A First South African Corpus of Multilingual Code-switched Soap Opera Speech

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Abstract

We introduce a speech corpus containing multilingual code-switching compiled from South African soap operas. The corpus contains English, isiZulu, isiXhosa, Setswana and Sesotho speech, paired into four language-balanced subcorpora containing English-isiZulu, English-isiXhosa, English-Setswana and English-Sesotho. In total, the corpus contains 14.3 hours of annotated and segmented speech. The soap opera speech is typically fast, spontaneous and may express emotion, with a speech rate that is between 1.22 and 1.83 times higher than prompted speech in the same languages. Among the 10343 code-switched utterances in the corpus, 19207 intrasentential language switches are observed. Insertional code-switching with English words is observed to be most frequent. Intraword code-switching, where English words are supplemented with Bantu affixes in an effort to conform to Bantu phonology, is also observed. Most bigrams containing code-switching occur only once, making up between 64% and 92% of such bigrams in each subcorpus.

Keywords: code-switching, spontaneous speech, South African languages, isiZulu, isiXhosa, Setswana, Sesotho

1. Introduction

South Africa has 11 official languages and since the majority of South Africans are multilingual, code-switching occurs commonly and spontaneously. Code-switching is the phenomenon of using more than one language within the same conversation or utterance (Van Dulm, 2007). Language switches may even occur mid-word, as examples in our data will demonstrate.

In an effort to be representative and accommodate a large viewer base, conversations in South African soap operas are multilingual and exhibit code-switching. Soap operas are therefore an interesting source of multilingual code-switched speech data. The corpus we describe in this paper displays various types of code-switching. Intersential code-switching occurs when the language alternates between utterances of a conversation. For example, a speaker may utter a sentence in English while the following sentence is spoken in isiZulu. Intrasentential code-switching occurs when the language alternates within a single utterance. For example, an utterance may start in English and mid-sentence switch to isiZulu. Intrasentential code-switching can further be divided into alternational and insertional switching. Alternational code-switching occurs when an utterance starts with a phrase in one language and switches to a phrase in another language and where the phrases conform to the grammar of the respective languages. Insertional code-switching occurs when a language element from a secondary language is embedded into the structure of a matrix language. Code-switching can also occur at morpheme-level within word boundaries (intraword). Examples of intraword switching from our corpus include the joining of Bantu language class affixes to English stems.

Currently our corpus contains 14.3 hours of language-balanced speech compiled from soap opera broadcasts. Four Bantu languages are paired with English to yield subcorpora containing English-isiZulu, English-isiXhosa, English-Setswana and English-Sesotho code-switched speech. isiZulu and isiXhosa are part of the Nguni language family, while Setswana and Sesotho are part of the Sotho-Tswana language family. Hence these five languages represent an interesting basis for studies into acoustic and language modelling for code-switched speech. The corpus is planned to be made available for research use.

2. Background

A number of code-switched corpora have already been described in the literature. Below we summarise a few notable examples. The list is however not intended to be exhaustive.

1. The SEAME corpus from Nanyang Technological University, Singapore, and Universiti Sains Malaysia, contains 63 hours of spontaneous Mandarin-English code-switched conversational and interview speech uttered by Malaysian and Singaporean speakers (Vu et al., 2012; Dong et al., 2010; Adel et al., 2015).
2. The HKUST Mandarin-English Corpus from the Hong Kong University of Science and Technology (Li et al., 2012; Li and Fung, 2013) consists of code-switched spontaneous speech from meetings and interviews and comprises 5 hours of transcribed and 15 hours of untranscribed speech.
3. The CECOS Chinese-English Corpus was compiled at the National Cheng Kung University in Taiwan (Shen et al., 2011). It contains 12 hours of speech collected from 77 speakers uttering prompted code-switch sentences.
4. The CUMIX Cantonese-English speech corpus (Chan et al., 2005) was compiled at The Chinese University of Hong Kong. It contains 17 hours of code-switched speech read by 80 speakers.
5. A small English-Spanish Corpus was compiled at the University of Texas. The corpus contains 40 minutes of transcribed spontaneous conversations with a vocabulary of 1516 words (Franco and Solorio, 2007).
6. A Frisian-Dutch corpus of radio broadcast speech was compiled at Radboud University, Nijmegen, containing 18.5 hours of speech with code-switching (Yilmaz et al., 2016).

7. A corpus of Sepedi-English code-switched speech was compiled by the South African CSIR (Modipa et al., 2013). It contains 10 hours of prompted speech, sourced from radio broadcasts and read by 20 Sepedi speakers.

The list above demonstrates that data collection for code-switched speech has focussed mostly on English with Asian languages. Recently this has been extended by a European language pair (Frisian-Dutch). Only one corpus containing an African language could be found. Our corpus extends this field by providing spontaneous data in several African languages, some of which are related.

3. Data Collection

The corpus is compiled from digital video recordings of 626 South African soap opera episodes. Mono audio sampled at 32kHz and coded as 16-bit PCM was extracted from the original source videos for each episode. The ELAN media annotation tool (Wittenburg et al., 2006) was used to segment the audio into segments corresponding to sentences. Figure 1 shows how ELAN displays the audio waveform and annotation tiers of a transcribed code-switched utterance. Sentences containing code-switching were further subdivided into segments corresponding to a single language. Such language segments were transcribed and tagged with a language label. Hence the following annotation tiers were used:

- monolingual sentence text,
- monolingual sentence language,
- code-switch segment text,
- code-switch segment language, and
- speaker name or ID.

Comparisons between the soap opera scripts and the uttered speech showed that the actors display a strong tendency to ad-lib. Therefore the speech can be regarded as spontaneous. Actors who code-switch usually do so between English and their Bantu mother tongue. Nevertheless, many utterances do contain more than two languages. These have been excluded from the current corpus, which focusses on code-switching in language pairs.
Table 1: Subcorpora statistics. (train; Training set; dev: Development set; test: Evaluation test set; eng: English; zul: isiZulu; xho: isiXhosa; tsn: Setswana; sot: Sesotho; tot: Total; tok: tokens; typ: types; utt.cnt: Utterance count; emdur: Duration of English monolingual sentences; zm dur: Duration of isiZulu monolingual sentences; xmdur: Duration of isiXhosa monolingual sentences; tmdur: Duration of Setswana monolingual sentences; smdur: Duration of Sesotho monolingual sentences; ecdur: Duration of English code-switched segments; zsdur: Duration of isiZulu code-switched segments; xcdur: Duration of isiXhosa code-switched segments; tcdur: Duration of Setswana code-switched segments; scdur: Duration of Sesotho code-switched segments; dur: Total speech duration.)

Table 2: Monolingual and code-switched utterance counts for each full subcorpus. (utt.cnt: utterance count; em: English monolingual; zm: isiZulu monolingual; ezcs: English-isiZulu code-switched; xm: isiXhosa monolingual; excs: English-isiXhosa code-switched; tm: Setswana monolingual; etcs: English-Setswana code-switched; sm: Sesotho monolingual; escs: English-Sesotho code-switched)

the preceding word, e.g.: w1_en w2_en name_en w1_zu w2_zu, where _en and _zu are the English and isiZulu language labels, respectively.

Many short English function words, such as but, why and if occur very frequently in Bantu speech. It is tedious and time-consuming to mark all instances of such words as English. It could even be argued that such common English words have been adopted as loanwords by the Bantu languages. As a time-saving strategy during annotation, these words were either:

- labelled with the language they are embedded in, e.g. but_zu w1_zu w2_zu w1_en w2_en, or
- labelled as English when adjacent to an English word, w1_zu w2_zu but_en w1_en w2_en.

Since the set of English function words in question is closed, these words can easily and unambiguously be identified in the transcriptions.

4. Data Analysis

Tables 1 and 2 show statistics for the current version of our corpus. For each subcorpus, the tables show the speech durations, word token, type and utterance counts as well as the divisions into training, development and test sets. Since the transcription process is on-going, these statistics are subject to change in future and will be updated accordingly.

Table 3 shows the number of times the language switches in the corpus. Switching to English occurs slightly more often than switching from English to another language. We can consequently reason that, for our data, there is a slightly higher probability of an imminent switch when the current language of use is not English.
Next, we consider the length of monolingual segments in code-switched sentences. Segment lengths are measured in terms of number of word tokens. Table 4 tabulates the frequency of segments of a particular length. For example, there are 2776 instances of single-word English segments among the 3784 code-switched sentences in the English-isiZulu subcorpus. Single-word English segments are the most frequent within each subcorpus and typically represent insertional code-switching. English segments consisting of two or more words are much less frequent. The insertion of an English word into a Bantu matrix language is therefore the most common form of code-switching in our corpus. For the Bantu languages, there is a more gradual decline in frequency as the segment length increases. Table 5 shows the training set occurrence counts of bigrams containing code-switching for the four subcorpora. The majority of code-switched bigrams occur only once. This is least pronounced for eng→zul, where 1210 of 1878 (64%) such bigrams occur only once, while it is most pronounced for eng→xho, where 719 of the 784 (92%) occur only once. The most frequent eng→zul code-switched bigram occurs 31 times. These figures emphasise the sparsity of the data with respect to code-switch events. This will pose a challenge in terms of their effective modelling. In particular, since the majority of code-switch bigrams occur only once in the training data, it will in general not be possible to model code-switch events occurring in new and unseen data directly from training data examples (Van der Westhuizen and Niesler, 2017).

A code-switched bigram consists of two tokens. We define the first token as the trigger and the second as the target. Tables 6 to 9 show the most frequent word types serving either as a trigger or target in the subcorpora. Triggers in the Bantu languages include prefixes which join to English stems. Conversely, Bantu targets include suffixes similarly joining to English stems. Such affixes serve to supplement the pronunciation of an English word to conform to Bantu phonology and was also observed by (Modipa et al., 2013). An atypical trigger is the Sesotho suffix -a (Table 9) which precedes a switch to English. Examples of such cases are shown in the following two sentence fragments:

\[
\text{u_so interview_en} \rightarrow \text{a_so a_en while_en ago_en and n_a na_so push_en}\rightarrow\text{a_so for_en this_en.}
\]

In both cases the Sesotho suffix -a follows an English stem and precedes a switch to an English word, sandwiching the suffix between two English units. Finally, Table 10 shows the speech rates calculated from aligned phone-level transcriptions for our corpus as well as for prompted speech in the same languages (Barnard et al., 2014). We see that the spontaneous soap opera speech is notably faster than the prompted speech in all cases.

### 5. Conclusion

We have compiled a 14.3 hour corpus of spontaneous multilingual code-switched speech from South African soap opera broadcasts. The corpus contains four language-balanced subcorpora: English-isiZulu, English-isiXhosa, English-Setswana and English-Sesotho. Many interesting...
Table 5: Occurrence counts of code-switch bigrams for the subcorpora training sets. (#bgs: number of bigrams; bgtok: bigram tokens.)

Table 7: Token counts for English and isiXhosa trigger and target types.

Table 8: Token counts for English and Setswana trigger and target types.

examples of code-switching are observed, with English word insertions the most frequent. However, the distribution of code-switch examples is sparse, which could make modelling of unseen code-switch events challenging. Intraword code-switching, where Bantu affixes are joined to English stems in an effort to change English words to conform with Bantu phonology, is also often observed. The corpus is useful in the study of code-switched automatic speech recognition, discourse and dialogue analysis. The corpus is planned to be made available for research use.

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Table 9: Token counts for English and Sesotho trigger and target types.

| Trigger | From English to Sesotho | Count | Target | Count |
|---------|-------------------------|-------|--------|-------|
| if      |                         | 50    | -a     | 226   |
| so      |                         | 40    | -e     | 127   |
| maybe   | 36                      | ke    | 117    |
| know    | 36                      | u     | 98     |
| why     | 34                      | ya    | 88     |
| well    | 29                      | ha    | 70     |
| then    | 29                      | e     | 69     |
| for     | 28                      | here  | 67     |
| mean    | 26                      | o     | 63     |
| because | 24                      | ea    | 59     |
|        |                         |       |        |       |

| Trigger | From Sesotho to English | Count | Target | Count |
|---------|-------------------------|-------|--------|-------|
| di      |                         | 175   | and    | 47    |
| ke      | 128                     | right | 34     |
| le      | 123                     | something | 33 |
| ka      | 78                      | you   | 30     |
| u       | 75                      | l     | 27     |
| mo      | 71                      | the   | 25     |
| -a      | 62                      | like  | 25     |
| ho      | 60                      | maybe | 22     |
| o       | 57                      | for   | 22     |
| e       | 56                      | so    | 19     |

Table 10: Speech rate in phones per second (ph/s) of spontaneous soap opera speech and prompted speech for English and isiZulu. (EZ: English-isiZulu; EX: English-isiXhosa; ET: English-Setswana; ES: English-Sesotho)

| Corpus | Language | Rate (ph/s) |
|--------|----------|-------------|
|        | Soap opera spontaneous | NCHLT prompted |
| EZ     | English  | 13.09       | 10.62 |
|        | isiZulu  | 16.50       | 9.04  |
| EX     | English  | 15.38       | –     |
|        | isiXhosa | 19.98       | 8.77  |
| ET     | English  | 13.37       | –     |
|        | Setswana | 16.29       | 10.39 |
| ES     | English  | 13.24       | –     |
|        | Sesotho  | 16.03       | 9.86  |

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