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Tibetan trisyllabic light verb construction recognition

Weina Zhao **Lin Li**

Qinghai Normal University

Huidan Liu **Jian Wu**

Chinese Academy of Sciences

ABSTRACT

The Tibetan trisyllabic light verb construction is a type of widely used verb phrase that is composed of a disyllabic noun or adjective and a light verb. A large number of Tibetan trisyllabic light verb constructions are widely found in Tibetan. Successfully recognizing this type of phrase greatly contributes to Tibetan information processing, however, thorough and systematic academic research in this field has not yet been launched. Therefore, we propose a model for the recognition of Tibetan trisyllabic light verb constructions based on an integrated strategy in this paper. Firstly, we extract all trisyllabic light verb construction candidates from a Tibetan corpus. In this step, light verbs are used as retrieval marks. Secondly, we filter candidates using a statistics-based model, rule-based model, and integrated model separately. Experimental results show that the integrated model performs much better than the other strategies, which proves that linguistic features contribute a lot to the automatic recognition of Tibetan trisyllabic light verb constructions by computers.

KEYWORDS

Tibetan, NLP, light verbs

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Weina Zhao Lin Li
Qinghai Normal University

Huidan Liu Jian Wu
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1 Introduction

Already in Old Tibetan, trisyllabic light verb constructions (hereafter referred to as TTLVCs) are to be found in historical documents, however, in small quantity. As economy and culture develop day by day in Tibetan society, TTLVCs are widely distributed in modern Tibetan texts (Jiang 2005). TTLVCs consist of two parts: one is a disyllabic noun or adjective, the other is a light verb. TTLVCs recognition plays an important role in fields including text segmentation, chunking, and parsing for Tibetan. Until now, there is no effective strategy to recognize and extract TTLVCs from Tibetan due to their particular distinguishing features including openness, productivity, quantitative uncertainty, and structural instability. Therefore, it is worthy to explore a practical and effective method to recognize TTLVCs.

Many studies have been conducted in collocation extraction, chunking, and multi-word expression identification. All these research achievements provide a valuable foundation for TTLVC recognition. Sun (2002) employs four different methods including mutual information, t-test, Chi-squared test, and likelihood ratio in collocation extraction and compares their performance. Church and Hanks (1990) extracts English collocations from a corpus by calculating their mutual information. Wang (2005) proposes a Chinese verb-object phrase recognition algorithm that combines mutual information with entropy. Sun (1997) builds up a quantitative evaluation system with three dimensions to systematically analyze Chinese phrases that consist of the specific word “能力 (ability)”. Qu (2004) extracts Chinese collocation candidates from a large corpus with a statistical method, and then filters correct collocations from candidates according to language rules. Jiang (2007) focuses on chunking in Chinese using a combination of statistic-based and rule-based methods, introducing a rule bank to his algorithm.

Current studies in TTLVCs mainly take a morphological perspective. A few researchers have studied TTLVC extraction based on their linguistic knowledge. Jiang (2005) analyzes the composition, structure, and syntactic function of TTLVCs. Hu (2005), Wang (1994), Gesang (1987), and Hu (1994) study the classification and structure of TTLVCs. According to these linguistic studies in Tibetan, Long (2007) proposes an algorithm to recognize TTLVCs that consists of three particular light verbs. In this paper, we propose an integrated model to extract TTLVCs from

unprocessed Tibetan corpora. Our model adopts a rule-based strategy and a statistic-based strategy including mutual information and maximum entropy methods.

2 Features of Tibetan trisyllabic light verb constructions

From a structural point of view, TTLVCs contain two parts a disyllabic word (hereafter referred to as *Dw*) and a light verb (hereafter referred to as *Lv*). It is worth noticing that some elements are inserted into TTLVCs in some circumstances. These inserted elements (hereafter referred to as *Ie*) include adverbs, classifier and so on. As a whole, a TTLVC can be expressed as formula 1.

$$TTLVC = Dw + Ie + Lv \tag{1}$$

In most cases, a *Dw* is a disyllabic noun or an adjective, and a *Lv* is a monosyllabic light verb. The meaning of a TTLVC is largely determined by the *Dw*.

2.1 Monosyllabic light verbs

According to their syllable length, Tibetan verbal phrases¹ can be classified into three categories: monosyllabic verb, trisyllabic verb phrase, and multisyllabic verb phrase. In Tibetan, the majority of verbs are monosyllabic, which has long history and high frequency. Lexical meanings of several monosyllabic verbs have slowly evolved, so these verbs are referred to as monosyllabic light verbs. To be specific, *Lv* only retains its general meaning as an action such as meanings of do, make, commit, or conduct.

Based on origin, monosyllabic light verbs can be divided into four categories.

(1) Light verbs that evolve from volitional verbs.

Some widely used light verbs such as གཏོང་།, ཐེད།, and ལྷན་། originate in volitional verbs and form TTLVCs like ལ་རྟུང་གཏོང་། (to denounce) or གསར་སྐྱེད་ཐེད། (to reclaim).

(2) Light verbs that evolve from nonvolitional verbs.

Light verbs such as རེབས།, རྟོག་།, ཡོང་།, and འགྲོ་། evolve from nonvolitional verbs that present objective results such as a TTLVC འཕེལ་རྒྱས་འགྲོ་། (to develop).

(3) Light verbs that originate from honorific morphemes. For instance, སློབ་སྦྱང་གནང་། (to learn) consists of སློབ་སྦྱང་ (learn) and a honorific morpheme གནང་། (to do).

(4) Aside from the aforementioned *Lv*, light verbs that originate from humilific morphemes like ལྷ། also can form TTLVCs, for instance ལྷན་ལྷ་གསལ་ལྷ། (to help).

Tibetan light verbs exhibit stem alternation according to tense², which persists when they are used as part of TTLVCs. For instance, གསར་སྐྱེད་ཐེད། (to reclaim) have three forms that are གསར་སྐྱེད་བྱ།, གསར་སྐྱེད་བྱས།, and གསར་སྐྱེད་བྱས།. These changes of tense of TTLVC are taken into consideration in our recognition model.

¹ In the current context we use ‘verb phrase’ as a more simply worded equivalent of ‘verbal syntagma’; we do not intend ‘verb phrase’ in the generative sense.

² Tibetan verb stems are capable of distinguishing up to four forms: present (*lda da ba*), past (*das pa*), future (*ma ongs pa*), and imperative (*skul tshig*). Terminological comfort might dictate that we refer to the imperative as a ‘mood’, but from the perspective of Tibetan morphology there is no reason to do so.

2.2 Disyllabic words

Hu (2002) analyzes the composition and structure of disyllabic words that form TTLVCs. He proposes a nine category morpheme pattern of disyllabic words that are V+V, N+V, D+V, A+V, V+N, R+V, N+N, N+A, A+A. V represents a light verb, N represents a noun morpheme, D presents an adverb morpheme, and A presents an adjective morpheme. The pattern V+V means that the disyllabic word is composed by two light verbs. For instance, in a TTLVC འཕེལ་རྒྱལ་འགྲོ་ (to develop), འཕེལ་ and རྒྱལ་ are both light verbs.

2.3 Inserted elements

The structure of TTLVCs are unstable because it is possible for some elements to be inserted between *Dw* and *Lv*. Inserted elements can be adverbs, adjectives, case-auxiliary words, enumerating auxiliary words, imperative auxiliary words, and so on. For instance, ཇལ་མེད་ཚིག་བརྒྱལ་ (to turn over once) consists of an indefinite article ཚིག་ and a TTLVC ཇལ་མེད་བརྒྱལ་ (to turn over), and བསམ་སྒོ་ཡག་པོ་བཏང་། (to think it over) consists of an adjective ཡག་པོ་ and a TTLVC བསམ་སྒོ་བཏང་། (to consider or to think).

Aside from the discontinuous TTLVCs discussed immediately above, there is another type of discontinuous TTLVC, namely one that is composed of more than one disyllabic word and one light verb. For instance, the TTLVC མོས་སྦྱང་དང་ཞིབ་འཇུག་བྱེད། (to learn and study) is composed of two nouns མོས་སྦྱང་ (learn) and ཞིབ་འཇུག་ (study), in the middle of these two nouns is a conjunction དང་ (and), and a light verb �བྱེད། (to do).

3 TTLVC candidates extraction

In this section, we introduce how to extract TTLVC candidates from raw Tibetan corpora according to the linguistic features of TTLVC discussed above. We start with building up a light verb list. A Tibetan and Chinese bilingual Lhasa Spoken Language Dictionary (Yu 1983) contains a number of TTLVCs. We extract light verb constructions from this dictionary, and integrate the results with light verb constructions listed in other works (viz. Jiang 2005; Wang 1994; Hu 1994; Zhou 2003). As result, we acquire a light verb list with 875 entries.

Our light verb list includes as information the light verbs themselves and the number of occurrences of each light verb. A few examples are shown in Table1, and please see Appendix 1 at the end of this paper for a complete light verb list adopted in this work.

ID	Light Verb	Occurrence Number	ID	Light Verb	Occurrence Number
1	བྱེད།	1027	2	རྒྱལ།	569
3	ལྷ།	134	4	བཞོ།	111
5	ཤོར།	109	6	བཤད།	84
7	ལེན།	70	8	འགྲོ།	61
9	སྒོག།	49	10	བཞག།	46

Table 1. Examples of Light verbs

According to the light verb list, we extract TTLVC candidates from a corpus. With regard to the inserted elements in TTLVCs, we work out TTLVC candidates using an extraction algorithm, the main procedures of which are listed in Tabel2.

-
- (1) Split a Tibetan sentence by *tsbeg* punctuation mark into syllables.
 - (2) To scan syllables obtained in step 1.
 - (3) If a *Lv* is found go to step 4, otherwise go back to step 1.
 - (4) If the syllable on the left of the *Lv* is an inserted element, extract two syllables on the left of the inserted element. These two syllables and the *Lv* compose one TTLVC candidate.
 - (5) If the syllable on the left of the *Lv* is not an inserted element, extract two syllables on the left of the *Lv*. These two syllables and the *Lv* compose one TTLVC candidate.
 - (6) If the *Lv* is at the end of a sentence go back to step 1, otherwise go back to step 2.
-

Table 2. TTLVC candidates extraction procedures

4 Statistic-based TTLVC recognition model

TTLVCs have two features: (1) although a TTLVC might be split by an inserted element, the elements of a TTLVC have a higher than average co-occurrence in corpus; (2) there is a clear boundary between the TTLVC and its context. Therefore, we propose two measures to grade a candidate. One is an internal measure and the other is an external measure. Several statistical methods are used to grade TTLVC candidates (Jiang 2007).

4.1 Internal Measure

From a statistical perspective, if the three syllables of a TTLVC candidate have a high co-occurrence frequency, they possess a strong degree of internal connectivity. Based on this theory, the higher the co-occurrence frequency the more likely they are to be a word or phrase, i.e. a true TTLVC. Mutual Information is usually applied to evaluate the level of co-occurrence probability of two words. The higher the mutual information of the two words is, the stronger internal connectivity they have. In this paper, we propose an internal measure formula based on the mutual information definition shown in formula2.

$$InMeasure(W) = \log_2 \frac{P_{XY}}{P_X P_Y} \quad (2)$$

P_{XY} presents the co-occurrence probability of Dw and Lv . P_X means the occurrence probability of Dw and P_Y is the occurrence probability of Lv .

4.2 External measure

Normally, we can identify the external boundary of a TTLVC by observing its context. In our work, a maximum entropy model is chosen to measure the external independence of a TTLVC. We use the model to evaluate the left and right boundary of a candidate separately. According to information entropy theory, a TTLVC candidate with higher information entropy is free to occur in various contexts. If a candidate stably appears in a variety of context, it has a higher probability of being a TTLVC.

In this paper, $Le(W)$ and $Re(W)$ are proposed to evaluate the external measure of a TTLVC, as shown in formula 3 and formula 4.

$$Le(W) = - \sum_{\forall a \in A} P(aW|W) \times \log_2 P(aW|W) \quad (3)$$

$$Re(W) = - \sum_{\forall b \in B} P(Wb|W) \times \log_2 P(Wb|W) \quad (4)$$

In formula 3, W is a TTLVC candidate, Le is the left boundary entropy; Re is the right boundary entropy; and A is a collection of syllables that appear on the left of candidates; a is a specific syllable on the left of the candidate; B is a collection of syllables that appear on the right of our candidates; b is a specific syllable on the right of the candidate.

We can combine formula 3 and formula 4, to yield a more general external measure as in formula 5.

$$ExMeasure(W) = \sqrt{(1 - Le(W))(1 - Re(W))} \quad (5)$$

4.3 Integrated algorithm based on internal measure and external measure

To improve precision and accuracy of a single statistic-based approach employing both the internal and external measures discussed so far, we propose a comprehensive formula (formula 6) that integrates internal measure and external measure. Additionally, a candidate has a higher probability of being a TTLVC, if it has a relatively high frequency in corpus. Therefore the frequency of the syllable sequence in question $F(W)$ has been introduced into our algorithm.

$$UniMeasure(W) = (1 - 1/F(W)) \times InMeasure(W) \times ExMeasure(W) \quad (6)$$

5 Rule-based TTLVC recognition model

Observing the Tibetan corpus, we find that a high frequency sequence of syllables may not be a TTLVC. Take the syllable sequence བར་ངོ་ཚོལ། as an example. In our corpus, བར་ངོ་ཚོལ། appears in various contexts, for instance, it is often used in ཡར་ཐོན་རྒྱུ་འགྲུབས་ཀྱིས་ལྷག་ལོག་རྒྱལ་བར་ངོ་ཚོལ། (Persist in progress and oppose retrogression!) Due to its high frequency, it is identified as a TTLVC by our statistic-based model. Actually, it is just a sequence of three syllables, not even respecting word boundaries, not to mention being a TTLVC. In fact, it is quite easy to rule out the possibility of བར་ངོ་ཚོལ། being a TTLVC according to linguistic knowledge. The structure of བར་ངོ་ཚོལ། is “བ (nominalization marker) + ར་ (case marker) + ངོ་ཚོལ།”. Because nominalization markers appear at the end of words, there cannot be a word break before a nominalization marker, so we know that བར་ངོ་ཚོལ། is not a TTLVC. Our statistic-based model does not perform very well in such cases; however, rule-based approach can deal with them effectively. As a result, we build up a linguistic knowledge rule bank to make up for the deficiency.

We make a rule to exclude the candidates such as བར་ངོ་ཚོལ།. For instance, if a Dw contains a case marker or a nominalizations marker, then the candidate should be removed. According to

Tibetan grammar, *Dw* are often nouns. If case markers appear in a *Dw*, there is a low chance the syllable sequence is a TTLVC. The rules are relative rather than absolute, thus the rule bank can be added, deleted, and modified according to needs. Several rules of our rule bank are listed in Table 3.

If a candidate meets one of the following rules, remove it from candidate list.

- (1) The first syllable of a TTLVC candidate is a case marker, a nominalizations marker, an adjective suffix, or a negative adverb.
- (2) The second syllable of a TTLVC candidate is a case marker.

Table 3. TTLVC filter rule sample

6 Experiments and Analysis

6.1 Experiments and Results

We test our TTLVC recognition model proposed in this paper using a corpus that composed of Tibetan publications. Our corpus contains fifty thousand sentences, whose genre includes government documents, news reports, legal texts, and so on. Based on the same corpus, we conduct three groups of experiments that adopt different methods shown as follow.

- Statistic-based Method 1: Mutual Information
- Statistic-based Method 2: Statistic-based Method1 + Left/Right Entropy
- Integrated Method: Statistic-based Method2 + Rule Bank

Considering the importance of light verbs, we build up a couple of light verb lists according to their number of occurrences (*F*). To choose an optimal light verb list, we conduct several experiments based on different lists, and the precision (*P*) of experiments are shown in Table 4.

<i>F</i> \ <i>P</i>	Statistic-based Method1	Statistic-based Method2	Integrated Method	Average Precision
>100	0.791	0.858	0.918	0.855
>50	0.787	0.819	0.906	0.837
>10	0.758	0.803	0.879	0.813
>0	0.700	0.717	0.865	0.760

Table 4. Results of TTLVC recognition experiments based on different light verb lists

The results of the experiments suggest that the scope of the light verb list plays a significant role in TTLVC recognition. When we employ a relatively small light verb list, we acquire the best precision 91.8% in the TTLVC extraction experiment. In this experiment we only employ the light verbs whose number of occurrence is greater than 100. But a large number of TTLVC candidates have been discarded because of the smaller light verb list. Thus we choose light verbs whose frequency is more than ten to build up a more thorough list of light verbs. In addition, all tenses of these light verbs are also added into our list. Our final list contains 210 entries.

Based on the final list, 65,764 TTLVC candidates have been extracted from the corpus. By morphological analysis and removing candidates whose occurrence frequency is lower than three, we retain 11,243 candidates.

According to the experimental results, the precision of Method1 is 75.8%, and it reaches 80.3% by introducing Left/Right Entropy. When the integrated method is adopt, the precision increases 7.6% and reaches 87.9%. These results prove that the integrated method performs the best in the TTLVC task. TTLVC samples recognized by our model are listed in Table 5.

Examples	Meaning	Number of Occurrence
ངོ་ཚོལ་བྱེད།	to resist	1,490
སྐལ་ལྷན་གཏོང།	to stimulate	240
ལེན་ལ་ཐག་གཅོད།	to determine	199
འཕེལ་རྒྱས་འགོ།	to make progress	561
འཕེལ་རྒྱས་གཏོང།	to develop	138
དབྱེ་བ་འབྱེད།	to distinguish	79
རྟལ་བ་འདོན།	to play a part in	351
ཚོར་འཇུག་ཤིང།	to make a mistake	48
བུ་ལོན་འཇུག།	to repay a debt	10

Table 5. TTLVC examples

6.2 Error analysis

In general, our integrated algorithm performs well in TTLVC recognition as shown in table 4. Table 5 lists actual TTLVC identified by our system. However, our algorithm makes some mistakes, most of which fall into three categories.

1. Misidentifying multi-syllabic verb phrases as TTLVCs. Aside from TTLVCs, there exist a large number of multi-syllabic verbal phrases such as four syllabic or five syllabic verbal phrases. Our algorithm falsely extracts the last three syllables of these phrases as TTLVCs. For instance, གནས་ཚུལ་ལེགས་འགྱུར་ (the situation has been changed) is a four syllable verbal phrase, and our algorithm extracts ཚུལ་ལེགས་འགྱུར་ and take it as a TTLVC. Because these multi-syllabic verbal phrases have a high frequency in our corpus, and they conform with linguistic rules related to TTLVC, it is very difficult to correct this type of error for our model.

2. Misidentifying some multi-word expressions as TTLVCs. There are many tri-syllabic multi-word expressions with high occurrence frequency in Tibetan, but which are not TTLVCs. For instance, དེ་ལྟར་བྱེད། (How should something be done?) is a sentence and it occurs 19 times in our corpus.

3. Misidentifying an adjective or adverb and a light verb as TTLVCs.

It is possible that TTLVCs are separated by inserted elements such as an adjective or an adverb. In some circumstances, our algorithm incorrectly recognizes inserted element and the light verb behind them as TTLVCs. The reason why our algorithm makes this kind of mistake is inserted elements probably co-occur with light verbs in corpus several times. Therefore, their co-occurrence makes our statistically based algorithm unable to get rid of these mistakes.

For instance, གཞིག་སྤྱད་ཏེ་ཚང་ཆེན་པོ་བྱེད། (to intensively concentrate on) consists of a TTLVC གཞིག་སྤྱད་བྱེད། (to concentrate on) and an adverb ཏེ་ཚང་ཆེན་པོ་ (intensively). Our algorithm, however, misidentifies ཆེན་པོ་བྱེད། as a TTLVC.

7 Conclusion

In this paper, we propose an integrated approach to identify Tibetan trisyllabic light verb constructions from a raw corpus. Experimental results show that a statistics-based strategy that combines mutual information and entropy performs well in TTLVC recognition. Accuracy and precession of our model have been largely improved when a rule-based method is introduced into our algorithm. The result proves that a multi-pronged strategy is more effective than a unitary strategy. In the future, we plan to apply our algorithm to other types of Tibetan phrase structure extraction problems such as the identification of noun phrases.

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Weina Zhao
zhaoweina1999@qq.com

ACKNOWLEDGEMENTS

ID	Light Verb	Number of Occurrence	ID	Light Verb	Number of Occurrence	ID	Light Verb	Number of Occurrence
1	ལྱེད	1027	71	ཞིབ	12	141	སངས	6
2	ལྱུག	569	72	གསོག	12	142	ཟད	6
3	ལྱུ	134	73	ལྱིས	11	143	དག	6
4	ལྱོད	111	74	འབད	11	144	ཉལ	6
5	ཤོད	109	75	བརྒྱུད	11	145	ཉན	6
6	ལགད	84	76	ལྱོད	11	146	བསད	6
7	ལོད	70	77	ལྱོད	11	147	བཀོག	6
8	འཕྱོད	61	78	ལྱོད	11	148	ལྱུས	6
9	ལྱོག	49	79	ལྱོག	11	149	བརྒྱུད	6
10	བཞག	46	80	ལོད	11	150	ལྱུས	6
11	ལྱོག	43	81	ལྱོག	11	151	ལྱོད	6
12	ལྱོག	41	82	ལྱོག	10	152	འབྱུངས	6
13	གཙོད	40	83	བཀག	10	153	འབྱུང	6
14	ཆགས	39	84	བཅག	10	154	འཕྱོད	6
15	འབྱུངས	39	85	ལྱོག	10	155	འབྱུང	6
16	ལྱོག	36	86	འབྱུང	10	156	ལྱུགས	6
17	ལྱོག	33	87	འབྱུང	10	157	གཉོད	6
18	ལྱོག	32	88	གཉོད	10	158	གཉོད	6
19	ལྱོག	30	89	ལྱོག	10	159	འདྲ	6
20	འབྱུང	29	90	འབྱུང	10	160	འབྱུང	6
21	བརྒྱུད	28	91	ལྱོག	10	161	འབྱུང	6
22	འབྱུང	27	92	ལྱོག	10	162	བརྒྱུད	6
23	འདྲ	26	93	འབྱུང	9	163	ལྱོག	6
24	འབྱུང	25	94	འབྱུང	9	164	ལྱོག	6
25	ལྱོག	25	95	ལྱོག	9	165	བཞེད	6
26	འབྱུང	24	96	འབྱུང	9	166	གཞོགས	6

27	ལྟོ	24	97	འགུལ།	9	167	གསོད།	6
28	བྱུག	24	98	ལྟོ།	9	168	བསྐྱེད།	6
29	བཞུག	23	99	བཞུག	9	169	གསུམ།	5
30	ལྟོ།	23	100	འདྲེ།	9	170	བཅའ་གསུམ།	5
31	འཇོག	23	101	ལྟོ།	9	171	བཞུག	5
32	ལྟོ།	22	102	འཇོག	9	172	བཞུག	5
33	འཇོག	22	103	ལྟོ།	9	173	ལྟོ།	5
34	ལྟོ།	22	104	ལྟོ།	9	174	ལྟོ།	5
35	ལྟོ།	22	105	འཇོག	8	175	ལྟོ།	5
36	ལྟོ།	21	106	འཇོག	8	176	ལྟོ།	5
37	ལྟོ།	21	107	འཇོག	8	177	ལྟོ།	5
38	ལྟོ།	19	108	ལྟོ།	8	178	ལྟོ།	5
39	ལྟོ།	19	109	ལྟོ།	8	179	ལྟོ།	5
40	ལྟོ།	18	110	ལྟོ།	8	180	ལྟོ།	5
41	ལྟོ།	18	111	ལྟོ།	8	181	ལྟོ།	5
42	ལྟོ།	18	112	ལྟོ།	8	182	ལྟོ།	5
43	ལྟོ།	17	113	ལྟོ།	8	183	ལྟོ།	5
44	ལྟོ།	17	114	ལྟོ།	8	184	ལྟོ།	5
45	ལྟོ།	17	115	ལྟོ།	8	185	ལྟོ།	5
46	ལྟོ།	17	116	ལྟོ།	8	186	ལྟོ།	5
47	ལྟོ།	16	117	ལྟོ།	8	187	ལྟོ།	5
48	ལྟོ།	15	118	ལྟོ།	8	188	ལྟོ།	5
49	ལྟོ།	15	119	ལྟོ།	8	189	ལྟོ།	5
50	ལྟོ།	14	120	ལྟོ།	8	190	ལྟོ།	5
51	ལྟོ།	14	121	ལྟོ།	7	191	ལྟོ།	5
52	ལྟོ།	14	122	ལྟོ།	7	192	ལྟོ།	5
53	ལྟོ།	14	123	ལྟོ།	7	193	ལྟོ།	5
54	ལྟོ།	14	124	ལྟོ།	7	194	ལྟོ།	5
55	ལྟོ།	14	125	ལྟོ།	7	195	ལྟོ།	5

56	བཞེས།	14	126	དུས།	7	196	འཕྲོག།	5
57	གཟེང།	14	127	ལྷོད།	7	197	འབེབས།	5
58	འཚོས།	13	128	ལྷོད།	7	198	ལྷོས།	5
59	ཚད།	13	129	ཁེངས།	7	199	བས།	5
60	བཞོད།	13	130	གཙོག།	7	200	འབྲེག།	5
61	ལྷག།	13	131	བཞེ།	7	201	ལྷོད།	5
62	གྲོས།	13	132	ལྷག།	7	202	ཚོན།	5
63	བཞོན།	13	133	དབ།	7	203	འཛོམས།	5
64	འབྲེག།	13	134	འབྲེག།	7	204	རྒྱགས།	5
65	བཟུང།	13	135	ལྷོད།	7	205	གཟེགས།	5
66	ཐུང།	13	136	མོན།	7	206	གཤོལ།	5
67	ལྷོགས།	13	137	ཤེས།	7	207	ལོངས།	5
68	འཇགས།	12	138	བཅད།	6	208	བཤིག།	5
69	འཇུག།	12	139	བཤལ།	6	209	གསོལ།	5
70	དོན།	12	140	ལན།	6	210	ལྷོབས།	5