The Phonology and Phonetics of Unaccentable Vowels in Kyungsang Korean

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1 Introduction

Epenthetic vowels tend to resist accent in Kyungsang Korean (KK) loanwords (Kenstowicz and Sohn 2001; Broselow 2008; Rhee and Kim 2003). Kyungsang Korean, which is spoken in southeastern Korea, is a pitch accent language where the locus of a high pitch accent is determined lexically, as in Japanese. However, words whose accent is not specified in the lexicon follow a default accent pattern, which is penultimate (Kim 1997). Therefore, there are two types of words in the KK native lexicon with respect to accent assignment: one is free accent words, whose accent is lexically specified (e.g. kāmanī ‘rice sack’, satarī ‘ladder’) and the other is default accent words with penultimate accent (e.g. apāci ‘father’, kosimtōcī ‘porcupine’). In loanwords, accentuation is predictable in words consisting of

* Thanks to Ellen Broselow, Marie Huffman, Christina Bethin, Shigeto Kawahara, and Seunghun Lee for their valuable comments and suggestions. All remaining errors are my own.

1 At least in North Kyungsang Korean, a default penultimate accent shows up clearly when it comes to words which consist of more than three syllables. Words longer than trisyllabic get...
only light syllables\(^2\), following a default accent pattern where the penultimate syllable is accented:

\(1\) Penultimate accent in loanwords

-jiŋ\(\text{ŋ}\)iko ‘Chicago’
kāti\(^3\) ‘guide’
ratī ‘radio’
amerīk\(\text{ŋ}\)a ‘America’

However, accent does not fall on the penult if the vowel in the penult is epenthetic (2).

\(2\) Non-penultimate accent with epenthetic vowels

-\(\text{ŋ}\)óst\(\text{ŋ}\)i ‘toast’
pēšt\(\text{ŋ}\)i ‘best’
sît\(\text{ŋ}\)rō ‘straw’
met\(\text{ŋ}\)rō ‘metro’

This failure to accent the penultimate vowel in (2) cannot be attributed to the presence of the vowel /\(\text{i}\)/ in the penultimate syllable because the lexical high back vowel in native words may be accented (e.g. sīm ‘monk’, ap\(\text{ŋ}\)ta ‘to be sick’). Why do epenthetic vowels behave differently from lexical vowels? Is it because they are different phonetically from lexical vowels?

In order to answer the questions raised above, I performed an acoustic study of epenthetic vowels in KK loanwords. The results showed that epenthetic vowels were not different phonetically from lexical vowels. Therefore, the different behavior of epenthetic vowels and lexical vowels cannot be attributed to acoustic differences between lexical and epenthetic vowels. If information concerning the status of epenthetic vowels is not available in

\(^2\) When words contain closed syllables, penultimate accent may be disturbed due to weight sensitive accent assignment. However, accent patterns in loanwords are still predictable. (For more details, see Kenstowicz and Sohn 2001)

\(^3\) The vowel sequences a.ī in kā.i.tī. and i.ō in rā.tī.o. are not diphthongs in Korean and each vowel is the nucleus of a syllable.
the KK acoustic signal, how do KK speakers access the nonlexical status of epenthetic vowels?

The paper is organized as follows: Section 2 presents an acoustic study of epenthetic vowels in KK. Section 3 discusses how KK speakers to access the underlying status of epenthetic vowels. Section 4 is the conclusion.

2 An acoustic study of epenthetic vowels in Korean loan words

Several previous studies have reported that epenthetic vowels in other languages were phonetically different from lexical vowels: for example, English speakers produce inserted schwas as shorter in duration and lower in F1 than lexical schwas (Davidson 2006). Gouskova and Hall (to appear) also found that epenthetic and lexical vowels in Lebanese Arabic are acoustically distinct for some speakers: epenthetic vowels are either shorter in duration or backer (lower in F2) or both.

An acoustic study of epenthetic vowels in Korean loanwords was designed in order to test the hypothesis that the epenthetic vowel is intrinsically shorter and less prominent than the corresponding lexical vowel.

2.1 Experimental Design

2.1.1 Participants

I recruited three male and three female speakers of Kyungsang Korean, all graduate/undergraduate students at Stony Brook University in New York, who came from Busan, a city located in the southern part of Kyungsang province. Their ages ranged from 23 to 31 (mean 28). The length of stay in the U.S. ranged from 4 months to 5 years.

2.1.2 Materials

The word list consisted of 80 words, including 9 test loan words, 16 test native words, 25 nonce words and 30 fillers. Most test words were CVCVCV, and the second vowel was a target vowel /i/ to be measured (epenthetic vs. lexical). Nonce words were included in order to see how vowel epenthesis was realized phonetically in online adaptation. The compared pairs were matched for the quality of the preceding and the following vowels in order to avoid any influence from vowel coarticulation. All test words used in the experiment are given in the appendix.

4 There were some differences in accent between the nonce words set and the native words set. However, I found that there was no accent effect on vowel duration in my other study.
2.1.3 Procedure

Participants were recorded in a sound-treated room using a Shure SM 48 microphone and a Marantz PMD 660 recorder at 44.1 kHz sampling rate. They read a randomized list of words given in a Korean carrier sentence, “nanin __________ putʰa malhætta” (I said from the word of ______ ) with 5 repetitions. Only three repetitions were analyzed; the first and the last were excluded. Nonce words were introduced as newly imported product names and asked subjects to read them in a way that they considered to be comfortable in the native language, although nonce forms were written in English. Each speaker looked through the word list in order to familiarize himself/herself with all the words before recording. Speakers were asked to read in their own dialectal accent.

2.2 Measurement

A total of 900 tokens (50 test words × 6 subjects × 3 reps) were measured. All measurements were taken using Praat (Boersma and Weenink 2005). Two duration measurements were taken: the target vowel (the second vowel in each test word), and the target word, excluding the first syllable. The first syllable was excluded because of some segmental differences in the word initial syllables between real words and nonce words. Average values of the first two formants (F1-F2) were automatically taken at the midpoint of the vowel by Praat’s Burg algorithm\(^5\). Formant frequency values were then verified manually. Extreme formant frequency values in 27 out of 665 tokens (4%), which fall two standard deviations away from the mean value, were excluded from analysis.

Vowels were segmented manually by examining the spectrograms and waveforms. The vowel boundary was determined by the presence of clear formant structure and a sharp change of waveform. In general, vowel duration was measured from the onset of the second formant to the offset of the second formant. The word duration was measured from the beginning of the second syllable (the offset of the second formant in the initial syllable when the onset consonants were fricatives in the second syllable; the closure of the onset consonants in the second syllables when the onset consonants were stops) to the closure of word initial consonants in the following word putʰa. The target vowel i was sometimes devoiced because some environments of the target vowel coincided with the context where vowel devoicing occurs in Korean (cf. Jun and Beckman 1993)\(^6\). The target vowel

\(^5\) The formant measurements were taken based on the settings of a maximum frequency of 5500 for female speakers and 5000 for male speakers and a window length of 0.025.

\(^6\) Previous studies (e.g. Jun and Beckman 1993) report that vowel devoicing of high vowels may occur between voiceless consonants, and aspirated stops trigger the most vowel devoicing
was devoiced in 235 tokens out of 900 tokens (26%), so those 235 tokens (32 of 288 native tokens, 11%; 41 of 288 nonce match tokens to native words, 14%; 90 of 162 loan tokens, 55%; 72 of 162 nonce match tokens to loanwords, 44%) were excluded from analysis.

Therefore, in total, 638 tokens (247 native tokens; 243 nonce match tokens to native words; 67 loan tokens; 81 nonce match tokens to loanwords) were analyzed for the study.

2.3 Results

2.3.1 Epenthetic vowels in nonce words vs. lexical vowels in native words

Mean duration and mean formant values of the target vowel between the two word groups, nonce words vs. native words, were compared using a repeated measures analysis of variance (ANOVA). In addition, mean proportion of vowel duration to word duration was computed and compared between the two word groups. The independent variables were underlying status (epenthetic vs. lexical) and subject. The dependent variables were measurements of duration, F1, F2 and the proportion of vowel duration to word duration. The hypothesis that epenthetic vowels are less prominent than lexical vowels predicts that epenthetic vowels will be shorter in duration than lexical vowels. If epenthetic vowels lack a target gesture, they should be pronounced more like schwa, and therefore should be realized in lower or more fronted (centralized) position since the corresponding lexical vowels are unrounded high back vowels. Thus, epenthetic vowels should be higher in F1 (lower in height) and higher in F2 (more centralized) than lexical vowels.

Contrary to the predictions of the hypothesis, results showed that, in general, there was no significant difference in acoustic quality between epenthetic vowels and lexical vowels for F1, F2, and duration. The F1 and F2 of the epenthetic vowel were slightly lower than those of the lexical vowel. The duration of the epenthetic vowel was somewhat longer than that of the lexical vowel. However, the vowel proportion to word duration did not show much difference and none of the differences was significant (p > 0.05). The ANOVA results are given in (3).

on the following high vowels i, u, i in Korean. The environment of vowel epenthesis such as voiceless consonant clusters coincides with the context where vowel devoicing often occurs in Korean.
Combined ANOVA results for all subjects\(^7\)

(ep: N=243; lex: N=247; V dur: vowel duration;
V/W: vowel proportion to word; computed using alpha = .05)

<table>
<thead>
<tr>
<th></th>
<th>Epenthetic Vs</th>
<th>Lexical Vs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean (s.d)</td>
<td>mean (s.d)</td>
</tr>
<tr>
<td>F1(Hz)</td>
<td>398.50(45.61)</td>
<td>409.06(49.33)</td>
</tr>
<tr>
<td>F2(Hz)</td>
<td>1492.49(127.42)</td>
<td>1532.24(121.75)</td>
</tr>
<tr>
<td>V dur.(ms)</td>
<td>41.21(5.67)</td>
<td>37.67(4.92)</td>
</tr>
<tr>
<td>V/W (%)</td>
<td>13.31(0.72)</td>
<td>12.99(2.21)</td>
</tr>
</tbody>
</table>

Overall, the results turned out to be opposite to the predictions of the hypothesis that the epenthetic vowel would be shorter and more centralized than the lexical vowel. In fact, epenthetic vowels in nonce words would be higher and backer than lexical vowels since they showed lower mean F1 and F2 values. This might be due to hyper-articulation since speakers might be more careful in pronouncing nonce words than in reading familiar native words. This might be caused by longer duration, providing enough time to reach the target gesture of high back vowel, \(\ddot{u}\).

However, the hyper-articulation account was undermined by the inconsistent patterns of individual speakers. Pearson correlation test of within subject effects showed that duration and formant values were correlated for some speakers but not for others as shown in (4). Therefore, it is difficult to conclude that duration and formant values were correlated in general because of the presence of individual differences.

** Pearson Correlation (** Correlation is significant at the 0.01 level (2-tailed);**.* Correlation is significant at the 0.05 level (2-tailed))

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Duration vs. F1</th>
<th>Duration vs. F2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation</td>
<td>p(2-tailed)</td>
</tr>
<tr>
<td>M1</td>
<td>0.156</td>
<td>0.305</td>
</tr>
<tr>
<td>M2</td>
<td>0.341</td>
<td>0.002**</td>
</tr>
<tr>
<td>M3</td>
<td>-0.095</td>
<td>0.367</td>
</tr>
<tr>
<td>W1</td>
<td>0.238</td>
<td>0.022*</td>
</tr>
<tr>
<td>W2</td>
<td>0.138</td>
<td>0.188</td>
</tr>
<tr>
<td>W3</td>
<td>0.169</td>
<td>0.103</td>
</tr>
</tbody>
</table>

To sum up, the hyper-articulation hypothesis cannot clearly account for epenthetic vowels in nonce words. In addition, the ratio of the duration of

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\(^7\) The ANOVA results analyzed by speaker gender showed that the patterns in each gender group were consistent with overall results, slightly lower F1 and F2 and a little longer duration in epenthetic vowels than in lexical vowels (but not significantly, \(p>.05\)). No significant interaction effects of gender and definant variables (F1, F2, duration) were found. Therefore, the data split by gender group is not reported here.
epenthetic vowel to word was similar to that of lexical vowel to word. Furthermore, the differences in duration and F1 and F2 for epenthetic vowels vs. lexical vowels do not reach significance. Therefore, I conclude that the quality of the epenthetic vowel and the lexical vowel is not different.

2.3.2 Epenthetic vowels in nonce words vs. Epenthetic vowels in loanwords

Concerning that epenthetic vowels in nonce words were produced a little longer than lexical vowels, it is conceivable that epenthetic vowels in nonce words might have been produced differently from epenthetic vowels in lexicalized loanwords, e.g. longer in duration due to unfamiliarity. If epenthetic vowels in loanwords are similar to those in nonce words, we remove the possibility that unfamiliarity caused epenthetic vowels in nonce words to be produced differently from normal epenthetic vowels in loanwords. On the other hand, the nonce word effect will be confirmed if inserted vowels in nonce words are significantly longer than those in loanwords.

The combined results showed that speakers did not have a significant difference in the phonetic quality of epenthetic vowels between loanwords and nonce words (p >0.05), as illustrated in (5).

(5) Combined ANOVA results of production of epenthetic vowels
(nonce: N=81; loan: N=67; V dur: vowel duration; V/W: vowel proportion to word; computed using alpha = .05)

<table>
<thead>
<tr>
<th></th>
<th>Vs in nonce words</th>
<th>Vs in loanwords</th>
<th>F(1,4)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1(Hz)</td>
<td>380.775(2.62)</td>
<td>369.695(2.23)</td>
<td>0.17</td>
<td>0.70</td>
</tr>
<tr>
<td>F2(Hz)</td>
<td>1471.174(118.132)</td>
<td>1335.00(182.74)</td>
<td>0.43</td>
<td>0.55</td>
</tr>
<tr>
<td>V dur.(ms)</td>
<td>34.18(7.58)</td>
<td>33.77(10.71)</td>
<td>0.06</td>
<td>0.82</td>
</tr>
<tr>
<td>V/W(%)</td>
<td>12.57(2.7)</td>
<td>11.85(2.5)</td>
<td>0.74</td>
<td>0.43</td>
</tr>
</tbody>
</table>

The overall mean duration and the proportion of epenthetic vowel in loanwords was almost the same as that of epenthetic vowel in nonce words. Average formant values of the vowels, however, were higher in nonce words both in F1 and F2, which suggests that they may be produced slightly lower and more fronted than in loanwords. Somewhat centralized epenthetic vowels in nonce words were not what would be predicted from hyper-articulation with a longer duration. The higher F1 and F2 values rather suggest that the vowels did not reach (or undershot) the target gesture of the conventional vowel /i/, which is unrounded, high and back. Nevertheless, the difference in the formants was not significant (F1, p=0.70; F2, p=0.55).

In sum, the overall results demonstrated that epenthetic vowels in both lexicalized loanwords and on-line adaptations were not different phoneti-
cally from lexical vowels, which suggests that the unaccentability of epen-
thetic vowels cannot be ascribed to acoustic properties.

3 Discussion
The evidence that Kyungsang Korean speakers produced epenthetic vowels
which were acoustically similar to lexical vowel /i/ suggests that KK speak-
ers do not distinguish epenthetic vowels phonetically from corresponding
lexical vowels. Also, this result suggests that there is no reason in acous-
tics for epenthetic vowels to resist accent. If epenthetic vowels sound like
lexical vowels, how do learners know not to put accent on them?

It is plausible that loanwords with non-penultimate accent would have
been lexicalized with non-penultimate accent since KK has a native lexical
group whose accent is unpredictable (e.g. kámání ‘rice sack’, satari ‘ladder’). Under the assumption that the first adapter could hear the contrast
between lexical vowel vs. no vowel and did not put accent on an epenthetic
vowel in the penult, it is possible that subsequent listeners would store
words with the non-penultimate accent faithfully.

Nevertheless, KK speakers still seem to have a strong tendency to as-
sign default penultimate accent to loanwords containing only light syllables
unless the penult is epenthetic. Lee (2003) reports that 91.8% of trisyllabic
loanwords with only light syllables (370 out of 403 tokens) carry penulti-
mate accent consistently. Twenty-six items of the remaining thirty-three
trisyllabic words, which have antepenultimate accent, contain an epenthetic
vowel in the penult. This demonstrates that existence of counterexamples
with non-penultimate accent does not undermine the default accent pattern.
Then, how do KK learners conclude that the words with non-penultimate
accent contain epenthetic vowels rather than that the accent is lexically
specified?

Distinct combinations of segment sequences in loanwords may give
learners a basis for analogical generalization for epenthetic vowels. First,
aspirated obstruents such as \( t^{h} \), \( p^{h} \), \( c^{h} \) are used relatively more frequently in
loanwords than in Korean native words. This is because there is no voicing
contrast in Korean and the voicing contrast in a source language is pre-
served as an aspiration contrast in loanwords: voiceless obstruents are re-
placed by aspirated correlates and voiced obstruents are replaced by lax or
sometimes tense ones. Second, due to the maximal syllable template CVC
(No complex clusters), vowel epenthesis prevails in loanword adaptation.
Initial and final clusters of voiceless consonants are common in English
words (straw, skew, best, gift), and sequences of consonants are repaired by
inserting a default vowel /i/. As a result, sequences of aspirated conso-

8 For more discussion of articulation of epenthetic vowels in KK, see H. Kim (in press).
nants($C^h$) or $sC^h$ clusters with an epenthetic vowel ($C^h iC^h$ or $siC^h$) are very common in loanwords (e.g. rip$^h$it$^i$ ‘lift’, téšik$^h$ ‘desk’, sit$^h$iró ‘straw’) although they are marked or rare combinations in native words$^9$. Third, because Korean coda consonants are never released, all consonants with release or aspiration are neutralized in coda position in native phonology. However, in loanwords, release of coda consonants of source words is preserved by inserting a vowel (e.g. pas $\rightarrow$ pásì ‘bus’, nok $\rightarrow$ nók$^h$ì ‘knock’).

Kang (2003) suggests that vowel epenthesis to preserve features of coda consonants such as release is motivated by perceptual similarity between the English input and the Korean output. Therefore, sequences of an aspirated or released consonant and an epenthetic vowel become very common combinations in Korean loanwords from English, since the main phonological environments of vowel epenthesis are following released coda consonants or between the initial/final voiceless consonant clusters. Based on these differences between loanwords and native words, KK speakers have a basis for assuming that a vowel /i/ which appears after released/aspirated consonants is epenthetic rather than lexical.

The segment distribution information may also help KK speakers to construct separate lexical strata in the Korean lexicon. The vowel /i/ is always epenthetic and never appears as non-epenthetic in loanwords$^{10}$. And it is usually not accented in loanwords from English. Rhee and Kim (2003) report that accented epenthetic vowels are only 9.5% (244/2562) regardless of position based on accent patterns determined by thirteen NKK native speakers’ judgments over 200 loanwords (2600 tokens (13x200)), which contrasts with 90% of accented lexical vowels in the final closed syllable. On the other hand, the lexical vowel /i/ contained in native words, which has the same phonetic quality as epenthetic vowels, does not have restrictions in accent assignment: namely, it does not resist accent in KK (e.g. sínim ‘monk’, sisiro ‘by oneself’). Assuming that the Korean lexicon is divided into at least two lexical strata, NATIVE and FOREIGN, based on the lexicon stratification hypothesis originally proposed by Ito and Mester (1999) for the Japanese lexicon, Korean speakers take the vowel /i/ to be epenthetic in the FOREIGN stratum.

To recapitulate, the finding that epenthetic vowels are identical phonetically to lexical vowels raises the question of how KK speakers learn the

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$^9$ síntì: 81 words; pîntì: 7 words; sîntì: 18 words are found in the frequency data (source: The National Institute of the Korean Language(2003); www.korean.go.kr), and all are foreign words.

$^{10}$ High front vowel /i/ is sometimes used as epenthetic vowels in loanwords (e.g. pîntí ‘bench’ vs. jìtsì ‘shirts’) motivated by preservation of perceptual cues (Kang 2001), and /i/ may be used as a non-epenthetic vowel (e.g. jìti ‘city’).
covert accent-epenthesis interaction, because the status of epenthetic vowels is not accessible from the surface form alone. The problem may be solved by assuming that KK speakers can access the underlying status of epenthetic vowels, relying on other cues such as the probabilistic or analogical information of distinct phonotactic distribution of the foreign lexicon.

4 Conclusion

The present phonetic study of epenthetic vowels in KK was performed in order to test the hypothesis that information concerning the status of epenthetic vowels is available in the acoustic signal. The results showed that epenthetic vowels were not different phonetically from lexical vowels in the surface form, which suggests that the unaccentability of epenthetic vowels cannot be ascribed to acoustic properties. Rather, learners must get information concerning the underlying status of epenthetic vowels somewhere beyond the phonetic realization of these vowels.

Given the fact that epenthetic vowels are completely neutralized with lexical vowels, learning the covert accent-epenthesis interaction involves complicated learnability issues. However, KK speakers still show evidence of a default accent pattern in loanwords even when there are words that violate the pattern. While these words contain historically epenthetic vowels, I have shown that these vowels are now phonetically indistinguishable from lexical vowels. However, if KK speakers identify foreign words based on probabilistic or analogical information of overall word structure such as distinct phonotactic distribution, they can assume that foreign words with non-penultimate accent contain epenthetic vowels.

Appendix. Stimuli

<table>
<thead>
<tr>
<th>Native words</th>
<th>Nonce words [expected form]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/pʰVd/</td>
<td>apʰida ‘to be sick’</td>
</tr>
<tr>
<td></td>
<td>kopʰida ‘to be hungry’</td>
</tr>
<tr>
<td></td>
<td>silpʰida ‘to be sad’</td>
</tr>
<tr>
<td>/pʰVg/</td>
<td>apʰigo ‘sick and’</td>
</tr>
<tr>
<td></td>
<td>kopʰigo ‘hungry and’</td>
</tr>
<tr>
<td></td>
<td>silpʰigo ‘sad and’</td>
</tr>
<tr>
<td>/pʰVs/</td>
<td>apʰísín ‘sick-infix(honorific)’</td>
</tr>
<tr>
<td></td>
<td>kopʰísín ‘hungry-infix’</td>
</tr>
<tr>
<td></td>
<td>silpʰísín ‘sad-infix’</td>
</tr>
<tr>
<td>/gVd/</td>
<td>tamgída ‘to soak’</td>
</tr>
<tr>
<td>/gVg/</td>
<td>tamgigo ‘soak and’</td>
</tr>
<tr>
<td>/gVs/</td>
<td>tamgísín ‘soak-infix’</td>
</tr>
</tbody>
</table>


/sVm/  pásimjan 'take off-if'  bosme [posimé]

/wusimjan 'laugh-if'  lusme [lusimé]

/sVn/  pásini 'take off-suffix'  bosni [posini]

/wusini 'laugh-suffix'  lusni [lusini]

II. Loanwords ~ Nonce words

<table>
<thead>
<tr>
<th>Loanwords</th>
<th>Nonce words [expected form]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/pʰVtʰ/</td>
<td>répʰ'tʰi' 'left'</td>
</tr>
<tr>
<td></td>
<td>teft [tʰɛpʰitʰi]</td>
</tr>
<tr>
<td>sörpʰ'tʰi' 'soft'</td>
<td>boft [pʰöpʰitʰi]</td>
</tr>
<tr>
<td>körpʰ'tʰi' 'gift'</td>
<td>vift [pʰipʰitʰi]</td>
</tr>
<tr>
<td>/sVtʰ/</td>
<td>kósítʰi 'ghost'</td>
</tr>
<tr>
<td></td>
<td>fost [pʰósítʰi]</td>
</tr>
<tr>
<td>/sVkʰ/</td>
<td>tésíkʰi 'test'</td>
</tr>
<tr>
<td></td>
<td>kest [késítʰi]</td>
</tr>
<tr>
<td>/gVtʰ/</td>
<td>wísíkʰi 'whiskey'</td>
</tr>
<tr>
<td></td>
<td>bithkee [pisíkʰi]</td>
</tr>
<tr>
<td>/gVtʰ/</td>
<td>togímá 'dogma'</td>
</tr>
<tr>
<td></td>
<td>bogma [tógimá]</td>
</tr>
<tr>
<td>/gVkʰ/</td>
<td>mágíkʰ xp 'muʃ cup'</td>
</tr>
<tr>
<td></td>
<td>tugkup [tugíkʰ xp]</td>
</tr>
</tbody>
</table>

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