The Use of *yig-cha* and *chos-kyi-rnam-grangs* in Computing Lexical Cohesion for Tibetan Topic Boundary Detection

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August 18, 2010
Tibetan IT Panel — IATS-12, Vancouver, BC

Introduction

- Simple Tibetan IR system requires segmentation (n-gram, POS-tagging, dictionary substring matching, etc.)
- For finer grain indexing, large-scale structure and (sub-)topic detection is needed

Previous Research

In a previous paper (Hackett, 2000), we reported on automatic techniques developed for Tibetan for:

- Word Segmentation,
- Part-Of-Speech tagging, and
- Sentence boundary detection

Large-scale Structures:
Exploiting Existing Features

- Explicit & Reoccurring Text Titles
- Chapter-boundaries
- Topical Outlines (sa bcad)

Chapter Boundary Detection

Case Example:

'Gro-lung-pa's Bstan-rim-chen-mo.

Full title from Title Page:

bde bar gshegs pa'i bstan pa rin po che la 'jug pa'i lam gyi rim pa rnam par bshad pa bzhugs so

Chapter Boundary Detection

Case Example:

'Gro-lung-pa's Bstan-rim-chen-mo.

Full title from Title Page:

bde bar gshegs pa'i bstan pa rin po che la 'jug pa'i lam gyi rim pa rnam par bshad pa bzhugs so

Chapter Boundary Detection

Combine Title "Key" Syllables:

bde | gshegs | bstan | rin | po | che |
'jug | lam | rim | rnam | bshad

Chapter Boundary Detection

With Chapter Colophon "Flags":

de | ste | te | le'u | las

Chapter Boundary Detection

... and Ordinal Numbers:

((nyer|nyi shu|((sum|bzhi|lnga|drug|bdun|brgyad|dgu|brgya) (bcu|cu)?))?

(((rtsa|so|zhe|nga|re|don|gya|go))?))?

(dang po|(((gcig|gnyis|gsum|bzhi|lnga|drug|bdun|brgyad|dgu|bcu|tham))+(pa)?))

Chapter Boundary Detection

Yields Automatic Colophon Identification:

TITLE + FLAG + ORDINAL

bstan pa la 'jug pa'i rim pa rnam par bshad
pa las dge ba'i bshes gnyen bsten pa la 'jug
pa ste le'u dang po'o

Automatic Tagging of Large-scale Structures

```
        . . .
</SENTENCE>
</CHAPTER>
<CHAPTER_COLOPHON>
    <SENTENCE Struct="S(NP(S,N),C247,VP(V5,SEC6),NP(S,N),NP(S,S,S,N),C5,
    NP(S,NEC6,S,N),NP(S,N),C247,VP(V5,N),RSP,N,NP(S,NUM)ETP)">
        <PHRASE>bstan pa la 'jug pa'i rim pa rnam par bshad pa las</PHRASE>
        <PHRASE>dge ba'i bshes gnyen bsten pa la 'jug pa ste le'u dang po'o</PHRASE>
    </SENTENCE>
</CHAPTER_COLOPHON>
<CHAPTER n="2">
    <SENTENCE Struct="...
```

Approaches to Topic Boundary Detection

Previous research explored three approaches:

- Statistical Methods
- Conceptual Hierarchies
- Exploiting lexical resources

Lexical Cohesion Method

Kozima (1993) put forth a method for calculating the Lexical Cohesion Profile (LCP) of English-language texts by:

- Building a weighted co-occurrence database of words from the Longman Dictionary of Contemporary English
- Performing a co-occurrence analysis over the text using a sliding Hanning window

LCP Method for Tibetan

- No resource comparable to Longman Dict.
  (Tshig-mdzod-chen-mo too uneven)
- Have two highly specialized genres of lit.:
  - Chos-kyi-rnam-grangs
    ("Enumerations of Phenomena")
  - Yig-cha ("Monastic Textbooks")

Chos-kyi-rnam-grangs

Sample Entry:

- 'dus byas kyi mtshan nyid bzhi:

  skye ba'i mtshan nyid
  rga ba'i mtshan nyid
  gnas pa'i mtshan nyid
  mi rtag pa'i mtshan nyid do

Chos-kyi-rnam-grangs (stemmed & segmented)

Sample Entry:

- 'dus_byas kyi mtshan_nyid bzhi:

  skye_ba mtshan_nyid
  rga_ba mtshan_nyid
  gnas_pa mtshan_nyid
  mi_rtag_pa mtshan_nyid do

Yig-cha

Sample Entry:

- yid dpyod:

  rang gi 'jug yul gyi gtso bor
  gyur pa'i chos la 'tha' gcig tu zhen
  kyang bcad don ma thob pa'i rig pa

Yig-cha
(stemmed & segmented)

Sample Entry:

- yid_dpyod:

  rang_gi_'jug_yul gyi gtso_bo
  gyur_pa chos la 'tha'_gcig tu zhen
  kyang bcad_don ma thob_pa rig_pa

Calculate TFIDF

- Term Frequency (TF) per entry, times Inverse Document Frequency (IDF) over the entire lexicon:

$$tfidf = \log(1 + \log(tf)) * \log(N / df)$$

Weighted & Normalized TFIDF

For example:

yid_dpyod (0.222390700)

rang_gi_'jug_yul (0.166793025)

'gyur_pa (0.008339651)

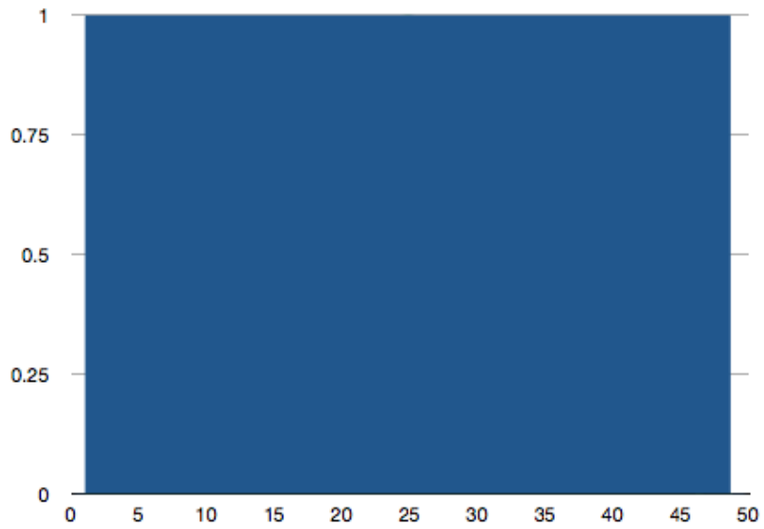
chos (0.011119535)

'tha'_gcig (0.166793025)

etc ...

Hanning Weights

Rectangular Window

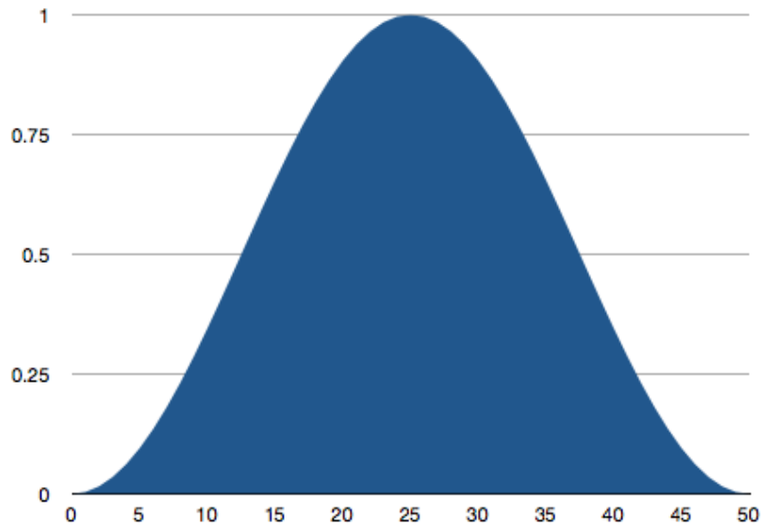


For window width, N

for $0 < n \leqslant N$, $w(n) = 1$

else, $w(n) = 0$

Hanning Window



For window width, N

$$w(n) = 1 - \cos(2\pi n / N - 1)$$

Evaluation Metric: Known Item Retrieval

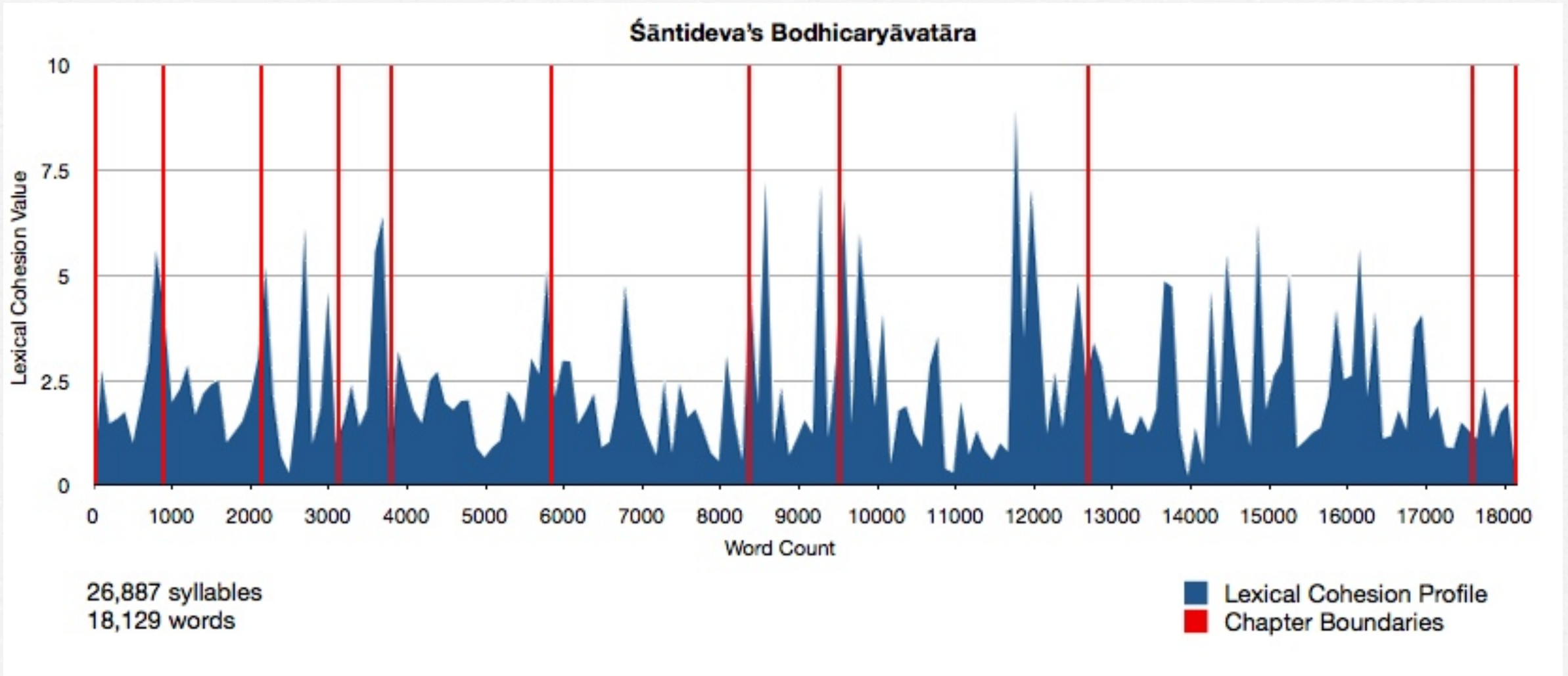
- Identify e-texts that have varied and rich vocabulary with known topic boundaries. Two test candidates — one canonical, one non-canonical:

  - Śāntideva's Bodhicaryāvatāra
    (10 chapters; 26,887 syll.; 18,129 words)

  - Tsong-kha-pa's Legs-bshad-snying-po
    (no chap. boundaries; 69,176 syll.; 42,956 words)

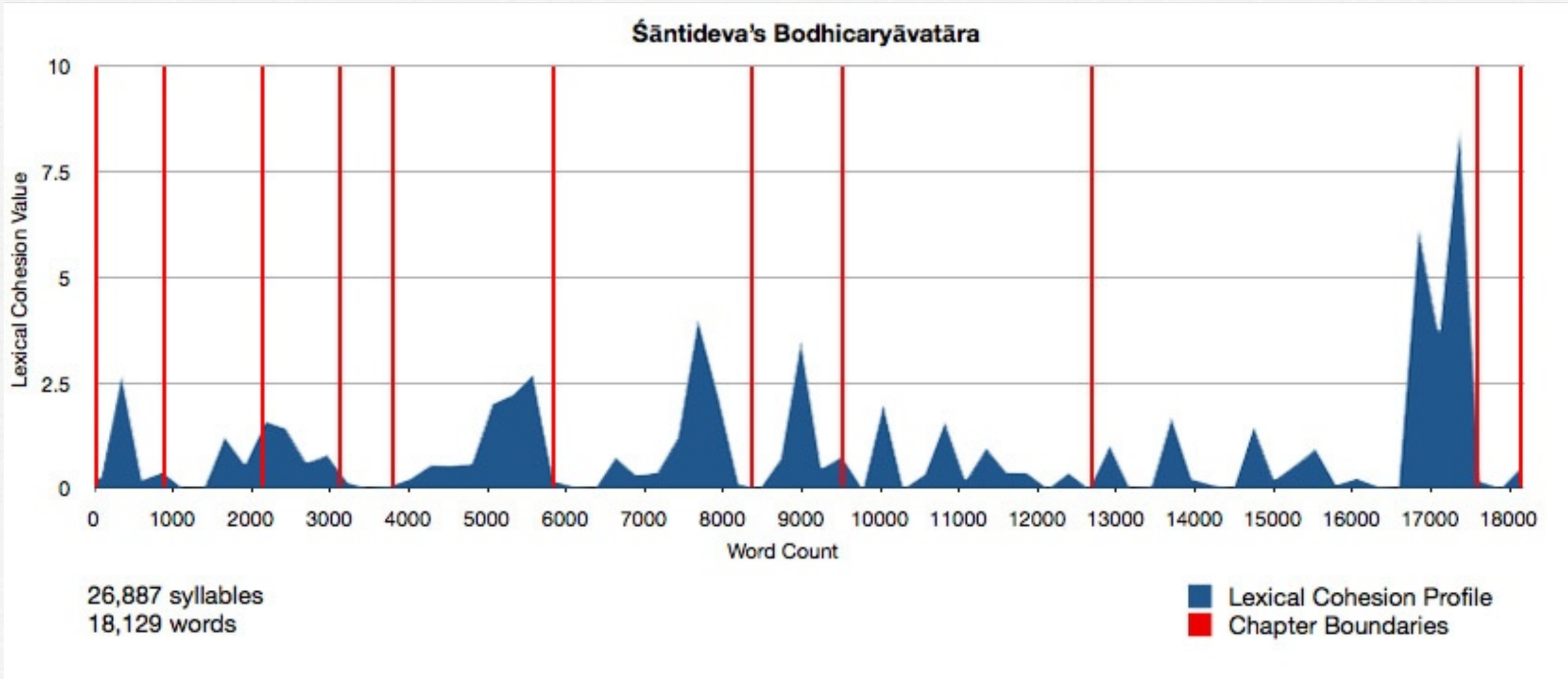
LCP for Śāntideva:

Chos-kyi-rnam-grangs



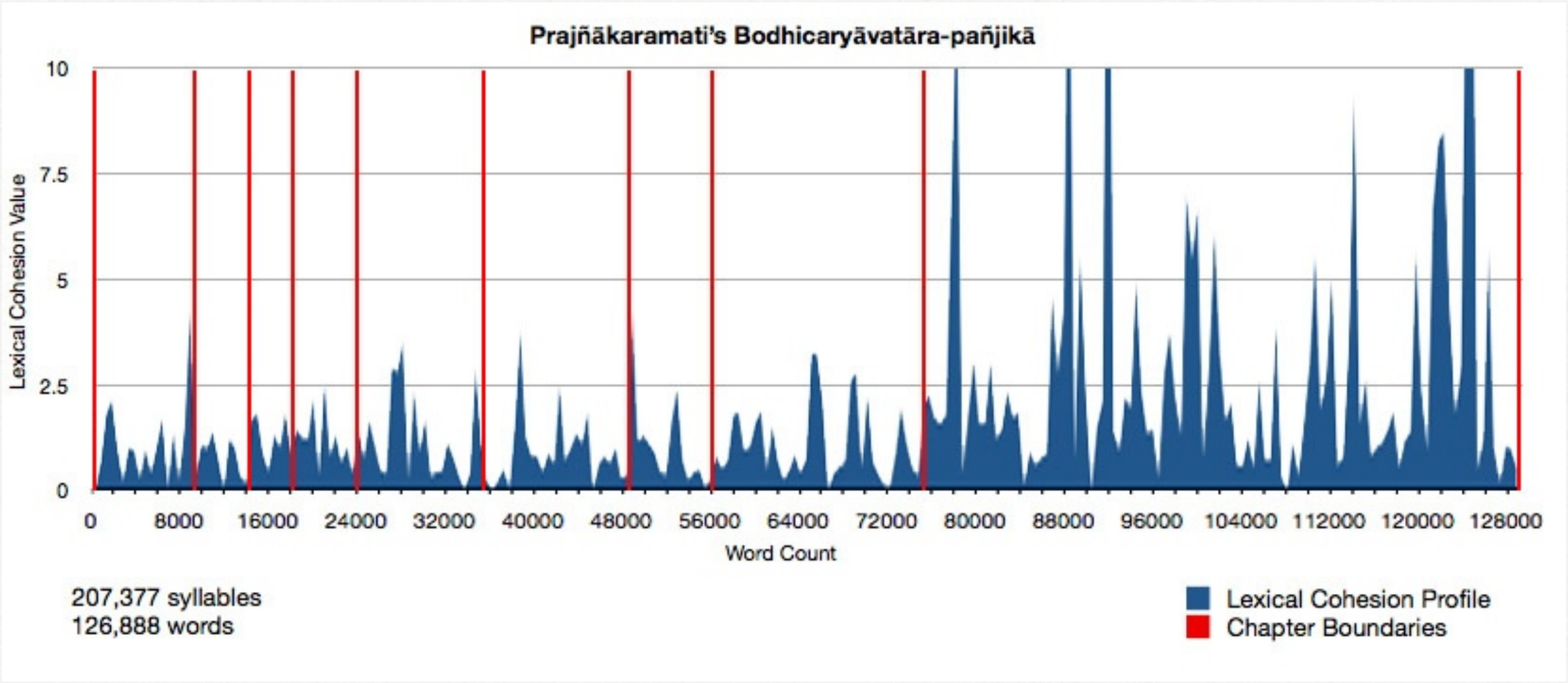
LCP for Śāntideva:

Yig-cha definitions



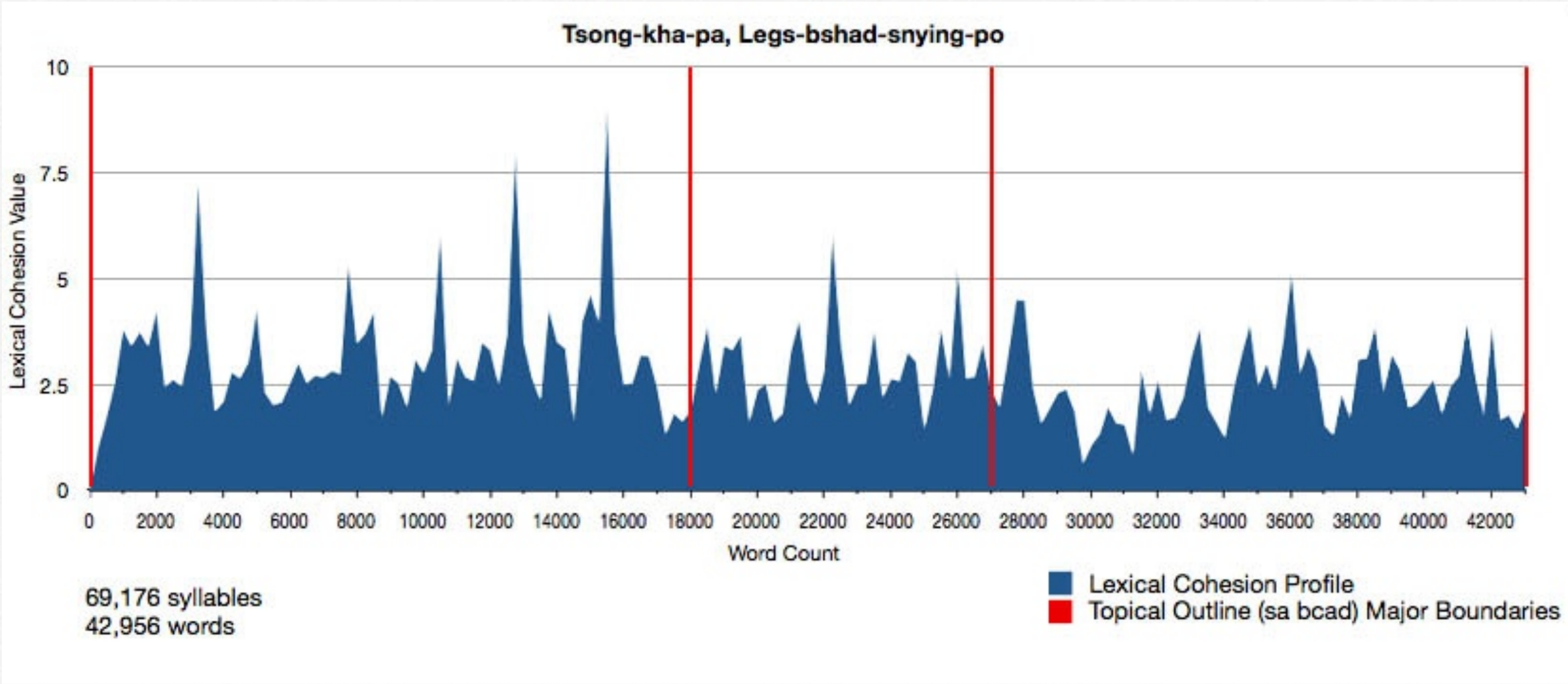
LCP for Prajñākaramati:

Yig-cha definitions



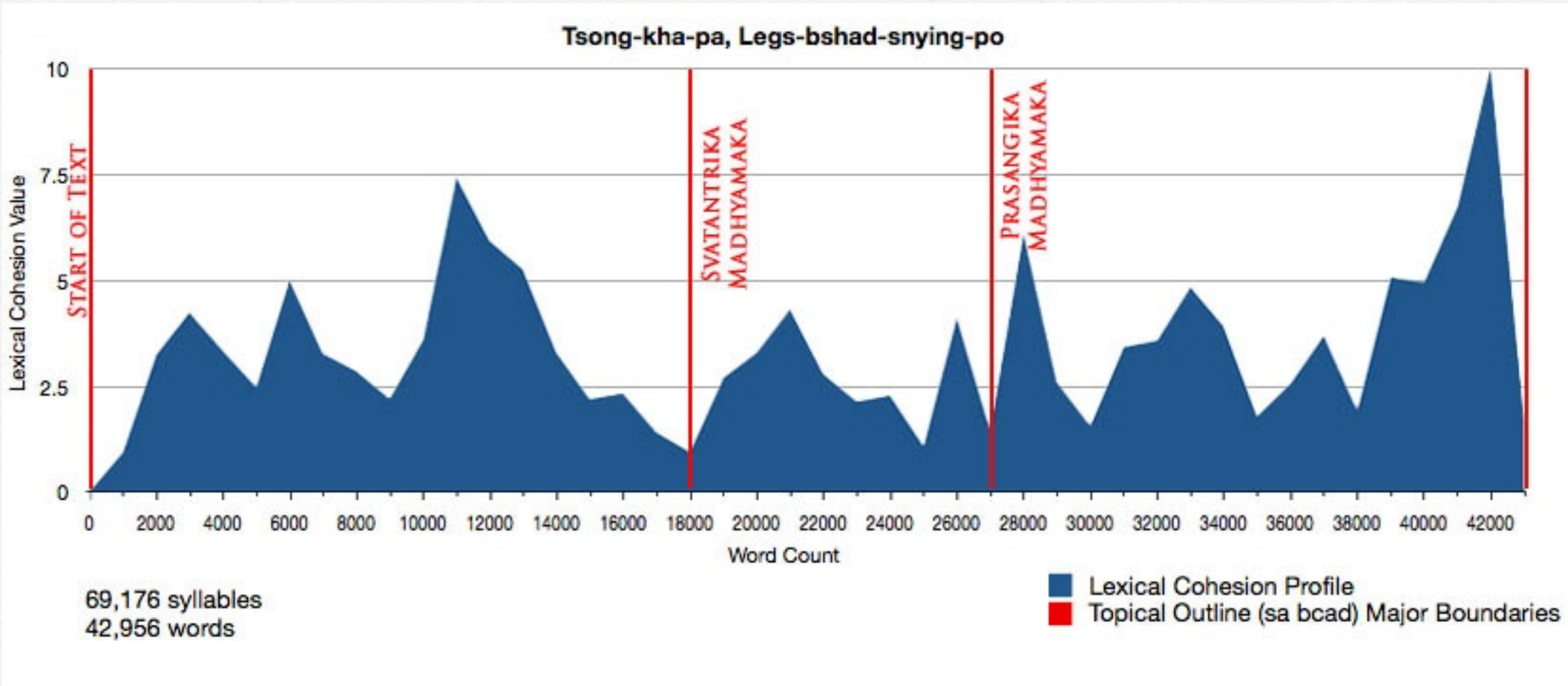
LCP for Tsong-kha-pa:

Chos-kyi-rnam-grangs



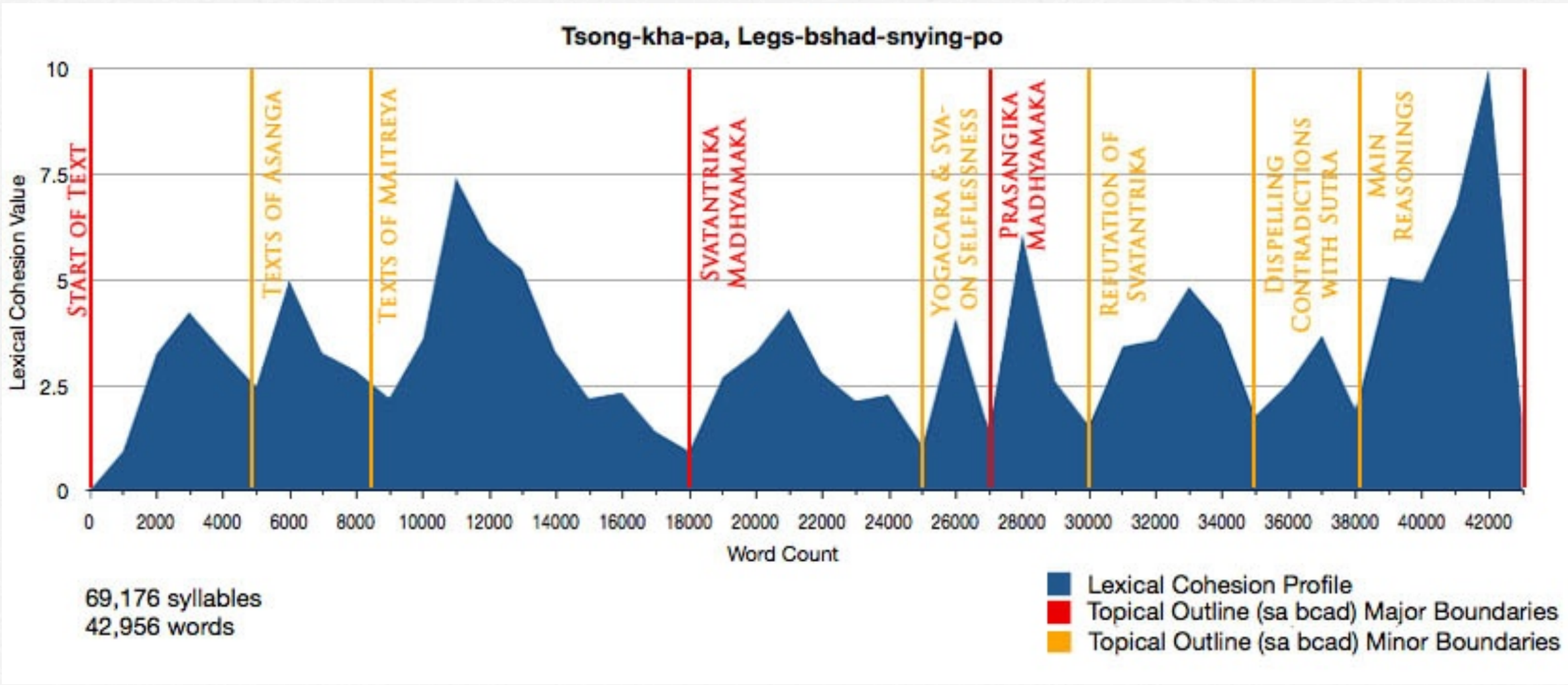
LCP for Tsong-kha-pa:

Yig-cha definitions



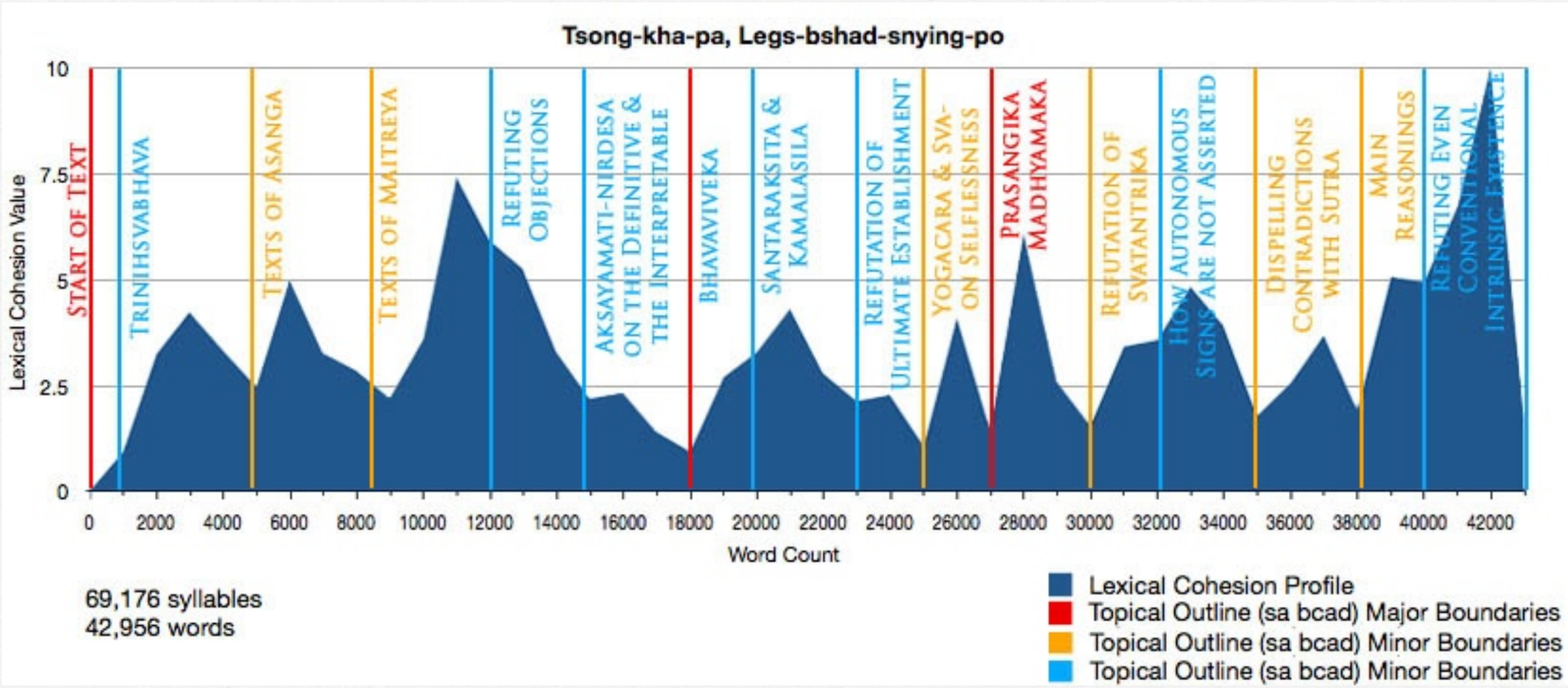
LCP for Tsong-kha-pa:

Yig-cha definitions



LCP for Tsong-kha-pa:

Yig-cha definitions



Analysis

Immediate Observations:

1. Topic boundaries detection is feasible
2. Chapter boundaries are best / easily captured by non-CL methods
3. Chos-kyi-rnam-grangs fail, likely due to being "un-natural" lists

Applications

1. Fine grain indexing of texts based on individual sub-topics
2. Topic identification can be deployed for translation equivalent disambiguation
3. Content analysis and automatic topic outline generation easily done

Future Work

- Expand lexical Cohesion database with additional / alternate definitions
- Add domain tags to lexical pairs
- Incorporate domain tags in XML tagged documents for gisting/translation

fin.