adult participants (e.g., Mayo & Turk, 2004; Nittrouer & Miller, 1997; Sussman, 2001; also see Jusczyk, 1993 for theoretical discussion). With respect to ambiguous phrase resolution, research has suggested that the relative weighting of the F_0 contour pattern and durational pattern cues change over the course of development.

Language development also includes non-native language development. This research was concerned with how adult EFL learners develop the skills to use prosody to segment a spoken sentence into short, lexical/syntactic units.

In this study, the results from EFL learners were compatible with the developmental cue-weighting shift hypothesis. As intended by the research design, there was a clear effect of durational pattern cue, which was fairly stable across the exposure conditions. That is, in the pre-exposure data, the proportion of the *sun, flowerpot* response as a function of the durational pattern gradually increased according to the five steps, from 0.02 (*sunflower, pot* endpoint) to 0.98 (*sun, flowerpot* endpoint). In the post-exposure data, the increase was from 0.09 to 0.92, respectively. The slight differences in the slope are also noteworthy (Figure 5). The effect of the durational cue is clearer at the endpoints (0.02 and 0.98) in the pre-exposure data than in the post-exposure data (0.09 and 0.92). In other words, the EFL learners were more confident in decision making when they heard the endpoint durational patterns regardless of the F_0 contour patterns. This may suggest a decreased cue strength of the durational pattern after exposure.

The change with the F_0 contour pattern cue appears to be more promising in

terms of the hypothesis of cue-weighting shift by EFL learners. Although only the *sun, flowerpot* endpoint F_0 contour pattern was affected by the exposure, the effect is rather impressive given the wider distance between the *sun, flowerpot* F_0 contour pattern (the dotted line with circles) and the other two lines in Figure 6. Prior to exposure, the EFL learners were confused when they heard the *sun, flowerpot* F_0 contour pattern combined with the ambiguous variations of durational patterns. That is, the proportion of the *sun, flowerpot* responses were 0.57 when the durational pattern was at the midpoint of the five levels, and 0.43 when the durational pattern was one level closer to the other interpretation. However, after exposure, these proportions changed to 0.60 and 0.87, suggesting that the EFL learners came to rely more on the F_0 contour pattern cue when the durational pattern cue was incongruently ambiguous. Together with the possible decrease in cue strength of the durational pattern cue, the increase in the F_0 contour pattern cue strength appears to be a reflection of the cue-weighting shift after intensive exposure during the one-month study abroad program.

With regard to the first language development, a comparison between Figure 4 (this study's results) and Figure 7 (cited from Yoshida, 2007) reveals a striking similarity in the direction of cue-weighting shift. It is noteworthy that these two studies performed the same investigation using the same material for different populations, i.e., children as native speakers and adult EFL learners. The panels of five-year-old children (Figure 7, panel A) and pre-exposure EFL learners (Figure 4, panel A) resemble each other, and so are the panels of 7-year-old children (Figure 7, panel B) and post-exposure EFL learners (Figure 4, panel B). In the Figures of 5-year-olds and pre-exposure EFL learners, the three lines representing the three levels of F_0 contour patterns (*sunflower, pot*, ambiguous, sun, and *flowerpot*) are relatively close to each other. In contrast, in the Figures of 7-year-olds and post-exposure EFL learners, the line representing the F_0 contour pattern of *sun, flowerpot*, is different from the other two lines.

Overall, the effect of the *sun, flowerpot* F_0 contour pattern was overwhelming

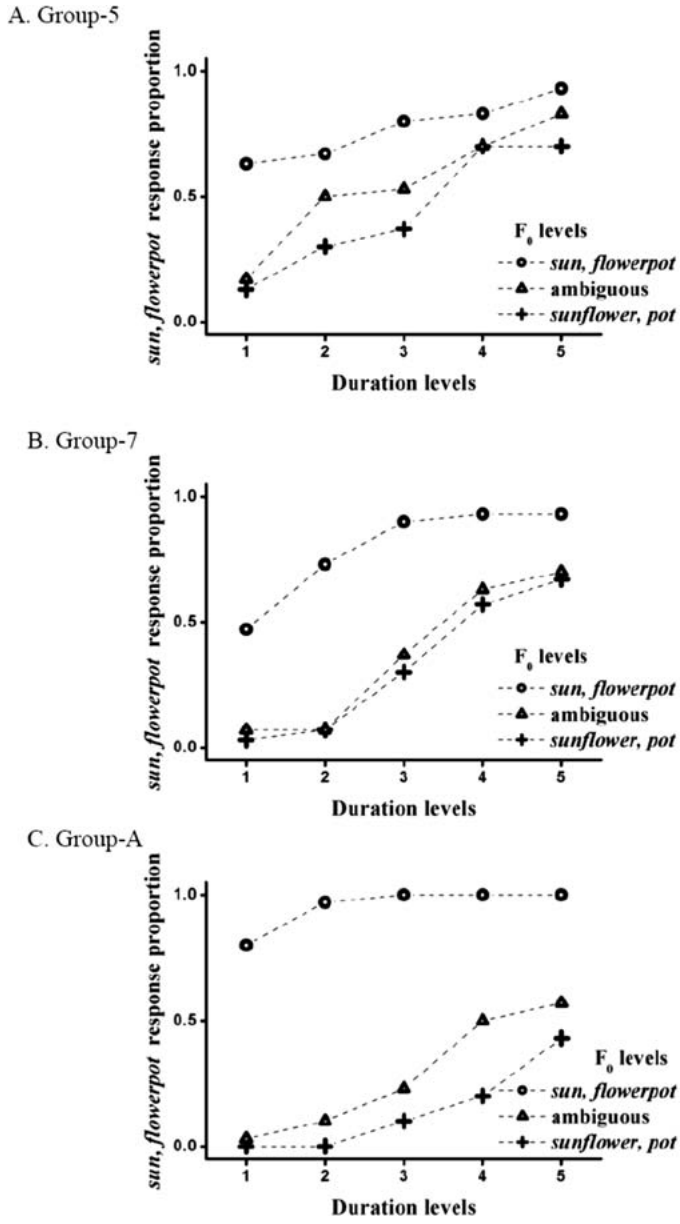


Figure 7. Proportion of *sun, flowerpot* responses as a function of the Duration and F_0 patterns grouped by age. (Yoshida, 2007, p. 37)

both in this study and in Yoshida (2007). This is probably a limitation due to the audio stimuli. Future studies should examine this issue using a different set of experimental materials.

In conclusion, the results suggest that a cue-weighting shift occurred for EFL learners with the F_0 contour pattern cue becoming stronger after intensive exposure to spoken English during the one-month study abroad program in Australia. Together with the findings of previous studies, this study supports the hypothesis that a developmental cue-weighting shift can apply for both native and non-native English developments.

Acknowledgements

I am grateful to Dr. William F. Katz from the University of Texas at Dallas for his guidance and support from the very beginning of this research. I also thank Dr. Takayuki Kagomiya from the National Institute National Institute for Japanese Language and Linguistics for his guidance in interpreting the statistical results. Most importantly, I thank the EFL learners who volunteered to participate in this study.

Notes

1 The prosodic properties of the acoustic signal also include amplitude. However, amplitude plays a relatively minor role in prosodic disambiguation (e.g., Streeter, 1979). Amplitude may play a major role if either the durational pattern or the F_0 contour pattern cues are masked. One example is whispered speech, in which F_0 variation (a property of voiced segments) is unavailable.

References

Assmann, P. F., & Summerfield, A. Q. (2004). The perception of speech under adverse conditions. In S. Greenberg, W. A. Ainsworth, A. N. Popper & R. R. Fay (Eds.), *Speech processing in the auditory system* (pp. 231–308). New York: Springer.

Beach, M. C. (1991). The interpretation of prosodic patterns at points of syntactic structure ambiguity: Evidence for cue trading relations. *Journal of Memory and Language*, *30*, 644–663.

Beach, M. C., Katz, W. F., & Skowronski, A. (1996). Children's processing of prosodic cues for phrasal interpretation. *The Journal of the Acoustical Society of America*, *99*, 1148–1160.

Boersma, P., & Weenink, D. (2004). PRAAT: doing phonetics by computer, version 4. 2. 25 [Computer software]. Amsterdam, The Netherlands: www.praat.org.

Cooper, W. E., & Paccia-Cooper, J. (1980). *Syntax and speech*. Cambridge, MA: Harvard University Press.

Jusczyk, P. W. (1993). From general to language-specific capacities: The WRAPSA model of how speech perception develops. *Journal of Phonetics*, *21*, 3–28.

Lehiste, I. (1973). Phonetic disambiguation of syntactic ambiguity. Glossa, *7*, 107–122.

Lehiste, I., Olive, J. P., & Streeter, L. A. (1976). Role of duration in disambiguating syntactically ambiguous sentences. *The Journal of the Acoustical Society of America*, *60*, 1199–1202.

Lieberman, A. M., Cooper, F. S., Shankweiler, D. P., & Studdert-Kennedy, M. (1967). Perception of the speech code. *Psychological Review*, *74*, 431–461.

Mayo, C., & Turk, A. (2004). Adult-child differences in acoustic cue weighting are influenced by segmental context: Children are not always perceptually biased toward transitions. *The Journal of the Acoustical Society of America*, *115*, 3184–3194.

Mertis, J. (2003). MeV: Measure, edit & view, version 6.01, Release 1.7 [Computer software]. Rumford, RI: www.mertus.org

Nittrouer, S., & Miller, M. E. (1997). Predicting developmental shifts in perceptual weighting schemes. *The Journal of the Acoustical Society of America*, *101*, 2253–2266.

Price, P. J., Ostendorf, M., Shattuck-Hufnagel, S., & Fong, C. (1991). The use of prosody in syntactic disambiguation. *The Journal of the Acoustical Society of the America*, *90*, 2956–2970.

Scott, D. R. (1982). Duration as a cue to perception of a phrase boundary. *The Journal of the Acoustical Society of America*, *71*, 996–1007

Streeter, L. A. (1978). Acoustic determination of phrase boundary perception. *The Journal of the Acoustical Society of America*, *64*, 1582–1592.

Sussman, J. E. (2001). Vowel perception by adults and children with normal language and specific language impairment: Based on steady states or transitions? *The Journal of the Acoustical Society of America*, *109*, 1173–1180.

Shattuck-Hufnagel, S., & Turk, A. E. (1996). A prosody tutorial for investigators of auditory sentence processing. *Journal of Psycholinguistic Research*, *25*(2), 193–247.

Yoshida, M. (2007). *Children's use of prosodic information to understand and produce phrasal distinctions in American English*. (Unpublished doctoral dissertation). University of Texas at Dallas.

Yoshida, M., & Katz, F. W. (2004). Children's use of prosody to identify ambiguous sets of compound nouns. *The Journal of the Acoustical Society of America*, *116*, 2645. https://doi.org/10.1121/1.4785551

Yoshida, M., Katz, W. F., Henley, S. S., & Golden, R. M. (2007, July). Modeling children's and adults' prosodic-cue perception for compound word ambiguity resolution Poster presented at the 40th annual meeting of the Society for Mathematical Psychology, Irvine, CA.