THE PHONETIC EVOLUTION OF REDUPLICATED EXPRESSIONS: REDUPLICATION, LEXICAL TONES AND PROSODY IN NA (NAXI)

Alexis Michaud ** and Jacqueline Vaissière***

*Laboratoire de Langues et Civilisations à Tradition Orale, CNRS/Sorbonne/Sorbonne Nouvelle
**Laboratoire de Phonétique et Phonologie, CNRS/Sorbonne Nouvelle
alexis.michaud@vjf.cnrs.fr, jacqueline.vaissiere@univ-paris3.fr

ABSTRACT

In Na, a Sino-Tibetan language with lexical tones, some reduplication schemes involve tone change, whereas others consist in full reduplication without tone change. The synchronic coexistence of these two sets allows for an experimental comparison, which leads to a simple explanation. Both sets appear to originate in total reduplication, without tone change, the schemes which now involve tone change resulting from a later evolution: the phonologisation of the effect of intonational boundaries on pitch. A High tone in final position within the reduplicated compound is lowered to Mid; an initial Low tone is raised, also to Mid. A reflection is set out concerning the historical conditions under which the allophonic variation of lexical tones could be reinterpreted as a difference of tonal categories.

Keywords: prosody; intonation; intonational junctures (boundaries); lexical tone; accent.

1. INTRODUCTION

Na (also known as *Naxi* and *Moso*), a Sino-Tibetan language spoken in China, has a wealth of reduplicated constructions, as do many Far Eastern languages. A phonological argument distinguishes between two sets of reduplication schemes: in two cases (reduplication of monosyllables with a High tone or a Low tone), a tonal change occurs, whereas no such change takes place in the other cases. The facts are set out in section 2.

Our research brings out a phonetic similarity between the schemes with and without a categorical tone change. We hypothesise (section 3) that all of these schemes originate in full reduplication, and that the schemes which now involve tone change result from the action of phonetic factors which are still observable in synchrony. The phonetic variation of some of the tones (allotonic variation) would have been reinterpreted as a phonological difference between tonal categories—under special historical conditions. This hypothesis is tested in section 4.

2. THE NA (NAXI) FACTS

The two dialects studied here are (i) that spoken in and around the town of Lijiang 丽江 (hereafter "Lijiang Na"), which is homogeneous as far as the tonal realisation of reduplication schemes is concerned, and (ii) that of the village of /fɣ̩ kʰō/ (丽江奉科乡善美行政村; hereafter "Fèng Kē Na"). Unless otherwise mentioned, the examples come from the Lijiang dialect [for a description of its phonemic system see 1]. The data were collected in the field by the first author.

The tone system of Lijiang Na is relatively straightforward: it consists of three level tones, High, Mid and Low (hereafter H, M and L), plus a lexically rare Rising contour, analysed as /LH/. In Fèng Kē Na, there are four lexical tones, H, M, L and a rising /LM/ contour, of comparable frequency in the lexicon. All combinations of the three basic tones are attested, over disyllabic words (HH, LH, ML etc.) as well as in continuous speech. Numerous instances of reduplication are found in dialogues and narratives, following regular schemes: in some cases (A > AA and AB > AABB), a categorical tone change takes place, whereas no such change takes place in the AB > ABAB scheme. (Following a widespread convention, the letters A and B stand for syllables: /lá lū/ "to quarrel", from the verb /lá/ "to strike", is an example of A > AA reduplication.)

The tone scheme of a reduplicated expression is predictable from the tones of the *simplex* form. The facts set out in table 1 are already reported in earlier publications [2, 3:10-11].

Table 1: A summary of the reduplication patterns for monosyllables in the Lijiang and Fèng Kē dialects.

Simplex	H	M	L	LM
Lijiang output	H + M	M + M	M + L	(n.a.)
Fèng Kē output	H + H	M + M	M + L	M+LM

As for disyllables, two cases are observed, as shown in table 2: (i) the AABB scheme is similar to that of monosyllables: the resulting tones are the same as if the two syllables were reduplicated independently of each other; (ii) the ABAB scheme involves complete reduplication, tones included.

Table 2: Illustration of reduplication patterns for a disyllable (tonal scheme valid for both dialects of Na).

Simplex	/lɣ̀ fɣ́/ "lukewarm" (tones: L + H)
AABB	/lɣ̄ lɣ̀ fɣ́ fɣ̄/ (tones: M+L + H+M)
ABAB	/lɣ̀ fɣ́ lɣ̀ fɣ́/ (tones: L+H + L+H)

To sum up, if the reduplicated syllables are not in immediate contact (ABAB scheme), no tonal modification takes place, whereas if they are in immediate contact (AA and AABB schemes), some tone sequences are modified.

The inspiration for the present research comes from a phonetic observation: auditory observation suggests that in ABAB reduplicated disyllables (i.e. in the reduplication scheme without categorical tonal change), the phonologically identical tones actually sound fairly different from each other. (In what follows, in order to refer unambiguously to the phonetic realisations of these four syllables, they will be referred to as A1 B1 A2 B2.) During fieldwork, our first notations of the LHLH scheme (resulting from the reduplication of a L+H disyllable) wavered between LHLM and MHLM; every time, language consultants corrected this back to LHLH.

3. DIACHRONIC HYPOTHESIS

We hypothesise that all the reduplication schemes found in Na originate diachronically in full reduplication. The transformation of H+H to H+M (which has not taken place in Fèng Kē Na, which thus appears more conservative from this point of view), of L+L to M+L, and of LM+LM to M+LM in Fèng Kē Na, have a common characteristic: they give reduplicated expressions a downward melodic pattern, whereby the first tone is higher than the second. A High tone in final position within the reduplicated compound is lowered to Mid; an initial Low tone is raised, also to Mid. Our hypothesis is that these transformations constitute the phonologisation (transformation into a categorical phenomenon) of a phonetic factor which is still attested in synchrony: the intonational marking of boundaries between words and between phrases. The marking of boundaries actually manifests itself at several levels, those of the lexical word, the phrase, the sentence, and broader discourse units. In Na, there is a downtrend within each constituent: a gentle decrease in F_0 in the course of the constituent at issue (e.g. in the course of the phonological word), followed by a faster and stronger downward tilt in F_0 at the end of the constituent [4:41-84].

This hypothesis raises the issue of the historical conditions under which the allophonic variation of lexical tones could have become phonologised: the permanent variation that takes place in language is to a large extent factored out by listeners; variation can become fixed only under specific conditions that are determined by the state of the linguistic system within which they take place. Martine Mazaudon (personal communication) suggests that, in the history of the Na language, there may have been a phase of evolution towards a word-tone prosodic system [as exemplified by Tamang: 5]. At that hypothetical stage, boundary-marking would have exerted a strong influence on the realisation of F_0 over reduplicated expressions, in the absence of a lexical pitch specification for each individual syllable. To take an example, the phonetic target of a L tone would have been reached only towards the end of the second syllable of a disyllable bearing this tone. At a later stage, before the evolution towards a word-tone system could be completed, this evolution would have been reversed (perhaps under the influence of neighbouring languages), and the words that had acquired word-tone reverted to a one-tone-per-syllable structure. This is where the (phonetic) pitch difference over the successive syllables of reduplicated compounds would have been reinterpreted in terms of different lexical tones.

At the hypothesised stage of return from a word-tone system to a one-tone-per-syllable system, the speakers reinterpreted some phonetic objects that had a phonologically uncertain status. The experiment reported below aims to simulate this situation, though it admittedly cannot reconstitute the exact historical conditions of this evolution.

4. THE EXPERIMENT

The experiment aims to evaluate in synchrony the tension between phonological categories and allophonic variation in tone realisation.

4.1. Method: a combined study of production and perception data

The experimental approach comprises two dimensions: a quantification of the differences between phonologically identical tones in ABAB reduplication (i.e. production data), and a perceptual study of these differences.

Eight native speakers of Lijiang Na, aged 27 to 55, recorded the same set of reduplicated expressions.

The first parameter studied is F_0. In order to obtain a very precise measurement, and an additional indication on voice quality—the glottal

open quotient—, an electroglottographic recording was recorded simultaneously with the audio; see accompanying documents (WAV files, and PDF file documenting the recordings). The open quotient provides an indication on the degree of adduction of the vocal folds [6 and references therein]. The other measurements reported here are duration and acoustic intensity (mean RMS amplitude).

The data from the first speaker were chosen for the perception test, which consisted in presenting the syllables individually (40 stimuli), then by combinations of two syllables, exploring all the combinations: A1+B1, A1+A2, B1+A1, etc (140 stimuli), and finally by combinations of four (48 stimuli). The electroglottographic signal was used, so that the listeners would focus on the tone, not on the phonemes and on the corresponding lexical items. Thus the subjects heard a melody carried by an indistinct buzz. Fourteen listeners (all of whom had Lijiang Na as their mother tongue) participated to the tests. A full description of the experimental setup is found in [4:61-63].

4.2. Results of the measurements on production data

Figure 1 shows, for the first speaker, curves averaged over 10 ABAB reduplicated disyllables with a L+H+L+H tonal scheme, e.g. /hỳ zý hỳ zý/ "very, very red", /pʰə̀ sá pʰə̀ sá/ "very, very white". They all consist of a colour adjective (/hỳ/ "red", /pʰə̀/ "white"), followed by an adjective that suggests a certain nuance of colour and texture. The structural similarity of these items allows for the calculation of average curves.

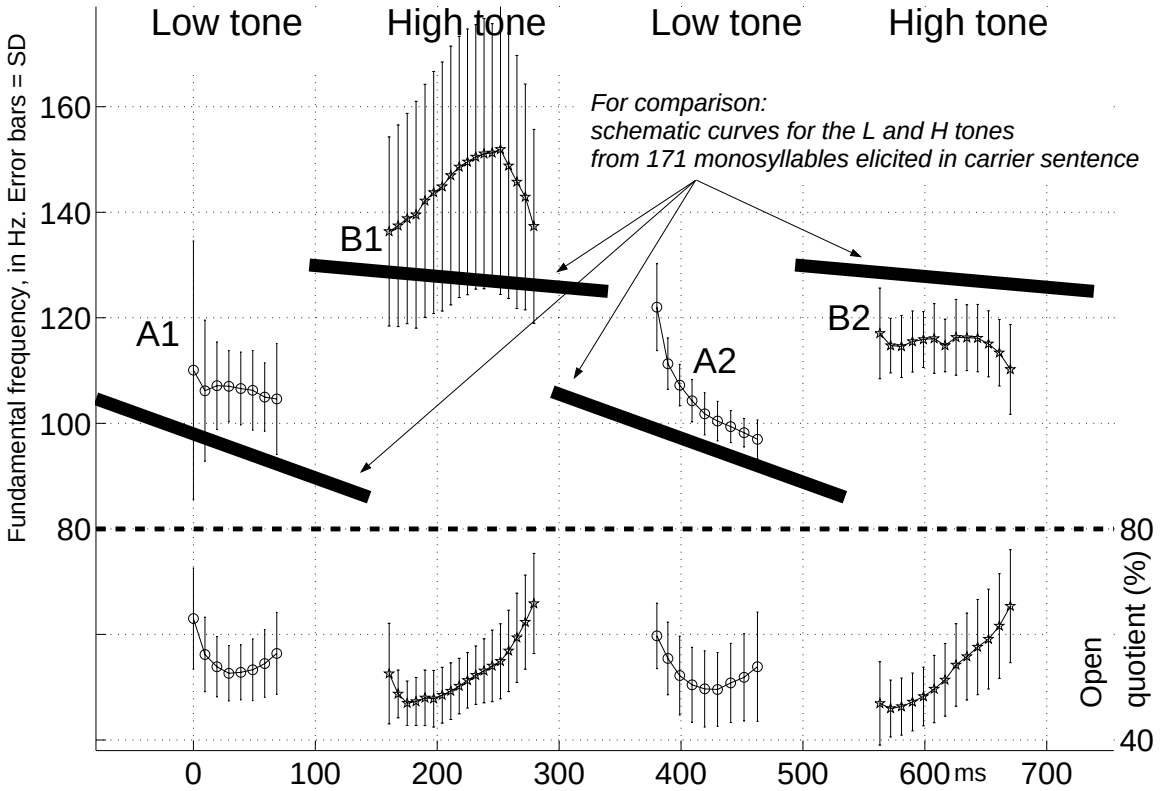

Figure 1. Average F0 curves (normalised by average duration) of the L and H tones in 10 reduplicated disyllabic expressions, compared with curves for L and H tones on monosyllables in carrier sentence (schematised from 171 items, same speaker).

The schematised F_0 curves of the L and H tones as realised in a carrier sentence by the same speaker are also shown on the figure as reference values. The following facts emerge:

(i) the F_0 of syllables A1, B1 and A2 is higher than that of the same lexical tone on a monosyllable in carrier sentence, whereas for B2 it is lower. As a preliminary statistical approach, two-tail t-tests applied separately at the 100 points of the resampled curves show a significant difference ($p < 0.05$) over more than 80% of the time points in all cases.

(ii) A1 is higher than A2, B1 higher than B2.

No significant difference in RMS amplitude was found between A1 and A2 or B1 and B2.

The results for the other 7 speakers are similar. They suggest that the tones of pairs A1/A2 and B1/B2 could be perceived as different, if they were side by side. Within the framework of the tonal categories of the Na language, this phonetic difference goes towards an evolution of H+H towards H+M, of L+L towards M+L. The perception test aims to verify this hypothesis.

4.3. Results of perceptual tests

Table 3: Results of the identification test for individual syllables extracted from A1 B1 A2 B2 reduplicated expressions. 40 stimuli, 14 listeners.

Position within the expression	Lexical tone	Perceived tone: % of cases where the tone was identified as:			
		H	M	L	LH (rising)
1st (A1)	L	14	**66**	19	1
2nd (B1)	H	**82**	10	1	7
3rd (A2)	L	3	**65**	31	1
4th (B2)	H	46	47	4	3

For each stimulus, a Chi-square test was used for assessing the difference in response frequency between the expected category and the most frequent alternative category. Both L tones are predominantly perceived as M (first L tone: 66% vs. 19%; Chi-square(1)=146, significant at p<.001; second L tone: 65% vs. 31%; Chi-square(1)=69, significant at p<.001). The first H tone is identified as such (82% vs. 10%; Chi-square(1)=309, significant at p<.001), the second creates a hesitation between H and M (46 vs. 47%; Chi-square<1, non significant).

The second part of the test shows that A1+A2 is perceived as M+M (51% M for A1, 62% M for A2), B1+B2 as H+M (87% H for B1, 88% M for B2). (See the confusion matrices in [4:61-74].)

Lastly, concerning the third part of the test, A1+B1+A2+B2 presented in a row—as a quadrisyllabic expression—are mostly perceived as M+H+L+M, i.e. the first L tone is perceived as M, the second L tone as L; the first H tone as H, the second H as M.

The reason why A1+A2 is mostly perceived as M+M, rather than M+L, may have to do with the overall rather high register in which both of these syllables are realised, which overrides the F_0 difference between them. In this respect, the experimental setup does not really simulate the conditions of evolution of a L > LL reduplicated expression: in our experiment, the L tones are embedded in positions 1 and 3 within a quadrisyllable, which tends to raise the F_0 of both of them. This result nevertheless confirms the intution that the allophonic variation of tones can lead to their categorical reinterpretation.

To sum up, the phonetic difference between the two H tones (B1 and B2) is perceived as a categorical difference—one that coincides with the AA and AABB reduplication schemes.

5. DISCUSSION AND CONCLUSION: TONES AND INTONATIONAL BOUNDARIES

The experimental results are consistent with the hypothesis that the *H > HM* and *L > ML* schemes of the Na language originate in full reduplication, and that they were later eroded by the action of intonational factors. The M tone is unaffected (*M > MM*), probably due to its central position.

The evolution of the AA and AABB schemes suggests that, under favourable phonological conditions, intonational allotones (variants of lexical tones) can be reinterpreted as belonging to different tonal categories. We take this to support models of prosody as a superposition of several phenomena [7].

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