French Prosodic Phrasing in Chinese Learners: ERP studies

Lei XI

Laboratoire de Phonétique et Phonologie (UMR7018, CNRS – Sorbonne Nouvelle), Paris, France
lei.xi@sorbonne-nouvelle.fr

Abstract

Electroencephalography (EEG), as one of the noninvasive electrophysiological methods, has been used to study language for decades. However, most of the studies in the literature focused on language processing in native speakers and EEG has not yet been largely used in second language acquisition, especially with respect to prosody.

Based on my previous acoustic and perceptive studies, we put forward hypotheses linked to how Chinese learners (CL) parse and segment French prosody. In this Doctoral Consortium paper, we will present two experiments, in which the CPS, N325 and N400 components of CL will be examined and compared with those of French native speakers. My main contribution will be the first relevant studies that are likely to provide important cognitive insights in the ability of CL for prosodic phrasing.

Index Terms: prosodic phrasing, CPS, N325, N400, L2 prosody acquisition, French, Mandarin Chinese

1.   Motivation of Research

Studying L2 prosody is a complicated issue because on the one hand, prosody is a language phenomenon covering several subdomains like stress, rhythm and intonation and each of them needs to be examined; on the other hand, "overall prosodic characteristics of second language (L2) speech contribute to the degree of foreign accent" [1] but prosody always only occupies a marginal place in the language teaching classroom.

Prosody has been called "the organization structure of speech" [2]: this structure provides an initial framework for syntactic and semantic parsing, especially prosodic boundaries, which play an important role in word recognition, syntactic structure construction and meaning interpretation (see [3] for a review).

Despite the fact that prosody phrasing is an important tool for language comprehension in communication [4], L2 learners have generally not been taught how to use it in language parsing [5], especially for Chinese learners (CL) learning French prosody. In the literature, research examining problems and difficulties which CL face in learning French prosodic elements are very rare and only a few studies have addressed this issue, for example [6], [7], [8] and [9].

For these reasons, the end goal of my PhD thesis is to investigate how CL acquire French suprasegmental elements from an acoustic, perceptive and electrophysiological perspective, and what problems and difficulties they encounter in this process. The present thesis describes two EEG experiments examining the ability for prosodic phrasing of CL.

2.   Studies Previously Done

The following section briefly presents the results of two published papers produced during the first two years of my PhD studies. They are presented in chronological order. My previous studies [10] and [11], have investigated productions of French rhythm and intonation in CL with different levels of proficiency from acoustic and perceptive point of view:

2.1 Paper A – A pilot study examining productions of three basic French intonation patterns in CL

[10] was my first pilot study about L2 French prosody acquisition problems in CL. In [10], we focused on three basic French intonation modalities (which were final neutral declarative, polar question with/without marker "*est-ce que*" and major continuation according to the terminology in [12]) and we specifically concentrated on F0 patterns. The results showed that, unlike native French speakers (NS), CL always realized little pitch variation range for rising or falling contours and they did not distinguish between different prosodic hierarchical levels.

2.2 Paper B – A pilot study examining final lengthening at prosodic boundaries in CL

[11], in which the same stimuli were used as in [10], was a pilot study examining vocalic and syllabic durations in the utterances, with special focus on French primary final accent. In this study, realizations of French final prominence in CL were examined. The data showed that low proficient CL had a wide irregular temporal variation among segments whereas high proficient CL had an isochrony tendency in their productions, similar to NS, who only lengthened the final vowel at the right edge of prosodic boundaries. However, ignoring the secondary initial accent, which also assumes a segmentation function according to the French canonical metrical template proposed by [13], [14], we did not give a full investigation to this question in [11].

3.   Key Issues: Identification and Solutions

My previous studies revealed CL' problems in the realization of French prosodic boundaries and prominence. The mentioned results from two separate pilot studies motivate us to examine how CL perceive French prosodic boundaries and whether they have the ability for prosodic phrasing. To this end, we are going to use electroencephalography (EEG), a technique with a temporal resolution of less than a millisecond, which provides brain waves without delay and reflects the neural activity relative to the research question, i.e. the event-related potential (ERP). Most psycholinguistic research EEG is rooted in native language processing or first language acquisition and a majority of the studies examine word recognition (N400) or morpho-syntactic parsing (LAN,

P600/SPS) [15]. Using ERP to investigate prosodic processing in second language learners has rarely been explored. To the author's best knowledge, no study has been carried out to investigate how second language learners acquire prosodic elements (see [16] for a review of using ERP in second language research). However, some existing relevant electrophysiological studies provide us with methodologies and experimental protocols to examine French prosodic parsing in CL.

In prosodic domain, [17] was the first study which retrieved an ERP component called CPS (Closure Positive Shift), a paradigm reflecting prosodic phrasing. The subsequent research [18], [19] and [20] suggested that the CPS is a universal reflection of phonological sentence parsing (but at the moment, no study has been done for French) and it exclusively relies on pure prosodic information, independent of other segmental information and input modality.

Some other electrophysiological studies using the MMN and N325 components to examine French lexical stress and prosodic prominence parsing are available in the literature. These studies showed phonological and cognitive representations of the metrical template of isolate French words in NS by using the MMN [21], [22] and N325 [23]; and in combination with the N400, these results demonstrated that NS relied on the metrical structure and in a sentence to interpret and evaluate semantic meaning [24], [25], [26], [27].

4.   Future Works and Road Map

My future two EEG experiments aim to examine French prosodic phrasing in CL and establish an ERP model of L1-L2 prosodic convergence depending on levels of proficiency, inspired by [28].

4.1 Experiment 1: Perception of French prosodic boundaries

In Experiment 1, we are going to investigate the perception of French intonational phrase break in NS and CL. 40-50 pairs of sentences will be prepared as stimuli. In each pair, two sentences have the same segmental information and NS will only distinguish the one from the other by different prosodic boundaries. For example:

Table 1: *Stimulus example for Experiment 1*
(where "#" means prosodic boundary).

	Phrase
Sentence N° 1	*« J'ai vu un château#ce matin. »*
IPA Transcription	/ʒevyɑ̃ʃato#səmatɛ̃/
Translation	I saw a castle this morning.
Sentence N°2	*« J'ai vu un chat#tôt ce matin. »*
Translation	I saw a cat early this morning.
IPA Transcription	/ʒevyɑ̃ʃa#tosəmatɛ̃/

As a first step, we will test the stimuli in NS with the aim of identifying the CPS in French prosodic boundary; in a second phase, we will try to find the CPS in 30-40 CL with different levels of proficiency and analyze amplitude, latency and scalp distribution of ERPs in all CL.

4.2 Experiment 2: Perception of French metrical pattern

In Experiment 2, based on the studies already done with NS, we concentrate on whether CL can perceive French primary final accents and the secondary initial accents in two conditions: isolated words and embedded in sentences. The final goal is to examine whether the French metrical pattern helps CL to segment prosody and process semantic information.

For this purpose, two experimental sessions will be needed:

1. In the first one, we will manipulate 120 trisyllabic French isolate nouns by creating two deviant stress forms [−FA] (without final accent) and [−IA] (without initial accent). The standard and deviant stimuli ([±FA] and [±IA]) will be played to CL and we aim to identify a N325-like component;

2. In the second session, two trisyllabic French nouns will be manipulated as in the first session and then placed in a sentence: one word will be semantically congruent in the sentence whereas the other will be incongruent. The N400 component will be examined in order to evaluate if standard and deviant French metrical patterns have an influence on CL' semantic processing.

4.3 L1-L2 prosodic convergence ERP model

In [28], it has been demonstrated that in late second acquisition, morphosyntactic real-time processing dynamically changes with proficiency and the corresponding ERP components can reflect this kind of tendency. As suprasegmental features in late bilingual acquisition have always been a relatively rare topic in cognitive linguistic research, we will attempt to figure out how the CPS, N325 and N400 change in amplitude, latency and scalp distribution depending on the CL' language proficiency in my two EEG experiments.

5.   Major Contributions of Research

In this present paper, based on conclusions of two previous pilot studies and inspired by recent electrophysiological research in phonetic and prosodic processing, I presented two EEG experiments designed for my PhD research. The major contributions can be summarized as follows:

1. Difficulties and problems in French prosody acquisition only have a limited number of references in the literature. In my PhD thesis, following the prosodic hierarchy, we will fill this literature gap by giving a fully detailed description from acoustic and perceptive points of views;

2. My electrophysiological studies will be the first studies in which prosodic ERP components are used to examine how late second language learners acquire suprasegmental features;

3. We will try to establish a L1-L2 prosodic convergence ERP model and this may provide us new insights about how cognitive activities change throughout the whole acquisition process.

6.   Acknowledgements

7. References

[1] K. Aoyama and S. Guion, "Chapter 16 Prosody in second language acquisition Acoustic analyses of duration and F0 range," *Language experience in second language speech learning: In honor of James Emil Flege*, pp. 281-297, 2007.

[2] M. Beckman, "The parsing of prosody," *Language and Cognitive Processes*, 11, pp. 17-67, 1996.

[3] A. Cutler, D. Dahan, and W. van Donselaar, "Prosody in the Comprehension of Spoken Language: A Literature Review," *Language and Speech*, 40[2], pp. 141-201, 1997.

[4] L. Frazier, K. Carlson and C. Clifton Jr, "Prosodic phrasing is central to language comprehension," *Trends in Cognitive Sciences*, vol. 10, no. 6, pp. 244-249, 2006.

[5] D. M. Chun, *Discourse intonation in L2: From theory and research to practice (Vol. 1)*. Amsterdam/Philadelphia: John Benjamins Publishing Company, 2002.

[6] P. W. Chi Lee, "Contribution à l'étude de l'intonation française prononcée par les Chinois en vue de l'apprentissage," Ph.D. dissertation, Université de Franche-Comté, Besançon, France, 1987.

[7] H. Kockaert and J. Li, *Guide pratique de prononciation française pour des apprenants chinois*. Paris : L'Harmattan, 2008.

[8] S. Landron, J. Gao, Y. Chang and Y. Tian, "Les sinophones," in *La prononciation du français dans le monde : du natif à l'apprenant*, 2016, pp. 193-199.

[9] X. S. Shen, "Ability of learning the prosody of an intonational language by speakers of a tonal language: Chinese speakers learning French prosody," *International Review of Applied Linguistics in Language Teaching*, 28(2), pp. 119-134, 1990.

[10] L. Xi and C. Pillot-Loiseau, "Acoustic and perceptive studies of Chinese learners producing three basic French intonation patterns," in *ICPhS 2019 – 19th International Congress of Phonetic Sciences, August 5-9, Melbourne, Australia, Proceedings*, 2019, pp. 2263-2267.

[11] L. Xi, S. Wachs and R. Ridouane, "Production of French final stressed syllables in Accentual Phrase by Chinese learners: A pilot study," in *Speech Prosody 2020 – 10th International Conference on Speech Prosody, May 25-28, Tokyo, Japan, Proceedings*, 2020, pp. 895-899.

[12] A. Di Cristo, *Les musiques du français parlé*. Berlin/Boston : DE GRUYTER, 2016.

[13] A. Di Cristo, "Vers une modélisation de l'accentuation du français : première partie," *Journal of French language studies*, 9, pp. 143-179, 1999.

[14] A. Di Cristo, "Vers une modélisation de l'accentuation du français (seconde partie)," *Journal of French language studies*, 10, pp. 27-44, 2000.

[15] K. Steinhauer and J. Connolly, "Chapter 9 Event-Related Potentials in the Study of Language," in *Handbook of the Neuroscience of Language*, 2008, pp. 91-104.

[16] K. Steinhauer, "Event-related Potentials (ERPs) in Second Language Research: A Brief Introduction to the Technique, a Selected Review, and an Invitation to Reconsider Critical Periods in L2," *Applied Linguistics*, 35/4, pp. 393-417, 2014.

[17] K. Steinhauer, K. Alter and A. Friederici, "Brain potentials indicate immediate use of prosodic cues in natural speech processing," *Nature Neuroscience*, 2(2), pp. 191-196, 1999.

[18] K. Steinhauer and A. Friederici, "Prosodic Boundaries, Comma Rules, and Brain Responses: The Closure Positive Shift in ERPs as a Universal Marker for Prosodic Phrasing in Listeners and Readers," *Journal of Psycholinguistic Research*, 30(3), pp. 267-295, 2001.

[19] K. Steinhauer, "Electrophysiological correlates of prosody and punctuation," *Brain and Language*, 86, pp. 142-164, 2003.

[20] A. Pannekamp, U. Toepel, K. Alter, A. Hahne and A. Friederici, "Prosody-driven Sentence Processing: An Event-related Brain Potential Study," *Journal of Cognitive Neuroscience*, 17(3), pp. 1-15, 2005.

[21] M. Aguilera, R. Yagoubi, R. Espesser and C. Astésano, "Event-Related Potential investigation of Initial Accent processing in French," in *Speech Prosody 2014 – 7th International Conference on Speech Prosody, May 20-23, Dublin, Ireland, Proceedings*, 2014, pp. 383-387.

[22] N. te Rietmolen, N. El Yagoubi and C. Astésano, "MisMatch Negativity-study showing prelexical sensitivity to both primary Final Accent and secondary Initial Accent in French," *BioRxiv*, 727776, 2019.

[23] N. te Rietmolen, R. El Yagoubi, R. Espesser, C. Magnen and C. Astésano, "Investigating the phonological status of the Initial Accent in French: an Event-Related Potentials study," in *Speech Prosody 2016, May 31-Jun 3, Boston, USA, Proceedings*, 2016, pp. 1181-1185.

[24] C. Astésano, M. Besson and K. Alter, "Brain potentials during semantic and prosodic processing in French," *Cognitive Brain Research*, 18, pp. 172-184, 2004.

[25] C. Magne, C. Astésano, M. Aramaki, S. Ystad, R. Kronland-Martinet and M. Besson, "Influence of Syllabic Lengthening on Semantic Processing in Spoken French: Behavioral and Electrophysiological Evidence," *Cerebral Cortex*, 17, pp. 2695-2668, 2007.

[26] N. te Rietmolen, R. El Yagoubi, A. Ghio and C. Astésano, "The phonological status of the French Initial Accent and its role in semantic processing: an Event-Related Potentials study," in *INTERSPEECH 2017 – 18th Annual Conference of the International Speech Communication Association, August 20-24, Stockholm, Sweden, Proceedings*, 2017, pp. 2436-2440.

[27] N. te Rietmolen, R. El Yagoubi and C. Astésano, "Interplay between metrical and semantic processing in French: an N400 study," *BioRxiv*, 738930, 2019.

[28] K. Steinhauer, E. J. White and J. E. Drury, "Temporal dynamics of late second language acquisition: evidence from event-related brain potentials," *Second Language Research*, 25, 1, pp. 13-41, 2009.