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Phonological awareness of French rising contours in Japanese learners

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Abstract

We investigate Japanese learners' ability to produce and understand the French continuative rising contour. In French, rising contours can be linked to syntactic, metrical, interactional and phrasing functions, while in Japanese, prosodic boundaries are marked with a default low tone (L%).

Our main hypothesis is that Japanese learners' proficiency is linked to their phonological awareness of rising contours in French. We expect that advanced learners will be able to correctly produce rising contours in internal AP and IP positions, and even distinguish between subtle differences in rising contours.

We present the results from two different experiments. To test learners' ability to produce rising contours, subjects were asked to naturally reproduce utterances containing violations in certain prosodic contours. Results show that, although the task remains difficult, learners were able to correct non-rising contours to varying degrees. We then conducted a sentence completion task where subjects listened to the beginning of a statement and chose the adequate sequence of words that followed what they had heard. Results show that Japanese learners, no matter their proficiency, are not able to distinguish the different types of rising contours that are dependent on different syntactic boundaries.

Index Terms: L2 prosody, rising contour, French, Japanese, sentence completion task, repetition task

1. Introduction

Understanding the prosodic structure of a language can be seen as understanding how rises and falls organise themselves in an utterance. Some prosodic events seem to be shared across languages. For instance, Gussenhoven [1] has pointed out that about 70% of the world's languages use a rising contour to mark a question. In French, a rising contour can appear at different prosodic levels. French prosodic structure allows at least two prosodic levels above the word: AP (accentual phrase) and IP (intonational phrase) (see among others, [2], [3], [4]). Michelas [5] argues the need for an intermediate phrase (ip) between the AP and the IP levels, an ip being larger than an AP marked by more lengthening of the phrase-final syllable. If we look at what happens at the right edge of these levels, non-final IPs and ips are characterised by the presence of a boundary tone, generally associated with a rising tonal movement (see e.g. [6], [7], [8], [4]). AP bears generally an H* pitch accent on its last full syllable (see among others [6], [9], [8], [4]), but, for phonotactic and dependency constraints, an L* pitch accent can also occur [9], [10].

The rising tonal movement found on a non-final position can be grammatically codified and realised with different prosodic patterns. For instance, in the distinction that Delattre makes between minor and major continuation, the target of the rising of minor continuation is less high (up to level 2 out of 4 levels distinguished by Delattre) than for major continuation (up to level 4). The same distinction can be found in the two tonal patterns LH* and LH* H-/H% for AP and ip/IP levels respectively, following an Autosegmental Metrical approach [8], [4]. Thus, ips are generally associated with non-final phrases of an enumeration or non-final syntactic phrases such as NPs, while non final IPs coincide with major syntactic boundaries.

Despite these findings, rising tonal movement can be difficult to categorise. For instance, Valtersson and Torreira [11] have shown that the rising movement differentiating polar questions from rising statements in French spontaneous speech is very subtle and subject to variation.

One question that arises is how learners deal with the rising contours that appear at different prosodic levels, especially when in their mother tongue, the prosodic structure is quite different and rising contours are dealt with in a different way. Such is the case for Japanese. Japanese, unlike French, is a pitch accent language [12]. The prosodic structure has only APs and IPs, related to the presence of a tonal accent, since an AP carries the tonal accent, while an IP is mostly characterised by downstepping [13]. The prosodic IP level corresponds to the XP syntactic category [14] which is the same syntactic level as the French ip. Moreover, in Japanese there is no notion of continuation at prosodic boundaries since each AP generally ends with a low tone [15]. However, in spontaneous speech, rising contours named Boundary Pitch Movements (BPM) can occur at the end of APs. This tonal movement contributes more to the pragmatic interpretation of utterances, marking emphasis phenomena, questions, or turn-taking [16],[17].

In this paper, we propose to focus on the production and perception of non-final rising contours that appear at the right boundary of minor non-final prosodic phrases, AP, and ip levels, by Japanese learners of French. Our main hypothesis is that the rising contour is an important component of French phonology but that Japanese learners do not have the phonological awareness of this rising contour. Thus, Japanese learners will encounter difficulties in distinguishing the rising contour at these prosodic levels but also in producing rising contours when expected. However, we predict that phonological awareness takes place after a certain period of time and that a higher proficiency level of French will induce better results.

In order to test our main hypothesis, we built a series of experiments testing the perception and production of rising contours by Japanese learners. In this paper, we present the results of two experiments testing Japanese learners' phonological awareness of rising contours. The aim of the first experiment, a sentence reproduction task, is to test whether Japanese learners are able to correct utterances where rising contours have been violated, while in the second experiment, we test the subjects' ability to associate the proper rising contour with the appropriate syntactic position.

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2. Experiment 1: Sentence reproduction task

In French, as discussed in section 1, a rising contour occurs at the right edge of subject NPs. However, as pointed out by Martin [9], a non-final AP within the subject NP can bear a falling contour in order to respond to dependency constraints, or maintain a rising contour for phonotactic reasons.

The first experiment is a sentence reproduction task where the stimuli were modified on purpose, creating prosodically grammatical AND ungrammatical utterances. The aim of this first experiment is to test the learner's ability to correct the violated prosodic contours at the right edge of AP boundaries. Our hypothesis is that since Japanese speakers' L1 generally produces a low tone at this position, non-rising contours will not be corrected even when a rising contour is expected. We thus predict that Japanese learners will have more difficulties than natives in correcting the contours. However, if phonological awareness increases over time [18], [19], we expect an improvement related to the proficiency level of the Japanese learners.

2.1. Methods

The stimuli for the model-sentence reproduction task follow a simple NP-VP syntax. A total of six sentences were recorded (Table 1) by four French native speakers. The composition of the NP was varied (a simple noun (N) / Two coordinated nouns (N+N) and a composed noun (Long N) in order to test whether the length and complexity of the NP is a factor to be taken into account.

Table 1: ***Stimuli***

1AP	N	Ma**rie** mange une banane *Mary is eating a banana*
		Maga**li** boit du café *Magali is drinking coffee*
2APs	N+N	Sa**rah** et Ma**rie** sont professeurs *Sarah and Mary are professors*
		Ma**rie** et Maga**li** sont amies *Mary and Magali are friends*
	Long N	Le **cours** d'an**glais** s'est bien déroulé *English class went well*
		Les en**fants** de Ré**mi** sont gentils *Remi's children are nice*

We obtained natural utterances with a rising contour (H) at the right edge of each AP. Each stimulus was manipulated using Praat [20] in order to obtain the four possible combinations (L_L, L_H, H_L and H_H) by alternating non-rising low (L) and rising high (H) contours. The rising height was also manipulated in order to obtain aligned rising contours. We selected the stimuli in which the voice sounded the most natural after manipulation in all the conditions. L_H and H_H combinations are considered grammatical, L_L and H_L are awkward and considered ungrammatical for a French native speaker. The sentence reproduction task was built using Psychopy [21].

The experiment was divided into four blocks of sentences: each block contained the manipulated sentences in one same condition (for example L_L prosodic pattern) and several fillers. This means that each sentence was in all four prosodic conditions, except for the 1AP sentences that had only two conditions and appeared just in the first (condition L_L for 2APs stimuli and condition L for 1AP stimuli) and the last blocks (condition H_H for 2APs stimuli and H for 1AP). We separated the four conditions to avoid interference of one prosodic pattern to another. A short silent video of 1 minute separated each block of sentences from another, hoping that it made the participants forget the sentences and the prosodic pattern used in the preceding blocks.

38 Japanese learners studying French as a second or third language at Sophia University, Tokyo participated in the experiment (31 females and 7 males, aged 18-28). None of them had stayed in a French speaking country for more than one month. The 38 learners were divided into 3 proficiency levels (beginner, intermediate, advanced) following the number of French classes they had followed. However, this categorisation corresponds to a A1 / A2 and B1 level following the CEFRL criteria [22]. A control group of 12 French speakers (4 males and 8 females, aged 19-29) also took part in the experiment.

The experiment took place in a soundproof room. Subjects wore headphones and were asked to reproduce as naturally as possible the sentence they heard after a three second delay. The purpose of this delay was to minimise the likelihood of direct mimicry [23].

2.2. Results

Accuracy rate is the dependent variable of our analysis. Since L_H and H_H (and H for 1AP stimuli) are considered as prosodically grammatical in French prosodic structure, we considered them as accurate responses (noted 1) while H_L and L_L patterns (and L for one AP stimuli) were considered as not accurate responses (noted 0).

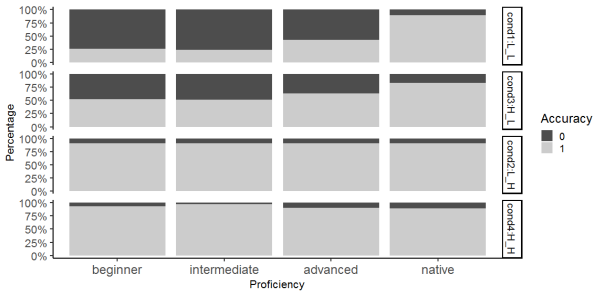

Figure 1: *Produced prosodic patterns' accuracy by proficiency when exposed to ungrammatical prosodic patterns (conditions 1 and 3, up) and grammatical prosodic patterns (conditions 2 and 4, down)*

The response variable being binary, we used a Generalised Linear Mixed Model (GLMM) analysis in R [24] with an interaction between proficiency and condition as fixed effects and a random intercept for subject and for stimuli. The interaction between proficiency and condition was significant (χ^2=9, *df* =39.014, p<0.0001***). For further analysis of the interaction we used the package *lsmeans*, analysing the contrasts in each condition.

In conditions 2 and 4, where participants were exposed to grammatical prosodic patterns (L_H and H_H), we observe no significant difference between the proficiency groups, meaning that the learners were as accurate as native speakers in a task where correction was not needed.

In condition 1 (L_L) native speakers produced significantly more accurate prosodic patterns than all groups of learners. In condition 3 (H_L) we observe a different result (see table 2):

natives do produce significantly more accurate patterns than beginners and intermediate learners, but the difference is not significant between advanced learners and natives. This result means that, even if advanced learners do not produce significantly more accurate patterns than the other two learner groups, in this condition, their accuracy is closer to that of natives.

Table 2: ***Contrasts in correlation proficiency * condition, condition 3***

contrast	estimate	SE	z.ratio	p.value
native-advanced	1.30	0.68	1.9	0.23
native-beginner	1.99	0.77	2.60	0.046 *
native-intermediate	1.99	0.69	2.87	0.02 *

For beginner and intermediate proficiency groups, the two APs stimuli (Long N and N + N) were more difficult to produce due to their complexity and we only had less than 50% of exploitable data in each condition, the rest were noted as NA. However, we obtained more than 90% of usable data in each proficiency group with one AP stimuli even for the beginners. For this particular data, we can see a linear progression, the mean correction rate in L condition going from 17% for beginners to 42% for advanced learners. But again, these differences are not significant due to the large variability in the proficiency groups.

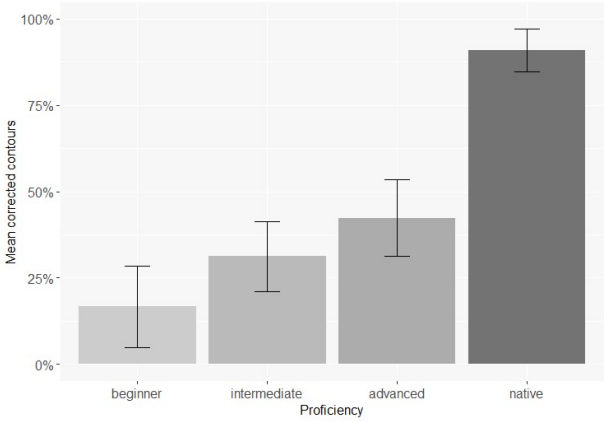

Figure 2: *Mean corrected contours by proficiency, 1 AP stimuli in L condition*

To sum up, results show that Japanese learners are able to produce rising contours when the model they hear has a rising contour. However, the fact that they are not able to correct the utterances when they face falling contours leads us to believe that phonological awareness of continuation has not yet taken place.

In condition 3, when the model produces a H_L pattern, we found that there was not a significant difference between the advanced learners and the native control group. In fact, there seems to be an improvement linked to the proficiency level. However, this result must be examined cautiously for two reasons. First, the accuracy rate was also lower in this condition for native speakers and that could explain the reason why the statistical result was not significant. The second reason is that the H_L can be considered as a prosodically grammatical pattern, for example when the constituent is focused. Thus, subjects may have reinterpreted the utterance giving a focus reading, accepting the H_L and thus not correcting it. Nevertheless, in one AP stimuli, a linear progression correlated to proficiency could be observed, leading us to believe that somehow the notion of continuation is slowly integrated by learners.

3. Experiment 2: Sentence completion task

The results of the first experiment revealed that Japanese learners are able to reproduce rising contours, but correcting the contours when utterances sound ungrammatical remains a difficult task. Proficiency level is not significantly correlated to accuracy rate but to a certain point, we can see that the correction rate is higher for advanced learners, allowing us to say that the notion of continuation in French is slowly being integrated.

If we admit that improvement takes time, one may wonder whether learners are able to differentiate fine-grained differences linked to different prosodic boundaries. In order to examine this question, we conducted a sentence completion task that highlights, among other things, the use of phonological cues during the syntactic analysis of a sentence [25].

The aim of the second experiment is to test subjects' ability to perceive the difference between the AP and the ip prosodic boundaries and to associate the awaited cues to the expected syntactic structure. We predict that since phonological awareness has not been established yet, learners will not be able to distinguish the two prosodic levels. However, we expect the results to differ following the concerned boundary and proficiency level.

3.1. Methods

This experiment is inspired from Michelas [5] and adapted to learners, using a more accessible vocabulary especially for beginners. The experiment we present here is a comprehension task, where participants hear the beginning of an utterance, and then complete the part they heard by clicking on one of two options of sequence of words that are visually presented.

We followed Michelas's experimental design and built stimuli with complex NPs in a subject position with either a simple syntactic branching containing 2 APs or a double branching containing 3 APs:

ip condition, e.g."[(les amis) AP (de Rémi)] **ip** (sont étudiants)",*'Remi's friends are students'*
AP condition, e.g. "[(les amis) AP (de Rémi) **AP** (de Dijon)] ip (sont étudiants)",*'Remi's friends from Dijon are students'*

[ ] : ip ( ) : AP

The test consists of 9 items in 2 conditions of prosodic level (AP and ip levels), completed with 18 fillers, that were recorded by 4 native speakers of French. Each utterance was truncated at the end of the second AP boundary corresponding to either an ip or AP boundary following the condition. The experiment was designed with Psychopy [21]. Participants heard a stimuli and then had to select one of the two written choices that was presented on the screen (e.g. 'sont étudiants' or 'de Dijon sont étudiants'). They were allowed to listen to the stimuli as many times as they desired before selecting one of the two possible written answers, using the associated keyboard key. The experiment was undertaken in a soundproof room with the same 38 Japanese learners of French and 12 native French speakers that took part in the first experiment.

3.2. Results

We used a Generalised Linear Mixed Models (GLMM) analysis with accuracy as the binary response variable, proficiency and boundary type (AP, ip) as fixed effects, a random slope for boundary within speaker and a random intercept for item.

Japanese learners' correct answer rate was around chance level for all proficiency groups, showing that they did not succeed in performing this task. The control native speakers group show significantly better results (see table 3).

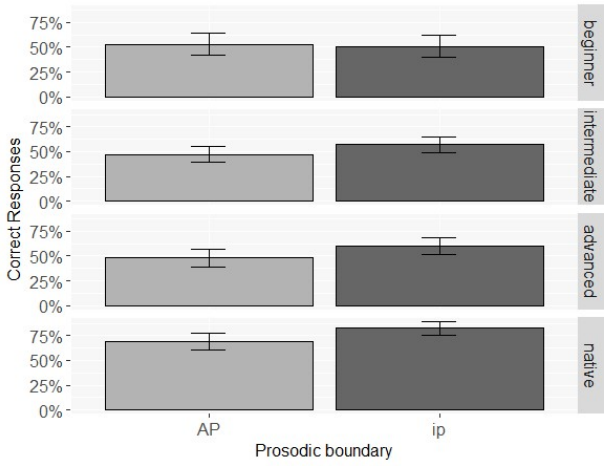

Figure 3: *Mean correct answer by proficiency and type of prosodic boundary*

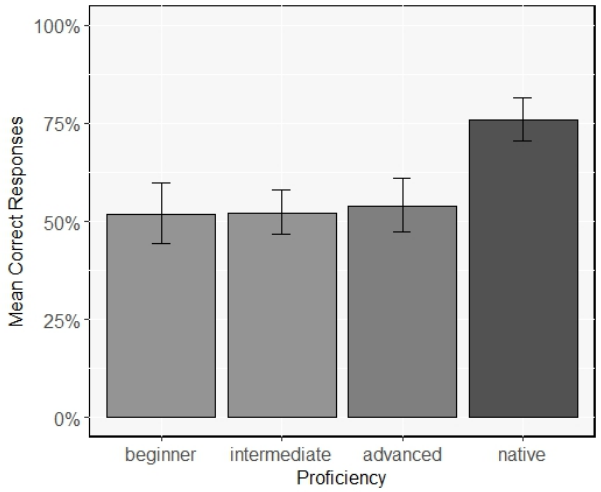

Figure 4: *Mean correct answer by proficiency*

As far as the boundary type is concerned, we observe a greater correct answer rate in the ip condition for native speakers (69,4% for AP and 82,4% for ip) and a slightly greater rate for intermediate and advanced learners (48% and 49% for AP and 57% and 59% for ip respectively), but this difference is not significant in the statistical model

Our results on French native speakers corroborate Michelas' study [5] who found that French native speakers had more accurate responses in the ip condition than the AP condition. However, for learners, results show that on the perceptual level, phonological awareness that could help them to make the correct choice in completing the utterances is not yet in place, not matter the boundary type and their proficiency level.

Table 3: ***Fixed effects significance - Reference level for proficiency is native***

Fixed effects	estimate	SE	z.value	p.value
(Intercept)	1.07	0.24	4.39	$< 0.0001^{***}$
boundaryip	0.41	0.27	1.52	0.128
proficiencyadvanced	-1.11	0.23	-4.76	$< 0.0001^{***}$
broficiencybeginner	-1.23	0.26	-4.78	$< 0.0001^{***}$
broficiencyintermediate	-1.19	0.22	-5.31	$< 0.0001^{***}$

4. Concluding remarks

This paper indicates that Japanese learners have difficulties in (re)producing and perceiving non-final rising contours in French, whatever their proficiency level and the prosodic level where it takes place. However, the slight improvement tendency following the proficiency level leads us to believe that continuation is slowly being integrated in their phonological representation of French, at least in their production. One possible explanation for this poor accuracy rate can be found in the difficulty of the task itself. In stimuli containing two APs, only advanced learners were able to reproduce more than half of the stimuli.

As far as the perception of rising contours is concerned, results of the French speakers' group were very similar to Michelas' [5] observations: a greater correct answer rate for the ip boundaries was found than for AP boundaries. This tendency is observed for the French group and slightly for the advanced learners' group (even though the difference was not significant) but not among the other learners. According to Michelas [5], correct response rate is higher in the ip condition because participants choose the less complex syntactic structure. Apart from the syntactic reason, we believe that there could be also a prosodic explanation related to phrasing [9]. It could also be possible that French speakers accept a minor continuation at the intermediate phrase level more easily than a major continuation at the end of the second AP of a double branching NP, in order to keep a unity within the complex NP; a significant prosodic boundary on this position can be seen as breaking this unity. However, further experiments must be conducted to develop this idea.

Finally, a way of explaining the lack of phonological awareness of continuation is the fact that the subjects, despite their advanced performance level, have been exposed to French exclusively in the classroom in Japan. Several studies have shown that exposure can impact second language prosodic acquisition [23] , [26] . Running the same experiments with subjects with similar proficiency levels but who have been learning French in immersion may help us understanding whether immersion is a factor that could accelerate the process of phonological awareness.

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