PIONEER
ACADEMIC PUBLISHING LIMITED

Journal of Linguistics and
Communication Studies
ISSN 2958-0412
www.pioneerpublisher.com/jlcs
Volume 3 Number 2 June 2024

The Use of Prosodic Cues in Resolving Ambiguity of Relative Clause Attachment — Prosodic Disambiguation of Chinese EFL Learners

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doi:10.56397/JLCS.2024.06.08

Abstract

Studies of prosodic disambiguation in second language production can help to explain the development of a learner's L2 prosody. Previous studies on prosodic disambiguation have found that Chinese EFL learners are capable of using prosodic cues for both boundary marking and focus encoding, but somewhat differently from native English speakers. No clear understanding has yet been obtained about their use of word prominence and prosodic boundary in their speaking production for RC attachment disambiguation. Thus, by using a read-aloud task at sentence level, the present study investigates whether Chinese EFL learners can produce prosodic boundaries and word prominence to disambiguate RC attachment ambiguous sentences in a way similar to native English speakers when informed of the ambiguities in advance. Also, the study gropes into the relationship between English proficiency level and L2 English prosodic disambiguation. The findings in this study will argue for prosodic disambiguation training in foreign language teaching.

Keywords: prosodic disambiguation, syntactic ambiguity, L2 proficiency

1. Introduction

Syntactic ambiguity has been widely studied in both native (L1) and second languages (L2) to investigate how parsers coordinate multiple information and resources to resolve ambiguity. Therefore, research on syntactic disambiguation can reveal sentence parsing strategies, specifically the attachment preference for a certain structure (Snedeker & Trueswell, 2003), such as the prepositional phrase attachment and the relative clause (RC) attachment.

Prosody is one of the crucial elements in spoken language comprehension. As Snedeker and Trueswell (2003) claimed, speakers of a language share certain implicit knowledge about the relationship between prosody and syntax. Different from written text, the message in spoken language can be conveyed through prosody. Prosody mainly refers to the suprasegmental properties of speech, including stress, rhythm, and intonation which realized by changing the fundamental frequency (F0), duration, and amplitude (Cutler & Swinney, 1987). Prosody helps listeners with their word recognition, syntactic parsing, providing information on the structure of the utterance and the speakers' affective mode. Another

important function of prosody is to segment the utterances into smaller phrases. The so-called prosodic phrasing can reflect the syntactic structure of a utterance. In the field of study examining the effect of prosodic phrasing on syntactic structure, prosodic disambiguation has been a particular interest. Some syntactic ambiguities can be successfully resolved by the placement of prosodic boundaries, especially for bracketing ambiguities. Listeners make use of the prosodic boundary as well as the syntactic boundary to determine the alternative interpretation of ambiguous sentence while reducing comprehension bias (Snedeker & Trueswell, 2003; Nakamura et al., 2012). Even child speakers and listeners reliably identify prosodic cues to resolve syntactic ambiguity (Warren & Schafer, 2011). Nevertheless, results of prosodic disambiguation in L1 production have been mixed. Some studies found that native speakers reliably use a prosodic strategy to disambiguate sentences. Others, however, demonstrated that the use of prosodic disambiguation relies on whether a speaker's awareness of ambiguous points is raised consciously in advance. Still, a couple of research indicated that the task type, which contains a communicative goal, can drive speakers to disambiguate syntactically ambiguous utterances through prosodic cues.

Sentence like *Sara met the sister*$_{NP1}$ *of the actress*$_{NP2}$ *[who was pregnant]*$_{RC}$. contains a RC attachment ambiguity. This same sequence of words may be associated with more than one syntactic structure. Low attachment can be understand as *Sara met the sister of the pregnant actress,* while high attachment is *Sara met the pregnant sister of the actress.* Several studies have confirmed that native English speakers revealed a default preference for low attachment readings in the absence of prosodic information (Fodor, 2002) when processing this kind of ambiguity. The intended meaning of RC attachment ambiguity structure can also be distinguished by bracketing the sentence in different ways. When processing RC attachment sentences, native English speakers are mainly affected by prosodic cues such as the relative strength of prosodic boundaries after NP1 and after NP2 (Clifton et al., 2002; Jun, 2003) or the relative prominence of the two nouns (Jun & Bishop, 2015).

The prosodic cues employed to resolve ambiguity may vary across languages, reflecting differences in prosodic systems. Despite the clear cross-linguistic variation, a majority of the research was done on native speakers (Jun, 2003; Fodor, 2002). However, comparing prosodic disambiguation of a certain syntactic ambiguity structure across languages can reveal how a certain prosodic structure reflects the underlying syntactic structure. But the fact is that few studies have been done to explain how prosodic cues function in L2 learners' syntactical disambiguation. There is a lack of systematic investigation on the prosodic disambiguation in L2 production and perception. Even though RC attachment ambiguity structure is relatively complex and infrequently used in spontaneous speech, prosodic resolution of RC attachment sentences by L2 speakers will give insights into the prosodic aspects of the target language they use to communicate. Meanwhile, given the essential role of L2 proficiency level in L2 prosodic production (Riazantseva, 2001), L2 proficiency levels may also affect L2 learners' production of prosodic disambiguation. Thus, the aforementioned concerns motivated the present study to examined whether Chinese English learners of different proficiency levels can produce reliable prosodic cues to disambiguate syntactically ambiguous English sentences like native English speakers in their the resolution of the RC attachment ambiguity. With the findings indicated from the study, it is hoped that the relationship between syntax and prosody of English education in Taiwan can be paid more attention to and then be more effective and efficient through explicit instruction.

2. Literature Review

2.1 Prosodic Disambiguation in First Language

Prosody is a hierarchical organization of speech which is cued by suprasegmental properties such as F0, duration and amplitude. It has both phonological and phonetic aspects. The phonological aspect is the hierarchical organization of segments into constituents (e.g., intonational phrase, prosodic phrases, Syllable) with a pattern of prominences. The phonetic aspect is the set of acoustic parameters (e.g., stress, length, tone, intonation) that provide evidence for prosodic organization. The prosodic system of English consists of two parameters summarized as word prominence and prosodic boundary. English marks word prominence with pitch accents, or well-defined pitch shapes, which is usually associated with

words or syllables to be accented (new information or salient information). Pitch accents are phonetically realized as pitch movements and increased intensity. On the other hand, prosodic boundary are marked as phrase accents, boundary tones, or final lengthening and pauses within intermediate phrases or intonational phrases. The four combinations of phrase accents and boundary tones constitute the 4 basic intonation types (Pierrehumbert & Hirschberg, 1990).

K. Lee and Watson (2011) showed that English speakers listening to sentences with RC attachment ambiguity were more likely to identify a noun as the head of the RC when it carried a pitch accent. Moreover, Jun and Bishop (2015) also found that listeners were biased toward the more prominent noun as the head of the RC and that this effect of word prominence was persistent even when the boundary cues were directed toward the other syntactic phrasing. Compared with similar studies mentioned above, Snedekera and Trueswell (2003) focused on the interaction between the speaker and the hearer. This division had led to some important advances in the understanding of prosody. In their research, a referential communication task was designed to determine the conditions under which speakers produce and listeners use prosodic cues to distinguish alternative meanings of a syntactically ambiguous phrase. Results showed that the speaker's prosody affected listener's interpretation prior to the onset of the ambiguous phrase, thus demonstrating that prosodic cues not only influence initial parsing, but can also be used to predict material which has yet to be spoken. That is to say, informative prosodic cues depend upon speakers' knowledge of the situation: speakers provide prosodic cues when needed; listeners use these prosodic cues when present.

Speakers' use of prosody for disambiguation has also been found in production studies. For example, Kraljic and Brennan (2005) investigated English speakers' production of sentences with PP attachment ambiguity, as in *Put the dog [in the basket]*$_{PP}$ *on the star*, in which the prepositional phrase *in the basket* can specify either the dog (modifier interpretation) or the location at which the dog is to be placed (goal interpretation). The results of their production experiment indicated that for modifier interpretations, the duration of the basket and the subsequent pause was longer than the duration of the dog and its subsequent pause. The use of prosody in Chinese has also been examined in speech production and perception. It was demonstrated in Shen (1993) that pause insertion, F0 lowering, intensity reduction, pre-boundary lengthening, and laryngealization at the prosodic boundary were the acoustic correlates to prosodic disambiguation. It has been proposed that pause is the primary prosodic cue and pre-boundary lengthening is less important.

To sum up, it is showed that speakers can employ different prosodic cues to resolve ambiguity and convey the alternative meanings of an ambiguous sentence. The major acoustic correlates of prosodic cues that speakers usually use include duration, F0, prosodic boundray, intensity and pause. However, the mixed findings from relevant studies of prosodic disambiguation in L1 production might be a result of different methodologies. Some methodologies require speakers to use information available in the context to clarify ambiguous utterances. Others need speakers to pay much computational attention when uttering ambiguous sentences. Since methodology can profoundly affect the relationship between prosody and syntax, it is more feasible to examine use of prosodic disambiguation in conditions where production of prosodic cues is needed, such as reading aloud task at sentence level. Baek and Yun (2018) showed that prosodic cues for disambiguation were saliently produced only when participants were explicitly attempting to differentiate competing interpretations in the absence of a disambiguating context. Similarly, it is also reported that the salience of disambiguating prosodic cues diminished when alternate sources of disambiguation information, such as biasing contexts, were present for the listeners. Therefore, the choice of methodology in the present study was motivated by the results of previous studies mentioned above.

2.2 Prosodic Disambiguation in Second Language

Recent years have witnessed an increasing investigation into the L2 learners' use of prosody in L2 processing. Studies have reported that the effect of prosody is partial and related to the learners' L1 background. For example, Chinese L2 learners were suggested to be less sensitive to prosodic cues than learners from other language groups (e.g., Mexican, German, French, Swedish,

etc.; Ying, 1996). The effect of prosody is also found to be related to the learners' learning experience. The second-semester college-level learners were less sensitive to prosodic cues than the fourth-semester learners. Moreover, Nickels and Steinhauer (2018) using ERPs found that Chinese learners of English showed different processing patterns from German learners and native English speakers, which might be due to their low proficiency. A further study found that L2 learners displayed different processing strategies even when their L1 and L2 had identical ambiguity and disambiguation pattern. In addition, the learners might be less able to integrate prosodic information to other domains of information compared to native speakers (Nakamura et al., 2020). The above findings indicate that L2 learners' prosodic disambiguation can be attributed to a variety of factors, such as L2 proficiency, L1 background, low sensitivity to prosodic cues, and difficulty in information integration.

However, relatively, few studies have tackled L2 prosodic disambiguation. Cross-linguistic differences in prosodic disambiguation are expected to influence L2 learning. To examine the effects of prosodic disambiguation on L2 learners, the existing literature has focused specifically on how L2 learners perceive prosodic cues to resolve syntactically ambiguous utterances in listening. Using a forced-choice continuation selection task, Hwang and Schafer (2006) justified that Korean-speaking learners of English at four levels of English proficiency (i.e., extra-advanced, advanced, intermediate, and beginning) were able to use relative boundary size to disambiguate Early Closure (EC) versus Late Closure (LC) English utterances. The authors found that prosody contributed to the processing of syntactic ambiguities by the L2 learners, regardless of their English proficiency levels. Additionally, it was also found that correct responses increased as proficiency increased.

Yang (2010) studied the use of prosody for disambiguation by Taiwanese-English L2 speakers at two proficiency levels (advanced and intermediate). In a read-aloud task, the speakers produced ambiguous English sentences with coordinate structures, such as the little (a) dogs (b) and cats chased a ball, where the prosodic boundaries at (a) and (b) were expected to help resolve the ambiguity. This study found that the advanced L2 speakers produced strong boundary cues at (a) when the adjective modified both of the following nouns, whereas these cues appeared at (b) when the adjective modified only the immediately following noun. This pattern was consistent with that the control group of native English speakers. In contrast, speakers with intermediate L2 proficiency produced both boundaries with a similar duration regardless of the intended interpretations and thus did not exhibit significant use of prosody for disambiguation.

Jackson and O'Brien (2011) elicited German sentences from English-German L2 speakers to examine their use of prosodic cues for the resolution of temporary PP attachment ambiguity. Their results showed that the L2 speakers used different prosodic cues for the different attachments, such as pre-boundary lengthening, pauses, and a phrase-initial pitch accent. Moreover, although the L2 speakers varied in their L2 German proficiency test scores, there was no significant relationship between their German proficiency and the extent to which they made use of these prosodic cues for disambiguation.

Xue (2015) focused on the prosodic features in speech processing by Chinese EFL learners. Her study is relatively comprehensive since the production, comprehension as well as the perception were included in her experimental design to compare the role of prosody in syntactical and pragmatical disambiguation with native English speakers as the control group. Results of the three experiments showed that Chinese learners who were not informed of the research purpose in advance did not produce reliable prosody for resolution. Her findings indicated that the awareness of the research purpose would help EFL learners improve their prosodic ability. Along the same line, Zhang and Ding (2020)'s study also suggests that learners' failure to use prosodic cues may be attributed to a lack of ambiguity awareness and difficulty in information integration, rather than their low sensitivity to prosodic cues.

Furthermore, Zhang, et al. (2018) adopted a game-based production experiment to examine the prosodic realization of syntactically ambiguous sentences by Chinese learners of English. Subjects followed the guides and instructed listeners to move objects on the computer screen by using the critical instructions with PP-attachment sentences. It

was found that both the native speakers and Chinese EFL learners used pre-boundary lengthening and pause to distinguish the alternative meanings of the ambiguous PP-attachment sentences. While native speakers also showed domain-initial strengthening, greater pre-boundary lengthening and longer pause than the learners. However, only pitch reset was measured in this study. Other pitch changes, such as pitch slope, should also be included in the acoustic analysis, as it has been found that Chinese speakers and English speakers employed these two cues differently.

Most recently, Baek (2021) investigated the use of prosodic cues for syntactic ambiguity resolution by first language (L1) and second language (L2) speakers. In a production experiment, sentences with RC attachment ambiguity were elicited in three language conditions: native English speakers' L1 productions as well as Korean-English bilingual speakers' L1 Korean and L2 English productions. Interestingly, he found out that through the bilingual speakers have learned to use the English phonological categories such as pitch accents for disambiguation, their use of phonetic cues to realize these categories still differed from that of native English speakers. In addition, they did not show a significant use of boundary cues. His study also added insights in relation to the typological differences between the prosody of English and of Korean.

By investigating whether second language learners can conduct disambiguation and perceive ambiguity, studies in this line are especially helpful in providing more empirical insights for prosodic research on EFL learners and more enlightenment for the teaching of spoken English and grammar.

2.3 Research Gaps

It can be concluded that though these studies are carried out in different target languages, the language learners do have some differences from the native speakers, especially in durational pattern. The prosodic cues indicating the specifically syntactic meaning might be language-specific. Although A. L. Fultz (2008), Yang (2010) and Jackson and O' Brien (2011) have made important contributions to our understanding of prosodic disambiguation by L2 speakers, their studies shared theoretical and analytical limitations. Firstly, prior studies have suggested that the learners' use of prosody to disambiguate in speech production is related to their language experience and proficiency, and that it may be influenced by their native language. Secondly, there has been much research on the use of a single type of prosodic cue in ambiguity resolution, either it is word prominence or prosodic boundaries. Another sort of research otherwise merely focused on prosodic phrasing phenomena in disambiguation. But when it comes to word prominence, another significant parameter in prosodic typology (Jun, 2014), there has been a dearth of studies on how L2 speakers utilize this cue in producing ambiguous sentences in the target language. Lastly, studies on the prosodic disambiguation in RC attachment ambiguity can hardly be found in this field of research, and the effect of L2 proficiency is rarely considered, either. Based on the inconsistent findings and research gaps discussed above, the present study would address the variable of L2 proficiency when investigating prosodic disambiguation in L2 learners' speech production experiment, and enrich the research along this line by considering prosodic cues in both word prominence and prosodic boundary.

3. Research Question

The purpose of the present study is to investigate whether Chinese English learners can use prosodic cues (word prominence and prosodic boundary) to disambiguate syntactically ambiguous utterances of RC attachment in their speech. Additionally, the study aims to explore the relationship between English proficiency level and prosodic disambiguation of Chinese EFL learners' speech. To consistently create conditions where no other disambiguation means is useful at hand, and enough attention was sustained and paid to producing ambiguous utterances, the present study conducted a reading aloud task at sentence level when seeking to answer the following research questions:

(1) Are Chinese EFL learners capable of distinguishing disambiguation with prosodic cues from both aspects of word prominence and prosodic boundary? If so, are there any differences between the Chinese EFL learners and native English speakers?

(2) Do English learners with different proficiency levels reliably produce prosodic cues to convey the appropriate meaning for ambiguous RC attachment utterances when

informed of the ambiguous points?

4. Methodology

4.1 Subjects

The subjects in the production experiment will be grouped into EFL learners and the native speakers. 5 English speakers and 30 EFL learners of different proficiency level will be recruited in the experiment. To assess the level of learners L2 linguistic knowledge, the Oxford Quick Placement Test (QPT) was employed. The test contains a number of exercises which tap into learners' pragmatic knowledge and language skills. The scoring system of the test also establishes an equivalence between the test scores and the levels of CEFR (Common European Framework of Reference for Language). Speakers with dialect or creaky voice quality will be excluded considering that the records may interfere with the accuracy of pitch measurement. Finally, three groups of subjects will perform in the present study. Group 1 consist of students with intermediate-level of English proficiency. Another part of students with advanced-level of English proficiency participate in Group 2. As a comparison group, Group 3 includes 5 English native speakers who are born and raised in America.

4.2 Materials

To elicit the production of ambiguous sentences in English, 12 English sentences with RC attachment ambiguity will be used as stimuli. The English sentences were adopted from previous studies (Jun & Bishop, 2015a, 2015b), in order to ensure that the selected sentences had the desired two ambiguous readings, two native speakers of English (not the subject) will be invited to check the semantic and grammatical accuracy, and then indicate their preferences for each sentence on a 5-point scale (e.g., Question: Who was dishonest? Choices: must be the boss/ more likely the boss/ equally likely/ more likely the clerk/ must be the clerk). If none of the sentences receive more than one response at either end of the scale, then it can be confirmed that they can be interpreted as ambiguous. Slight lexical changes will be done to ensure the sentences are easier to pronounce and also less biased towards either of the readings. The final list of stimuli is given in Appendix. To avoid the mechanical production of target structures, filler sentences of other types of ambiguity will also be inserted between each targeted sentence.

4.3 Production Task

The production of prosodic disambiguation relies mainly on the fact that speakers are aware of the alternative meanings of an ambiguous utterance, and think it is needed. Or if no other means other than prosodic means are available for syntactic disambiguation, speakers might consciously produce prosodic boundaries. In this sense, use of prosodic disambiguation in spoken language may occur under certain specific circumstances. Thus, the task in the present study is to read out the appropriate meaning for each ambiguous sentence aloud twice (one reading after the other), as indicated by the highlighted sentences (Figure 1). The order between the two attachment readings were counterbalanced across participants and across items. This choice of methodology was motivated by the results of a previous study (Baek & Yun, 2018), which showed that prosodic cues for disambiguation were saliently produced only when participants were explicitly attempting to differentiate competing interpretations in the absence of a disambiguating context. Otherwise, salience of disambiguating prosodic cues diminished if biasing contexts of disambiguation information were present for the listeners.

Sara met the sister of the actress who was pregnant.

(a) it was the sister who was pregnant.

(b) it was the actress who was pregnant.

Figure 1. Task sample

4.4 Procedure

The experimental session will take place in a sound-treated recording studio. All subjects were recorded individually. Each target sentence will be presented on a computer screen along with two short sentences representing two different interpretations, as shown in Figure 1. Before formal recordings, they are provided with the materials and are given enough time depending on individual differences to plan and monitor their reading. At the end of the session, all subjects complete a brief questionnaire on their language background. Their language background information of the questionnaire will include: age of starting learning English speaking and reading, self-evaluated English proficiency of speaking, listening, reading and

writing

(Self-evaluated English proficiency was rated on a 10-point scale from 0 (none) to 10 (perfect)).

The collected data will consist of two language data sets (L1 English and L2 English) with the former (L1 English) consisting of 120 utterances (12 sentences × 2 attachments × 5 speakers) and the latter (L2 English) 720 utterances (12 sentences × 2 attachments × 40 speakers). Two professors who specialized in phonetics will be invited to evaluate sentences produced by Chinese EFL learner so as to see whether they had employed reliable prosodic cues to disambiguate stimuli sentences. Only sentences with correct prosody will be selected for further study.

4.5 Acoustic Measurements

The total utterances will be word-segmented by hand in Praat, version 6.3.10 (Boersma & Weenink, 2019). Praat is a tool used for doing phonetics by computer which can analyse, synthesize, and manipulate speech and analyzes different aspects of speech including pitch, formant, intensity, and voice quality. In each recorded sentences, three intervals and two pauses were segmented as shown in the example below:

Sara met the sister (pause 1) of the actress (pause 2) who was pregnant.
NP1 NP2 RC

After segmentation, the following acoustic measurements were extracted: (i) the duration of pauses (ms), (ii) the mean pitch of the intervals (Hz), and (iii) the mean intensity of the intervals (dB). The duration of pause is an index of prosodic boundary and the mean pitch mean intensity of the intervals is an index of word prominence following Baek (2021)'s research. Individual differences in speaking rate will be normalized across speakers by dividing the duration of each interval from that of the entire utterance (Zhang et al., 2018). Pitch values in Hz were converted into semitones to control for individual variation. The use of mean intensity measurements was motivated by previous studies reporting a relationship between word mean intensity and word prominence, such as focus marking (A. Lee & Xu, 2012; Y. Lee et al., 2015).

4.6 Data Analysis

To examine whether there are any differences in prosody when the speaker utter the intended meaning of both low and high attachment RC sentences between different Language groups, a series of mixed two-way ANOVA with attachment conditions (low attachment and high attachment) as within-subjects variable and Language groups (native speaker, intermediate learner, and advanced learner) as between-subjects factor will be conducted to test the significance of pause duration, pitch and intensity changes respectively.

First of all, the mean pause duration ratios, mean pitch and intensity of each intervals for the three groups under two attachment conditions will be summarized in three separate figures. Then the mixed two-way ANOVA will be computed on pause duration ratios. If the results show that the changes are significant across the two attachment conditions ($p < 0.01$), and significant differences also exist between the three language groups ($p < 0.01$), post-hoc pairwise comparisons will be conducted to determine which item in the utterance caused the significant differences between the three groups. In the same way, mixed two-way ANOVA and post-hoc analysis will be done subsequently to test the significance of pitch and intensity variation between the three groups across two attachment conditions.

5. The Expected Results

5.1 Word Prominence and Prosodic Boundary

It has been demonstrated in Chinese that pause insertion, F0 lowering, intensity reduction, pre-boundary lengthening, and laryngealization at the prosodic boundary were usually the acoustic correlates used to prosodic disambiguation. It has also been proposed that pause is the primary prosodic cue. Comparative studies between the prosodic cues used in English and Chinese conducted before found that the way their use of pitch changes differed. Therefore, the prosodic cues indicating prosodic boundaries may be language specific. For this reason, the present study assumes that the Chinese ELF learners may employ prosodic cues differently from native speakers.

Native English speakers are expected to use both word prominence and prosodic boundary cues for disambiguation, that is, native speakers' productions of RC attachment ambiguity structure would differ depending on what kind of ambiguity readings they intend to deliver. On the contrary, English is an intonation language, while Chinese is a tonal language, in which pitch is used to distinguish lexical items at the word level and signal variations in intonation at the sentence level (Zhang, 2012). Thus, Chinese EFL learners would use prosodic boundaries more often since their English production might be affected by L1 transfer and thus lacking a prosodic parameter of marking word prominence (Baek, 2021).

It has also been suggested in Zhang et al. (2018) that the learners might pause more often, resulting in more prosodic boundaries. In such a case, the learners presumably use relative prosodic boundary strength to resolve syntactic ambiguity. Therefore, when Chinese EFL learners produce sentences with RC attachment ambiguity in English, they would be expected to use prosodic boundaries after NP1 and NP2 as native speakers do, but to fail to manipulate the prominence of NP1 and NP2 in a native-like manner.

5.2 L2 Proficiency Level

Previous studies have shown that L2 proficiency level is a factor in the prosody of L2 production and perception. It is presumed in present study that advanced learners could alter prosody to express the appropriate meaning for an ambiguous utterance like native speakers to a larger degree. On the contrary, intermediate learners may behave much differently from native speakers. It may also be the case that advanced learners could use more distinguished pause duration to produce prosodic boundaries than native speakers (Yang, 2010). The hypothesis is that the advanced Chinese EFL speakers might have established new category representations for pitch accents, namely, relative pitch targets for tones and their alignment with lexical items, while having difficulty doing so for prosodic boundaries, such as target durations of a lengthened unit and its subsequent pause as well as the placement of prosodic boundaries in relation to syntactic boundaries. Besides, the advanced English learners might have also learned how to use the English phonological categories such as pitch accents for disambiguation, but their use of phonetic cues to realize these categories still differed from that of native English speakers. On the other hand, possibilities to explicate the intermediate learners' prosodic behaviors could be that even if they had learned concepts of the syntactic structure of an utterance, they did not have knowledge about the relationship between prosody and syntax in English. Or even if they had such declarative knowledge, their declarative knowledge could not successfully be converted into procedural knowledge.

6. Conclusion

This study investigates the use of prosodic cues for syntactic ambiguity resolution by native and second language speakers. In the production experiment, sentences with relative clause attachment ambiguity were elicited in three language conditions: native English speakers' production as well as intermediate and advanced Chinese EFL speakers' production. The expected results are that the native English speakers could use both boundary marking (pause) and relative word prominence (elevated pitch and intensity) for disambiguation, while Chinese EFL speakers may mainly rely on boundary marking (pre-boundary lengthening and pause) to resolve ambiguous sentences. Also, the study gropes into the relationship between English proficiency level and L2 English prosodic disambiguation. It is assumed that advanced English learners can intentionally resort to prosodic features to express the appropriate meaning of RC ambiguous sentences, whereas intermediate English learners may perform less desirable than that of the advanced English learners. Besides, even though the advanced English learners might have learned how to use the English phonological categories such as pitch accents for disambiguation, but their use of phonetic cues to realize disambiguation is still differed from that of native English speakers. These findings may support a developmental stage of L2 English prosody. The findings obtained in the present study will provide pedagogical implications for English education in China. It is necessary to enhance explicit teaching of what syntactic structures or constituents are, such as verb phrases, noun phrases, and prepositional phrases. It is of equal importance for English teachers to explicitly execute pronunciation training, especially the production of suprasegmental features such as duration, stress, pitch, and intonation contour. The best way of

pronunciation training is to expose learners to native English-speaking environments.

Nevertheless, the present study still suffers several limitations. Firstly, only the critical constituents of the pause duration, mean pitch and mean intensity are analysed in this study, leaving other prosodic features aside, which has been proved to be an important prosodic cue to mark prosodic disambiguation. Secondly, since it is more uncertain to elicit the sentences from spontaneous speech, reading aloud is the last resort to investigating L2 learners' production of prosodic disambiguation. Thirdly, owing to lack of English learners at elementary level, the findings obtained here cannot provide a more comprehensive evidence for a developmental stage of prosodic disambiguation in L2 production. Finally, results in this study are from a small sample size so it could only provide a tentative conclusion. Thus, further research on production of L2 prosodic disambiguation is clearly needed.

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Appendix A

List of Stimuli

(1) Jennifer blackmailed the boss of the clerk who was dishonest.

(2) Stacey wanted to invite the friend of the secretary who was Asian.

(3) Sara met the sister of the actress who was pregnant.

(4) The drunk man hit the brother of the neighbor who was yelling.

(5) George questioned the brother of the soldier who recently got divorced.

(6) Peter met the uncle of the guest who was a well-known boxer.

(7) The driver talked to the guides of the tourists who were waiting in line.

(8) The receptionist called in the clients of the lawyers who were arguing loudly.

(9) Susanna was dating the cousin of the famous artist who was a veteran.

(10) Rob talked to the coach of the champion swimmer who had a daughter.

(11) Linda helped to carry the child of the young woman who was upset.

(12) Wendy saw the teachers of the naughty students who were outside.