A STUDY ON PHONATION PATTERNS OF TONES IN BATANG TIBETAN

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ABSTRACT

In the study of tone origin in Sino-Tibetan language, Tibetan is the only language whose dialects reflect the development from non-tonal to tonal language systematically. Tibetan consists of three main dialects, which are Anduo (non-tonal), Kang (developing tonal) and Weizang (tonal). In the tone study of Kang, the biggest problem is that it is very difficult to identify the tones, because the tone system is in a developing period. This paper is concerned with the study on tone phonation patterns in Batang Tibetan in Kang with the method of EGG (electroglottograph) analysis. The results shows: 1) there are 4 tones according to phonation patterns which reflect the natures of tones; 2) F0 (fundamental frequency) contours and SQ (speed quotient) contours are all in an image distribution in one syllable and OQ (open quotient) contours in each syllable are falling except that of tone type 3 which is Level; 3) the phonations can be the conditions in the tone evolution of Batang Tibetan.

Keywords: EGG analysis, phonation patterns, Batang Tibetan tones, origin of Tibetan tones

1. INTRODUCTION

As is well known, most of the languages are tonal languages in Sino-Tibetan language family, so it is lack of living language materials in the study of the evolution of tones. However, we have found that Tibetan is the only language whose dialects can reflect the evolution of tones in the Sino-Tibetan language family systematically. The reasons are: 1) it has a large number of native speakers; 2) the geographical environment is very special, because most of Tibetan speakers live at high altitude; 3) the humanity environment is that Tibetan live relatively isolated and use the same language; 4) it has a traditional writing system with large quantity of written materials; 5) it has many dialects which show the different phases of Tibetan evolution, especially the evolution from non-tonal to tonal.

According to the study of historical linguistics, Tibetan dialects can reflect the different stages and information in the development of Tibetan tones. Usually Tibetan dialects are divided into 3 or 5 dialects by scholars according different materials and principles. In 80s, 3 dialects and many sub-dialects are divided in [9]: 1) Weizang (central) dialect with 4 sub-dialects; 2) Kang dialect with 6 sub-dialects and 3) Anduo dialect with 4 sub-dialects. Briefly speaking, the sub-dialects which have tones and do not have voiced stop, voiced affricate and voiced fricative are regarded as Weizang dialect, the sub-dialects which do not have tones and have voiced stop, voiced affricate and voiced fricative are regarded as Amdo dialect and the rest sub-dialects are regarded as Kang.

From the viewpoint of historical linguistics, the evolution of Tibetan tones has close relationship with the decrease of Tibetan initials and finals. According to our database, there are 220 initials, and 100 finals [7]. From the written Tibetan and dialects, we know that the decrease of initial has relationship with the increase of homonym which leads to the development of Tibetan tones.

According to the study on the homonym rate of Tibetan [8], the homonym rate calculated through initials and finals of Lasa speech which is tonal is 4.3698 and the homonym rate of Xiahe speech which is non-tonal is 1.9089. The homonym rate of Batang speech is 3.0408. We have found that the pitch or tone patterns in Tibetan sub-dialects whose homonym rate is around 3 is very difficult to identify. The problem tells us that phonation analysis needs to be used in the study of languages which is developing its tone system from pitch pattern. This paper is concerned with the study on the phonation patterns of single syllable through which we expect to explain the tones and the development of tones from the phonation patterns.

2. RESEARCH METHOD

2.1. Phonation study through EGG

In phonation study, many methods have been developed, in which the method of EGG analysis is one of the most convenient way for obtaining the information of vocal vibration, which does not interfere with phonation [1, 2, 4]. Although EGG signal can not reflect the exact change of glottal area, the signal is really significant in obtaining the information in the activities of vocal fold, especial the contact of the vocal folds. Studies on phonation types are reported by many researchers [3, 6]. In these researches, the basic and most popular parameters are 1) fundamental frequency (F0), open quotient (OQ), and speed quotient (SQ).

2.2. Tibetan materials

The tones in the Tibetan dialects have close relationship with the initials and final endings. Usually the tones with high pitch onset have developed from the voiceless initials of the ancient Tibetan and the tones with low pitch onset have developed from the voiced initial of the ancient Tibetan. In addition, the tones with low pitch offset have developed from the final stops. Based on these, we have designed a Tibetan corpus. There are two tables bellow in which some examples are illustrated. Table 1 shows the words with voiceless initials and three different finals, the first two with no final ending, the second two with voiced ending and the third two with stop endings. Table 2 lists the words with voiced initials and the three final types as displayed in Table 1.

In these two tables, not only the IPA of Batang dialect but also the IPA of Lasa dialect which is a developed tonal dialect in Tibetan are given.

Table 1: Tone type with voiceless initial.

Tibetan	Trans.	English	Tone type	Batang	Lasa
ས	sa	earth	T1(HS)	sha51	sa53
སུ	su	who	T1(HS)	su51	su53
གསེར	gser	gold	T3(HL)	se55	se55
གསུམ	gsum	three	T3(HL)	sam55	sum55
སྟག	stag	tiger	T5(HC)	dok51	ta?51
གཅིག	gcig	one	T5(HC)	tɕik51	tɕi?51

In this table 'Trans.' stands for Latin transcription of written Tibetan. 'H' stands for voiceless initial, 'S' stands for short final, 'L' stands for long final and 'C' stands for final with stop. 'T' stands for tone type.

Table 2: Tone type with voiced initial.

Tibetan	trans	English	Tone type	Batang	Lasa
ཕུ	bu	son	T2(LS)	pu343	phu12
ཟ	za	eat	T2(LS)	sa343	sa12
དཔལ	bal	wool	T4(LL)	pe343	pha15
དཔྱལ	drel	mule	T4(LL)	tʂy343	tʂhe15
སྡོད	sdod	stay	T6(LC)	nduk342	to?132
འདེད	vded	trace	T6(LC)	tek342	the?132

In this table 'Trans.' stands for Latin transcription of written Tibetan. The first 'L' stands for voiced initial, 'S' stands for short final, the second 'L' stands for long final and 'C' stands for final with stop.

2.3. Data sampling

The speech data used in this study were all obtained in Batang county by the side of Jinsha river, where the altitude is around 2500 meters high. The equipments include thinkPad notebook, Sony microphone and laryngograph produce by Kay and Audition. There were 4 persons, two male and two female local native speakers who were all teachers in a Tibetan primary school. For each person, 24 single syllables were pronounced twice, and 48 samples were recorded with speech sound and EGG signal simultaneously. There were 192 samples of single syllable words obtained.

2.4. Parameter extracting

In the study of EGG analysis, all the parameters were extracted from the EGG signals. F0 is defined as 1/period, OQ is defined as open phase/period and SQ is defined as opening phase/closing phase. There are usually two methods which are "criterion level algorithm" [10] and "differential EGG or DEGG" [5]. The parameters of F0, OQ and SQ of all samples are extracted by the method of "Differential EGG" in this study and they are then averaged according to tone type. Finally the averaged parameters of tone types are displayed in 6 figures as follows.

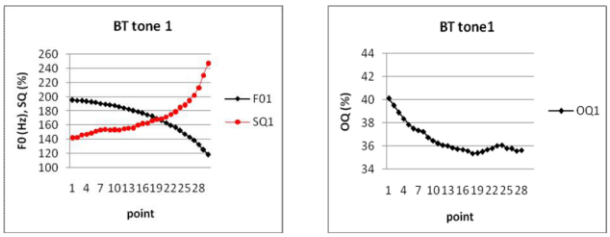
3. PHONATION ANALYSIS

3.1. Result and parameter analysis

According to the parameters, F0, OQ and SQ are displayed in contours and each figure has two plots. The left plot displays the F0 and SQ and the right plot displays the OQ. In order to analyze them conveniently, the range of F0s whose unit is 'Hz' is shown in 5 scales, the range of SQ whose unit is "%" is shown in 8 scales, and the range of OQ is shown in 5 scales. In this way, it will be easy to

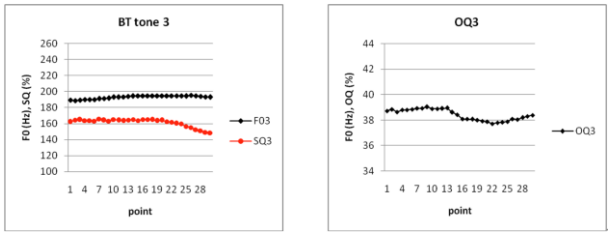
explain Batang tone types by Zhao Yuanren's 5 letters tone system. In order to study the relationship with SQ and OQ, F0 is not displayed in log scale.

Figure 1: The contours of F0, SQ and OQ of T1.



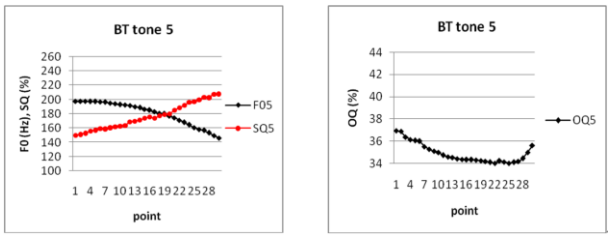
In the left plot of figure 1, the F0 of T1 is high falling whose value can be described as 51 and the SQ is rising whose value can be described as 38. They are in an image distribution. In the right plot, the OQ of T1 is falling whose value can be described as 41.

Figure 2: The contours of F0, SQ and OQ of T3.



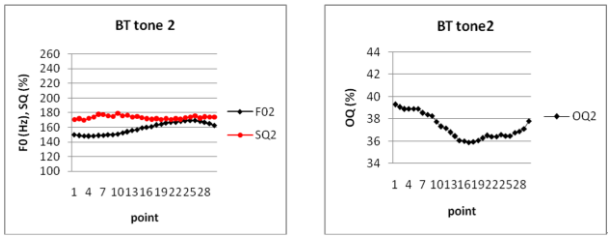
In the left plot of figure 2, the F0 of T3 is high level whose value can be described as 55 and the SQ is also level except little falling at the offset, whose value can be described as 44. They are also in an image distribution. In the right plot, the OQ of T3 is mainly level whose value can be described as 33.

Figure 3: The contours of F0, SQ and OQ of T5.



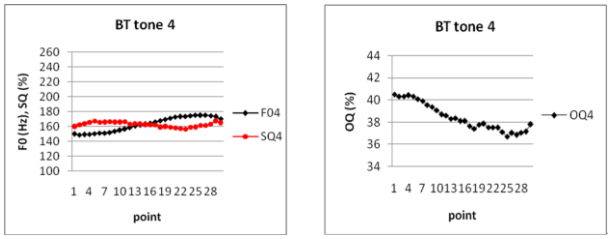
In the left plot of figure 3, the F0 of T5 is high falling whose value can be described as 53 and the SQ is rising whose value can be described as 36. They are clearly in an image distribution. In the right plot, the OQ of T5 is falling whose value can be described as 21.

Figure 4: The contours of F0, SQ and OQ of T2.



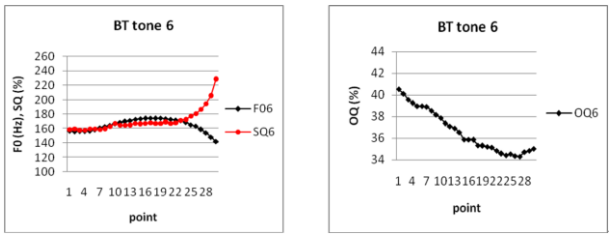
In the left plot of figure 4, the F0 of T2 is rising whose value can be described as 34 and the SQ is a little falling but the range is very small whose value can be described as 44. They are also in an image distribution. In the right plot, the OQ of T2 is falling whose value can be described as 32.

Figure 5: The contours of F0, SQ and OQ of T4.



In the left plot of figure 5, the F0 of T4 is rising whose value can be described as 34 and the SQ is a little falling but the range is very small whose value can be described as 44 like that of T2. They are in an image distribution. In the right plot, the OQ of T4 is falling whose value can be described as 42.

Figure 6: The contours of F0, SQ and OQ of T6.



In the left plot of figure 6, the F0 of T6 is rising and falling whose value can be described as 342 and the SQ is level and rising whose value can be described as 347. They are in an image distribution on the whole. In the right plot, the OQ of T6 is falling whose value can be described as 41.

3.2. Phonation values and feature

According to the analysis above, the phonation patterns can be described by the values of F0, OQ and SQ. Phonation values of F0, OQ and SQ of different tone types are displayed in Table 3.

Table 3: Phonation values.

	T1	T3	T5	T2	T4	T6
F0	51	55	53	34	34	343
SQ	38	44	36	44	44	347
OQ	41	33	21	32	42	41

Based on these values, Table 3 can be transferred into Table 4 by features which can be illustrated the phonation patterns in another way.

Table 4: Phonation feature.

	T1	T3	T5	T2	T4	T6
F0	F	L	F	R	R	RF
SQ	R	L	R	L	L	LR
OQ	F	L	F	F	F	F

In this table 'F' stands for falling, 'R' stands for rising and 'L' stands for level.

From Table 4, we can see that the phonation features show the phonation patterns of Batang Tibetan tone types and 4 tones can be clearly distinguished.

3.3. Phonation analysis

In the study of tones phonetically, F0 is usually used to identify tones. But tone phonation types are also important in some languages, such as Hani and Yi language. From the viewpoint of historical linguistics, the origin of Tibetan tones has very close relationship with phonations. Based on all these, the phonation analysis is very significant.

From the F0 values in the above figures, we can see that tone 1, 3 and 5 which come from voiceless initials in ancient Tibetan all have high onset of F0 and those come from voiced initials in ancient Tibetan all have middle onset of F0. So the tone type 1, 3 and 5 can be classified as high tones and the tone type 2, 4 and 6 can be classified as relative low tones. In the low tones, T2 and T4 can be regarded as one tone, for they have the same value of F0. In detail, we can also find that the values of OQ of T2 are little different. Finally the 6 tone types can be classified into 5 tones.

Based on the phonation features, T1 and T5 are F(F0), R(SQ) and F(OQ), which can be regarded as the same tone and T2 and T4 are R(F0), L(SQ) and F(OQ) which can be regarded as the same tone, though their phonation values exist small different. Because T1 and T5 are in the supplementary distribution and T2 and T4 are in a supplementary distribution phonemically, the final result is that there are 4 tones in Batang Tibetan, but there still exist phonation conditions which come from the initials and finals.

4. CONCLUSION

According to the preliminary study on the tone phonations in Batang Tibetan, the following conclusions have been drawn: 1) there are 4 tones according to phonation patterns which reflect the natures of tones; 2) F0 contours and SQ contours are all in an image distribution in one syllable and OQ contours in each syllable are falling except that of tone type 3 which is Level; 3) the phonations can be the conditions in the tone evolution of Batang Tibetan.

5. ACKNOWLEDGMENTS

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