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ACOUSTIC AND PERCEPTIVE STUDIES OF CHINESE LEARNERS PRODUCING THREE BASIC FRENCH INTONATION PATTERNS

Lei Xi¹, Claire Pillot-Loiseau¹

¹Laboratoire de Phonétique et Phonologie (LPP) UMR7018 CNRS / Sorbonne Nouvelle University
lei.xi@sorbonne-nouvelle.fr, claire.pillot@sorbonne-nouvelle.fr

ABSTRACT

The productions of French final neutral declarative, polar question with “est-ce que” and major continuation by seven Chinese learners of French (CL) and six French native speakers (NS) were perceptually (perception tests for two of these intonation patterns) and acoustically analysed (difference between F0 ending and F0 beginning a stress group (F0-diff); F0 range in stress group).

The “est-ce que” questions produced by the NS were perceived as an affirmation, those of the CL as a question. The major continuations of the NS were perceived as a question, those of the CL as an affirmation and a question. For declarative, the CL did a falling contour with a F0 range too small or too large compared to the NS; for rising contour, the same F0-diff and F0 range characterized the polar and the total questions of the CL. Concerning major continuation, unlike NS, CL sometimes perform rising and falling contours.

Keywords: L2 intonation acquisition, French, Mandarin Chinese, perception, acoustic.

1. INTRODUCTION AND GOAL

It has been widely shown that prosodic factors are as important as segmental factors in speech [2,5,8,9,12,17]. Globally speaking, prosody is an important element for understanding meaning in speech perception and for making oneself understood in speech production [2,5,17]. Despite the fact that prosody is an important tool for negotiating meaning, managing interaction, and achieving discourse coherence, L2 learners have generally not been taught how to use intonation to signal discourse strategies [5]. Especially, research examining problems and difficulties which Chinese learners (CL) face in learning French, suprasegmental elements are very rare. In the literature, only a few studies have addressed this question [4,12,13,15]. Therefore, the current study examines some difficulties of CL in the acquisition of French intonation. In this study, three basic French intonation patterns (according to Di Cristo [9]: final neutral declarative, polar question with

“est-ce que” and major continuation) produced by seven CL with different levels of proficiency in French are analysed and compared with the productions of six French native speakers (NS).

In the field, approaches and models for the description of the French intonation system are plentiful: ten basic French intonations of Delattre [6], intonosyntactic theory of Di Cristo [7], prepositional theory of Martin [14] and autosegmental-metrical theory of Jun & Fougeron [11]. In contrast, not much descriptive research exists for Chinese intonations; we only have a list of 13 intonation types established by Chao [3]. In Shen’s recent model on the Chinese intonation system [16], 3 general patterns in Chinese speech are proposed (*Tune I, Tune II, Tune III*).

Since Mandarin Chinese is a tonal language, the interaction between lexical tones and intonation is also an important factor in acquisition of French L2 intonation. However, to our knowledge, a study on how lexical tones influence Mandarin speakers acquiring non-tonal language’s intonation has not been found.

Among all the studies on phonetic crosslinguistic transfer from Mandarin Chinese to French, the majority of them investigated segmental transfer. There are only a few studies on suprasegmental transfer [4,12,13]. According to this research, the main challenges in intonation production are steep slopes in rising and falling contours, lack of variation in F0 and lengthening in stress group. Perceptually, CL have no problems in distinguishing between rising and falling contours [10,15].

The goal of the present paper is to examine productions of the three basic French intonation patterns using acoustic and perceptive measurements, in order to determine the problems and difficulties in CL of French as a Foreign Language (FFL).

2. HYPOTHESES

Based on the conclusions in previous research and our empirical observations from the recording experience, we have come up with several hypotheses for this study: i) final neutral declarative: CL realize a falling contour and slope, but the slope will be monotone or discontinuous; ii) polar question

with “est-ce que”: rising contours produced by CL will be the same as what they produce in polar question without a marker; iii) major continuation: there will be a mix of rising and falling contours in CL’ productions; a falling contour as in the case of final neutral declarative contour, and a rising contour as in the case of polar question.

3. METHODS

3.1. Speakers and corpora

Seven female CL of FFL (mean age: 25.43, SD: 4.95) with varying levels of proficiency in French (1 learners with a level B1, 3 with B2, 2 with C1 and 1 with C2 according to the *Common European Framework of Reference for Languages*) took part in the recording experience. All CL speak Mandarin Chinese as their mother tongue, started learning French as adults (between 2 and 6 years), and had been living in France for at least two years at the time of recording. Six female Parisian French native speakers (NS) (mean age: 24.6, SD: 1.14) participated as references for perceptive stimuli and acoustic comparisons. The recording took place in a sound proof room. Participants were recorded one by one, using Pro Tools program, with an AKG C520L wireless head worn microphone (distance mouth-microphone: 3 cm) and a sound card MOTU ULMK3. The corpora included 10 French sentences (four of them contained major continuation) and each of the 10 sentences had three different intonation modalities: final neutral declarative, polar question without a marker and polar question with “est-ce que”. Totally, we had 30 sentences in the corpora. All participants were asked to read the corpora with a natural tone.

3.2. Perceptive study

To examine and compare intonation productions between CL and NS, two perception tests, which were destined to polar question with “est-ce que” and major continuation, were implemented with ten French listeners (each test with five listeners) on Praat [1]. The stimuli for the test of polar question with “est-ce que” were manipulated by a truncation: we removed the syntactic question marker “est-ce que” and remained the part behind the marker for perception. For example, “*Est-ce qu’il est joli ?*” becomes “*~~Est-ce qu’il~~ est joli ?*” in our test. The same method, a truncation, was also used to manipulate the sentences with major continuation: the part following the major continuation was removed from the sentence: “*Vous aimez l’anglais et vous étudiez la littérature.*” becomes “*Vous aimez l’anglais et ~~vous étudiez la littérature.~~*”, for

example. In both tests, French listeners were requested to choose between “Affirmation” and “Question” according to what they have heard.

In our perception tests, choices made by each listener were collected and gathered to be compared and analyzed by t-test in R statistical computing software [18]: in each test, for the “affirmation” responses, we calculated the p value between CL’ and NS’ productions. The same method was also used to the “question” responses.

3.3. Acoustic study

After the perception tests, an acoustic analysis was performed, using quantitative and qualitative methods. Quantitatively, i) values of F0 beginning (point at 10% of stress group, for example “joli” in “il est joli?”) and F0 ending (point at 90% of stress group) were generated by a script, whose differences (converted into semi-tone with 200 Hz as reference: F0-Diff) allow to determinate a rising/falling contour; ii) range of F0 variation in the whole stress group were also calculated. Qualitatively, melodic contours were generated by Praat [1] in order to compare them with NS’ realizations. We chose several most typical examples to show here.

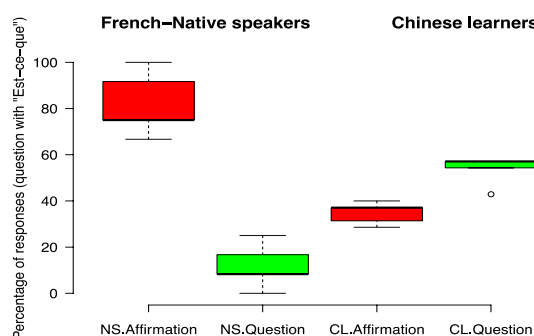
4. RESULTS

4.1. Perceptive tests (identification)

4.1.1. Test 1: polar question with “est-ce que”

After the comparison for the polar questions with “est-ce que”, CL’ productions were usually perceived as “question” (figure 1 right) whereas NS’ productions were mostly perceived as “affirmation” (figure 1 left). By unpaired t-test, we found that the productions of polar questions with “est-ce que” by CL and NS were significantly different (“affirmation” responses: $t_5=7.24$, $p < 0.05$; “question” responses: $t_5=-8.29$, $p<0.05$).

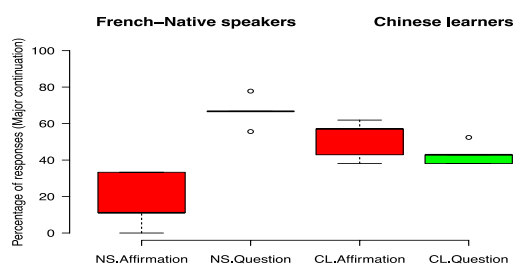
Figure 1: identification percentage of polar question with "est-ce que" produced by NS (left) and CL (right).



4.1.2. Test 2: major continuation

The same procedure was applied to major continuation. It was established that, for this pattern, NS' productions were mostly perceived as "question" (figure 2 left) whereas CL' productions were usually perceived as "affirmation" and "question" (figure 2 right). By unpaired t-test, productions of major continuations by CL and NS were shown to be significantly different ("affirmation" responses: $t_5=-4.16$, $p < 0.05$; "question" responses: $t_5=5.44$, $p < 0.05$).

Figure 2: identification percentage of major continuation produced by NS (left) and CL (right).



4.2. Acoustic analysis

4.2.1. Polar question with "est-ce que"

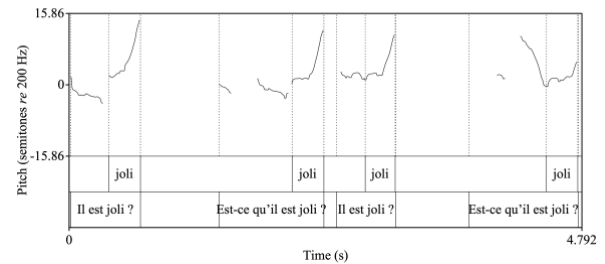
After F0-Diff values, all CL produced a rising contour. However, the difference and the range of F0 variation almost had the same values as in polar question without a marker. However, among the NS, both F0-Diff and F0 range were smaller in polar question with "est-ce que" than in polar question without a marker. An example of productions of "Il est joli ?" vs. "Est-ce qu'il est joli?" is provided in Table 1. We can clearly see that among NS, a polar question with "est-ce que" had a much smaller difference than in a polar question without a marker, which was totally opposite to CL' productions.

Table 1: F0-Diff and F0 range for NS and CL in the production of polar questions with/without a marker ("Est-ce qu'il est joli ?"; "Il est joli ?", Unit: semi-tone).

Speaker(level)	Pattern	F0-Diff (st)	F0 range (st)
NS1		+2.1 / +7.3	6 / 10
NS2		-1.2 / +9.8	2 / 11
NS3	Polar Question	+2.2 / +8.4	6 / 14
NS4	with the Marker	-0.1 / +9.3	4 / 11
NS5	"est-ce que"	+3.7 / +8.9	5 / 11
NS6		+3.3 / +7.6	5 / 10
CL1 (B1)	/	+9.1 / +10.6	12 / 12
CL2 (B2)	Polar Question	+8.3 / +8.7	13 / 12
CL3 (B2)	without the Marker	+6.3 / +5.6	9 / 8
CL4 (B2)	Marker	+10.5 / +12.5	12 / 12
CL5 (C1)	"est-ce que"	+5.4 / +6.4	8 / 9
CL6 (C1)		+6.1 / +7.8	8 / 18
CL7 (C2)		+10.1 / +0.9	2 / 12

Qualitatively, by melodic contour in stress group, we showed that CL's slope went up as high as in the polar question without a marker (figure 3, left) whereas, NS's slope kept as a plateau in the polar question with "est-ce que" (figure 3, right).

Figure 3: F0 contours in polar questions without and with a marker: CL3's production (left); NS4's one (right).



This difference in polar questions gives an explanation as to why the NS' productions were mostly considered as an affirmation but not a question while the CL' productions were mostly considered as a question but not an affirmation in our perception test 1 (see 4.1.1.).

4.2.2. Major continuation

After calculation of the F0-Diff, our hypothesis has been confirmed: in some productions of CL, rising and falling contours were mixed. A falling contour was the same as in the final neutral declarative and a rising contour was similar to a contour in polar question. First, three CL' falling productions (table 2) is provided below as examples to compare the F0-Diff and the F0 range with three NS' productions:

Table 2: comparison of falling contours between final neutral declarative ("Il a parlé du paysage.") and major continuation ("Il a parlé du paysage, et de tout autre chose.") for CL and NS. Unit: semi-tone (st).

Speaker (level)	Pattern	F0-Diff (st)	F0 range (st)
NS1		-2.8 / +5.7	6 / 6
NS2		-2.7 / +4.3	4 / 6
NS3		-2.7 / +5.4	4 / 4
NS4	Final Neutral Declarative	-3.4 / +3.7	6 / 3
NS5		-2 / +4	5 / 3
NS6		+0.3 / +5.7	6 / 4
CL1 (B1)	Major Continuation	-9.4 / -10.4	14 / 14
CL2 (B2)		-18.5 / -12.7	18 / 17
CL3 (B2)		-9 / -7.6	9 / 21
CL4 (B2)		+0.1 / +6.5	4 / 7
CL5 (C1)		-6.8 / +6.2	9 / 9
CL6 (C1)		-1.8 / -1.3	3 / 2
CL7 (C2)		-1.3 / +0.5	16 / 4

Second, for this pattern, when CL produced a rising contour, quantitatively, it was the same as with NS' productions, except that NS' productions had a smaller F0 range in major continuation than in polar

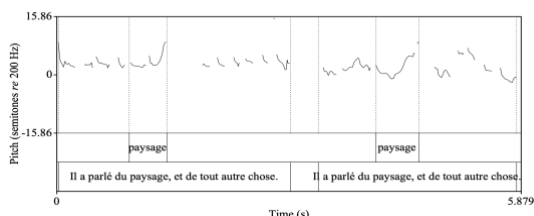
question without a marker, but we had the same F0 range in both of the two patterns in CL (table 3).

Table 3: comparison of rising contours between major continuation (“*Il a parlé du paysage, et de tout autre chose.*”) and polar question without a marker (“*Il a parlé du paysage ?*”) for CL and NS. Unit: semi-tone (st).

Speaker (level)	Pattern	F0-Diff (st)	F0 range (st)
NS1		+5.7 / +7	6 / 9
NS2		+4.3 / +7.8	6 / 9
NS3	Major Continuation	+5.4 / +5.9	4 / 7
NS4		+3.7 / +6.7	3 / 7
NS5	/	+4 / +4.5	3 / 7
NS6		+5.7 / +6.7	4 / 7
CL1 (B1)		+10.8 / +12.5	15 / 16
CL2 (B2)	Polar Question without the Marker “est-ce que”	+4.7 / +5.6	6 / 7
CL3 (B2)		+5.1 / +6.2	15 / 15
CL4 (B2)		+6.5 / +8.6	7 / 10
CL5 (C1)		+6.2 / +7.8	9 / 18
CL6 (C1)		-1.3 / +1.5	2 / 7
CL7 (C2)		+0.5 / +1.6	4 / 6

Qualitatively, productions of NS were characterized by a falling contour at pretonic syllable and a small rising contour at tonic syllable. In CL, this was characterized directly by a steep rising slope (figure 4).

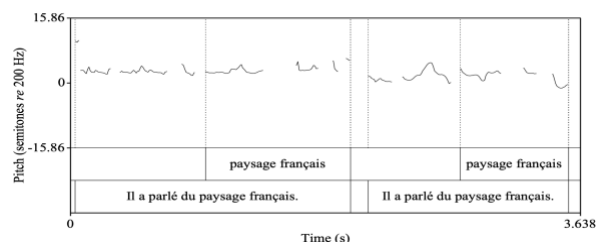
Figure 4: comparison of two melodic contours of major continuation produced by CL4 (left) and NS6 (right).



4.2.3. Final neutral declarative

All our CL produced a falling contour in this modality. Though falling, qualitatively, it always was a plateau in whole sentence. In contrast, the contour in NS has a bigger F0 variation and a progressive and gradual falling contour at stress group (figure 5).

Figure 5: comparison of two melodic contours of final neutral declarative produced by CL2 (left) and NS5 (right).



According to our calculation, we concluded that “est-ce que” question is a problematic pattern for all CL, except the one with C2 level. For major continuation, it is a difficulty for the learners of intermediate level.

5. DISCUSSION AND CONCLUSIONS

In this study, we have examined three basic French intonation patterns learnt by CL. In our perception tests, we have found a significant difference in the productions of polar questions with “est-ce que” and major continuations by NS and CL. After that, acoustic measurements have detailed the problems of CL in French intonation learning: i) polar question with “est-ce que”: in CL’ productions, they didn’t distinguish different rising contours for polar questions with a marker from without a marker. But, quantitatively, in “est-ce que” questions, NS’ productions had a smaller F0-diff and a smaller F0 range than in a total question. Qualitatively, in CL’ productions, the rising contours in these two modalities reached a same level while NS’ contours had a higher lever in total question but a lower lever in “est-ce que” question. We suppose that in a language, when speaker produces a question without a marker, melodic variation would be more evident; when a question marker is present (e.x. *est-ce que* for French, *ma* for Mandarin Chinese), melodic contour would not have a big variation. It is the reason why NS’ “est-ce que” question contours had a quasi-plateau. For native Chinese speakers, it has been also proved that question without a marker has a bigger F0 variation [19]. We may consider that the marker “est-ce que” for CL has not been interiorized; ii) quantitatively and qualitatively, a mix of rising and falling contours were appeared in CL’ major continuations: a falling contour when the sentence is declarative and a rising contour when the sentence is interrogative. We consider that CL have been influenced by sentence modality; iii) in final neutral declarative, our analysis has confirmed the conclusions in the work of Chi Lee [4]. CL’ productions were characterized by a plateau or a steep slope, as concluded by Chi Lee [4]. We suppose that lexical tone 1 (high, constant) of Mandarin would influence CL’ French declarative production, which is manifested by a series of tone 1 without melodic variation in their productions. Thus, CL’ productions were said to be monotone.

However, there are several limitations with this present study: i) F0-duration interaction should have been studied in our analysis; ii) influences of lexical tones on French intonation acquisition remain until now unknown. In our further research, these factors will be taken into consideration.

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