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Abstract
Gujarati, an Indo-Aryan language primarily spoken in the state of Gujarat in northwest India, is a synthetic agglutinative language. Examining its systematic and extensive suffixation system provides an opportunity to shed more light on Gujarati stress by allowing observation of how stress shifts during suffixation. This paper investigates stress shift and corresponding root alternations accompanying suffixation in Gujarati Type 1 causatives and passives. It is shown that in these causatives and passives, Gujarati maintains a well-defined stress pattern, i.e. the ultimate syllable in di-syllabic words and the penultimate syllable in tri-syllabic words, by shifting the stress to the suffix.
Stress Shift Accompanying Verb Suffixation in Gujarati

Chenchen Wang

1 Introduction

Gujarati is an Indo-Aryan language primarily spoken in the state of Gujarat in Northwest India. It has approximately 45 million speakers as of the 2001 census. Stress in Gujarati has attracted much interest among linguists. Gujarati is a synthetic agglutinative language, which has a systematic and extensive suffixation system (UCLA Materials). Suffixes can be applied one after the other, with new suffixes affixing to previous ones. Examining Gujarati suffixation provides an opportunity to shed more light on Gujarati stress by allowing observation of how stress shifts during suffixation.

Type 1 Gujarati causatives and passives are derived by suffixation to the verb roots, which can be further suffixed to derive additional verb forms such as second causatives (Cardona 1965:114–118). The causative suffixes are -ɑʋ, -ɑɖ, -ɖɑʋ, -ʋ, and -eɖ. The passive suffix is -a. In these causatives and passives, three types of root alternations can occur (Cardona 1965:112): (i) ʋ-epenthesis: ʋ, which has two allophones [w] and [v], is inserted before the suffix if the word ends in a vowel or [ɦ]; (ii) α-reduction: the [ɑ] in the last syllable of the root is replaced by a [ə] if the suffix has an [ɑ]; and (iii) α-deletion: [ə] of the final syllable of the root is deleted if the suffix starts with a vowel.

This paper examines root alternations accompanying suffixation in Type 1 Gujarati causatives and passives and their relation to stress shift. It shows that in these causatives and passives, Gujarati maintains a well-defined stress pattern.

2 Data and Analysis

Data were collected from a fluent heritage speaker of standard Gujarati and were analyzed using Praat.

2.1 ʋ-epenthesis

The following are examples of ʋ-epenthesis observed in the data. For causatives, (1) shows the insertion of ʋ after a root-final vowel, while (2) shows the insertion of ʋ after a root-final [ɦ]:

(1) a. [ˈkʰɑ] (‘eat’) vs. [kʰɑv ɖɑv] (‘feed’)
    b. [ˈpi] (‘drink’) vs. [piˈvɑv] (‘cause to drink’)

(2) [ˈnɑɦ] (‘bathe’) vs. [nɑɦv ɖɑv] (‘bathe’ (transitive))

For passives, the word pairs in (3) show the insertion of ʋ after a root-final vowel, while the word pair in (4) shows the insertion of ʋ after a root-final [ɦ]:

(3) a. [ˈkʰɑ] (‘eat’) vs. [kʰɑv ɑ] (‘be eaten’)
    b. [ˈpi] (‘drink’) vs. [piˈvɑ] (‘cause to drink’)

(4) [ˈnɑɦ] (‘bathe’) vs. [nɑɦ vɑ] (‘be bathed’)

2.1 α-reduction

Examples of α-reduction in the data are shown in (5):

(5) [ˈkɑp] (‘cut’) vs. [kɑˈpɑv] (‘cause to cut’) vs. [kɑˈpɑvɖɑv] (‘cause to cause to cut’) vs. [kɑˈpɑ] (‘be cut’)

Table 1 below shows the F1 and F2 of the vowels of each syllable of words in (5). The formant values are extracted from the spectrograms shown in Fig. 1.
Table 1: F1 (Hz) and F2 (Hz) of words in (5).

<table>
<thead>
<tr>
<th></th>
<th>['kap']</th>
<th>[kaˈpav]</th>
<th>[kaˈpav[av]]</th>
<th>[kaˈpa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st syllable</td>
<td>913</td>
<td>568</td>
<td>667</td>
<td>660</td>
</tr>
<tr>
<td></td>
<td>1438</td>
<td>1308</td>
<td>1231</td>
<td>1265</td>
</tr>
<tr>
<td>2nd syllable</td>
<td>697</td>
<td>785</td>
<td>664</td>
<td>1268</td>
</tr>
<tr>
<td></td>
<td>1248</td>
<td>1270</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd syllable</td>
<td></td>
<td>747</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1427</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The spectrograms of these words are shown in Fig. 1(a-d) below:

![Spectrograms of (a) ['kap'] ('cut'); (b) [kaˈpav] ('cause to cut'); (c) [kaˈpav[av]] ('cause to cause to cut'), and (d) [kaˈpa] ('be cut'). Red: formant contour; blue: pitch contour; yellow: intensity contour.](image-url)

Although a majority of the causatives and passives in the dataset underwent a-reduction, the collected dataset contains one pair of words which are clearly inconsistent with the a-reduction rule: in (6) ['av'] ('come', F1=780Hz) vs. [aˈva] ('be come', F1=1001Hz).

(6) ['av'] ('come') vs. [aˈva] ('be come')
Table 2 shows the F1 and F2 values, vowel lengths, pitch, and intensity. Intensity and pitch are extracted in a region close to the peak intensity. This exception case will be further discussed in conjunction with stress.

<table>
<thead>
<tr>
<th></th>
<th>F1 (Hz)</th>
<th>F2 (Hz)</th>
<th>Vowel length (sec)</th>
<th>Intensity (dB)</th>
<th>Pitch (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ɿ'əvə ('come')</td>
<td>780</td>
<td>1354</td>
<td>0.27</td>
<td>67</td>
<td>120</td>
</tr>
<tr>
<td>[ɑˈvə] ('be come')</td>
<td>1st syllable</td>
<td>1001</td>
<td>1472</td>
<td>0.17</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>2nd syllable</td>
<td>707</td>
<td>1338</td>
<td>0.22</td>
<td>67</td>
</tr>
</tbody>
</table>

Table 2: F1 and F2 of words in (6).

2.2 ə-deletion

The deletion of ə in causatives is shown in (7):

(7) a. [sɔˈmədʒə] (‘understand’) vs. [səmˈdʒəv] (‘explain’)
    b. [sə̣bʰəl] (‘hear’) vs. [səmˈbʰəv] (‘tell’)

For passives, the deletion of ə is shown in (8):

(8) [ʃiˈkʰəv] (‘teach’) vs. [ʃiˈkʰəv] (‘be taught’)

The word pair in (9) shows that ə-deletion is not applied to monosyllabic roots:

(9) [ˈləkʰ] (‘write’) vs. [ləkʰəv] (‘be written’)

The spectrograms of words in (7a) are shown in Figs. 2(a-b) below.

Fig. 2: Spectrograms of (a) [sə̣mədʒə] (‘understand’); and (b) [səmˈdʒəv] (‘explain’).

2.4 Stress

The Type 1 causatives and passives of Gujarati provide an excellent opportunity to observe phonological processes accompanying the suffixation process. The data showed that suffixation causes the stress to shift to the suffixes in both causatives and passives. It is shown that in these causatives and passives, Gujarati maintains a well-defined stress pattern, i.e. the ultimate syllable in di-syllabic words and the penultimate syllable in tri-syllabic words, by shifting the stress to the suffix.

The stress pattern was also investigated in connection to the corresponding root alternations by examining parameters relating to stress, i.e., intensity, pitch, and vowel length (Ladefoged and Johnson 2011:111). Table 3 shows these parameters for words in (5).
The data indicate that both α-reduction and η-deletion correlate with stress shift to suffixes. This may be the motivation for these two of the root changes. For example, α-reduction is a well-known process to de-stress the syllable (Ladefoged and Johnson 2011:109-110, Crosswhite 2018).

This is further supported by the observation that although [a] is often somewhat reduced in many suffixes (see above section), i.e., having F1 close to [ə], the lengths of these vowels are usually longer than the root vowels. A longer vowel is known as the most reliable thing for a listener to detect a stressed syllable (Ladefoged and Johnson 2011:111). The stress shifts were achieved by both α-reduction of the roots and the longer suffix vowels. In this regard, the word pair that was inconsistent with the α-reduction rule, i.e., (6), may not be inconsistent with the stress pattern observed in Type 1 causatives and passives in that in [aˈva], the second syllable has a longer vowel length (see Table 2).

η-deletion is a common phonological process in Indo-Aryan languages. Previous studies show that η-deletion is influenced by the stress environment (Ryu and Hong 2013). In the data collected here, η-deletion seems to be motivated by the stress shift. For example, in [səmˈdʒa] (see (7a)), the deletion of the second schwa generates a disyllabic word with the stress on the second syllable. If the schwa is not deleted, the word becomes trisyllabic with stress falling on the ultimate syllable. Such a stress pattern is not common to Gujarati.

In order to examine if the stress continues to shift to the last syllable, addition of the second suffixes in second causatives and passives of causatives are also examined. As the examples in (13) show, the second suffixes do not further shift the stress.

(13)  a. [koˈpavə] (‘cause to cause to cut’)
    b. [koˈpəvə] (‘be caused to cut’)

These results further support the finding that in the context of verb alternations relating to the causative and passive suffixations, Gujarati maintains stress on the ultimate syllable in a 2-syllable word or on the penultimate syllable in a 3-syllable words.

Data on some disyllabic words that are not derived through verb suffixation show that the stress patterns observed in conjunction with causative and passive suffixation are not a universal stress pattern in Gujarati causatives and passives. For example, the data in (14) shows that stress is often on the first syllable:

(14)  a. [ˈmənkj] (‘swift mare’)
    b. [ˈsəyəm] (‘control’)
    c. [ˈsəvəd] (‘dialogue’)
    d. [səŋˈkia] (‘numbers’)

### Table 3: Intensity, pitch, and vowel length of words in (5).

<table>
<thead>
<tr>
<th></th>
<th>[ˈkəŋ]</th>
<th>[kəˈpav]</th>
<th>[kəˈpavəvə]</th>
<th>[kəˈpəv]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity (dB)</td>
<td>61</td>
<td>62</td>
<td>63</td>
<td>64</td>
</tr>
<tr>
<td>Pitch (Hz)</td>
<td>undefined</td>
<td>120</td>
<td>113</td>
<td>128</td>
</tr>
<tr>
<td>Vowel length (sec)</td>
<td>0.19</td>
<td>0.08</td>
<td>0.20</td>
<td>0.08</td>
</tr>
</tbody>
</table>

1st syl  2nd syl  1st syl  2nd syl  3rd syl  1st syl  2nd syl
3 Summary

The results show that in the context of suffixation in causatives and passives, Gujarati, by shifting the stress to the suffixes, maintains a well-defined stress pattern, i.e., the ultimate syllable in di-syllabic words and the penultimate syllable in tri-syllabic words. The corresponding root alternations are consistent with this observation.

References