CHAPTER 4  VOWELS

4.1 Chapter introduction

This chapter describes important aspects of Gǀui vowels. Concerning Gǀui vowels, Voßen’s (1997) extensive comparative work on the Khoe family provides preliminary descriptive information, such as a phonemic sketch of Gǀui vowels (p.110), observations on the distribution of vowel features in Khoe languages (pp. 139-141), and example words found in a comparative Khoe vocabulary in the appendix (pp. 413-511). In the course of the more precise and detailed description below, I discuss Voßen’s (1997) relevant descriptions.

This chapter consists of six sections. The next section identifies the vowel inventory and classifies the attested vowel phonemes of Gǀui. The following three sections describe important phonetic details of the plain vowels (Section 4.3), the nasal vowels (Section 4.4) and the pharyngealized vowels (Section 4.5). The final section of this chapter deals with the distributional constraints of vowels in Gǀui. They include a type of constraint, the so-called Back Vowel Constraint, which Traill (1985) first used for describing !Xôô and suggested its validity for a wider range of Khoisan languages. I discuss the applicability of the Back Vowel Constraint to Gǀui.

4.2 Vowel inventory

Underlyingly, Gǀui has five plain (non-nasal and non-pharyngealized) vowels, /i e a o u/, three nasal vowels, /ɪ ā ũ/, and two pharyngealized vowels, /ā u/. These ten distinct vowels can be classified as in Table 4.1 in terms of three conventional features for vowel quality, i.e. height, backness and lip-rounding, and two additional features, i.e. nasality and pharyngealization. Important phonetic details of each vowel are fully described below.

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>a</th>
<th>o</th>
<th>u</th>
<th>ī</th>
<th>ā</th>
<th>ũ</th>
<th>a</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>+</td>
<td>-</td>
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<td>low</td>
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<td>round</td>
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<td>nasal</td>
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<td>-</td>
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</tr>
<tr>
<td>pharyngeal</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 4.1 A classification of Gǀui vowels
The vowels are exemplified with ten words in Table 4.2.

Table 4.2 Words illustrating the G|ui vowels

<table>
<thead>
<tr>
<th>Plain</th>
<th>Nasal</th>
<th>Pharyngealized</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ǔ/ “tree”</td>
<td>/hǔ/ “do”</td>
<td></td>
</tr>
<tr>
<td>/tễ/ “it”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/ʔã/ “that”</td>
<td>/ʔã/ “dress”</td>
<td>/hẫ/ “hole”</td>
</tr>
<tr>
<td>/ʔõ/ “inside”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/ʔú̃/ “send”</td>
<td>/hú̃/ “just”</td>
<td>/tsù́m/ “wild vegetable”</td>
</tr>
</tbody>
</table>

Voßen (1997: 110) interpreted the rounded pharyngealized vowel as /ɔ/ instead of /u/. As described in Section 4.5, however, this vowel patterns with /u/ in terms of diphthongization, and should therefore be phonologically interpreted as the pharyngealized counterpart of /u/. In addition to the ten vowels, Voßen (1997: 110) reported two vowel phonemes, namely, one plain /e/ and one pharyngealized /e/. These two additional vowel phonemes, however, have not been attested in any G|ui dialectal varieties that I have investigated.


Table 4.3 The six words with /e/ in Voßen (1997)

<table>
<thead>
<tr>
<th>Voßen (1997)</th>
<th>Nakagawa</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>xʔè</td>
<td>/k</td>
</tr>
<tr>
<td>(2)</td>
<td>/xʔè</td>
<td>/k</td>
</tr>
<tr>
<td>(3)</td>
<td>kxʔè</td>
<td>/qɔ’áè/</td>
</tr>
<tr>
<td>(4)</td>
<td>dâbè</td>
<td>/dâbè/</td>
</tr>
<tr>
<td>(5)</td>
<td>/xʔédè</td>
<td>/k</td>
</tr>
<tr>
<td>(6)</td>
<td>xɛnã</td>
<td>/k</td>
</tr>
</tbody>
</table>

Table 4.3 compares Voßen’s and my transcriptions for these six words. (Note that in his notation, long vowels and short vowels are neutralized and transcribed as short vowels, as cited in (1), (2) and (3) in Table 4.3.) In my observation, the vowel /e/ in these six words falls into either (i) the phoneme /e/, which tends to be phonetically
slightly opened due to the influence of /a/ or /ɑ/ in the preceding syllable, as in (1), (2), (3) and (4), or (ii) the phoneme /a/ which tends be phonetically slightly fronted due to the influence of the following /e/ or the following coronal sonorant /r/ or /n/, as in (5) and (6) in the table. Regarding the phoneme /e/, examples of it are not given in Voßen (1997). Therefore, this phoneme cannot be verified. I conclude that the G|ui vowel inventory includes neither /ɛ/ nor /æ/.

4.3 Plain vowels

The common five plain vowels /i e a o u/ are illustrated in Figure 4.1, in which the F1 and F2-F1 values of these vowels spoken by five speakers are plotted. (“F2-F1” means the difference between F2 and F1.) As reflected in this acoustic vowel space, /a/ can be regarded as [+back], together with other two back vowels, /u/ and /o/, as opposed to the remaining [-back] vowels /i e/. As will be seen in Section 4.6.2, the feature specification with [+/- back] is necessary for the constraint on a vowel occurrence, which is called the Back Vowel Constraint.

As shown in Figure 4.1, the five plain vowels are not evenly distributed in the acoustic vowel space, especially with respect to the vowel height, /e/ and /o/ (particularly the latter) being closer to /i/ and /u/ than the typical mid position. This uneven distribution agrees with the auditory impression that /e/ is close to /i/ and /o/ to /u/. As described in the next section, because of this phonetic detail of /e/ and /o/, the high nasal vowels /ɨ/ and /ʊ/ tend to sound more like nasalized counterparts of /e/ and /o/ than nasalized counterparts of /ɨ/ and /ʊ/. Evidence for interpreting these two nasalized vowels as /ɨ/ and /ʊ/ as opposed to /ɛ/ and /o/ will be presented in Section 4.4.
The rounded vowel /u/ shows an uncommon allophonic realization. This vowel is always pronounced as a diphthong before the coda /m/ or /n/. The diphthong is characterized by (i) a transitional tongue-body lowering, and (ii) a transitional lip-movement from rounded to unrounded. This diphthong would be transcribed as [wa] or [ua] in the IPA (henceforth just [wa]). This diphthongal realization of /u/ is illustrated with a spectrogram of /k|úm| [k|wám] “suck” shown in (1) of Figure 4.2, which shows a clear raising of the first formant toward the latter half of the vowel, together with raisings of higher formants. This formant-raising corresponds to the transitional movements of the lip and the tongue-body.
Figure 4.2 Spectrograms of (1) /k'úm/ [k'värni] “suck”, (2) /k'ámi/ [k'vámi] “sun”, and (3) /k'úmá m/ [k'ğámá] “a child’s” pronounced by speaker KEX.
It should be noted that this diphthong bears only a single tone occurring with one mora; accordingly, it is regarded as forming not two morae but one mora. The duration of the diphthong [wa] is always much shorter than a sequence of two vowels, and similar to the duration of the monophthong. This is illustrated in Figure 4.2, where the duration of [wa] /u/ in (1) /k|ûn|/ is approximately the same as that of [a] /a/ in (2) /k|ân|/ “sun”, being approximately 190 ms, and this is approximately half of the duration of a sequence of the two vowels [ûa] /ûa/ (approximately 380 ms) in (3) /k|ûa m/. “a child’s”.

The diphthong [wa] alternates with [u] in accordance with the change of the syllabic structure. In the formation of a compound verb (see Chapter 2 for details), the first element is followed by the so-called juncture morpheme /-a/ when it has a CVN structure. This changes the coda of the first element into the onset of the following syllable. Accordingly, /u/ is realized as the monophthong [u] (e.g. /k|ûn|/ [k|wân|] “rub” → k|ûn-a mâa [k|ûmû mâa] “rub for someone”).

The diphthongization of /u/ before a coda is not reported in other Khoisan languages, even in G|ana, the genetically and structurally closest Kalahari Khoe language, in which [wa] preceding the coda in G|ui corresponds to [u] (e.g. [k|wâm|] “rub” in G|ui; [k|ûm|] “rub” in G|ana).

At this stage, it is not clear to me why only G|ui exhibits this diphthongization.

### 4.4 Nasal vowels

Out of the five plain vowels, three peripheral vowels /i, a, u/ are underlyingly combined with the feature nasality, forming /i ə û/. This three nasal vowel system is predominant among Khoe family languages, according to Voñen’s (1997: 141) comparative observation.

As I mentioned earlier, however, in G|ui, the height of the two nasal high vowels, /i û/, are usually auditorily lower than that of the plain high vowels /i u/ and near to the height of the mid vowels /e o/. They may be phonetically transcribed as [ë ô]. This auditory
height correlates with in F1 values of these vowels. Figure 4.3 compares F1 mean
values (shown with standard deviations) among /ũ/ , /u/ and /o/ and those among /i/ , /i/
and /e/. (Five speakers. Three tokens for each speaker.)

The F1 mean values of /ũ/ and /i/ are much higher than those of /u/ and /i/ , and near to
those of /o/ and /e/. This agrees with the relative auditory heights of the two nasal
vowels.

Morphophonologically, however, it is clear that the two nasal vowels behave in the
same way as /i u/, not as /e o/. As described in Section 2.5.2.1.2 in Chapter 2, in the
compound verb construction, the first element is marked by the suffix –/a/ (i.e. the so-
called “juncture morpheme”) when the second vowel in a root (V2) is /i u i ũ/. This is
illustrated in (1) to (4) in Table 4.4. In contrast, the first element is marked by means
of /r/-insertion (realized as [r] or [n]) when V2 is /a ţ e o/ as illustrated with (5) to (8) in
Table 4.4. This indicates that /i ũ/ form a natural class with /i u/ , and not with /e o/.
Table 4.4 The natural classes /i u ī ū/ and /a ā e ə/ involved in compound verb construction. The examples in (1) to (4) involve /a/-suffixation, and those in (5) to (8) involve /r/-insertion. Concerning the nasalization rule /r/ → [n] in (6), see Section 2.5.2.1.4

<table>
<thead>
<tr>
<th>Citation form</th>
<th>gloss</th>
<th>first element of a compound verb</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) /kʰū/</td>
<td>“pierce”</td>
<td>/kʰū- [kʰú]</td>
</tr>
<tr>
<td>(2) /χāu/</td>
<td>“be ashamed”</td>
<td>/χāu- [χaw]</td>
</tr>
<tr>
<td>(3) /g</td>
<td>āi/</td>
<td>“be constipated”</td>
</tr>
<tr>
<td>(4) /tsʔū/</td>
<td>“make”</td>
<td>/tsʔū- [tsʔu]</td>
</tr>
<tr>
<td>(5) /k!āā/</td>
<td>“lose”</td>
<td>/k!ār- [k!ār]</td>
</tr>
<tr>
<td>(6) /k!?ʔāā/</td>
<td>“know”</td>
<td>/k!?ʔār- [k!?ʔān]</td>
</tr>
<tr>
<td>(7) /kʰāē/</td>
<td>“sting”</td>
<td>/kʰār- [kʰār]</td>
</tr>
<tr>
<td>(8) /k</td>
<td>ōō/</td>
<td>“finish”</td>
</tr>
</tbody>
</table>

4.5 Pharyngealized vowels

The two pharyngealized vowels, unrounded /a/ and rounded /u/, occur only in the first vowel of roots (V1).

Pharyngealized vowels in G|ui are characterized by a raising of F1 and F2 and an optional feature of auditorily noisy voice quality. Figure 4.4 compares /a/ and /a/ by a minimal pair (/g|ām/ “like” and /g|ām/ “carry on the shoulder slantwise”) produced by three male speakers. The first formant of /u/ is clearly higher than that of /a/ for all the speakers. The second formant is also raised toward the mid part of the vowel, although often less clearly. The noisy voice quality is used by some speakers. It is illustrated in /u/ of speaker (3), in which there are irregular vibrations seen particularly in F1 and F2.

It should be pointed out that /u/ is regularly realized as a diphthong, i.e. [wa] or [ua], which involves a certain transient lip-rounding articulation from rounded to unrounded, just like the diphthongization of /u/ before a coda, /m n/, (see Section 4.3). Also like the diphthongized /u/, this diphthong always bears a single tone, and is therefore regarded as monomoraic.
Figure 4.4 A comparison between /a/ and /g/. Panels (1) to (3) show the minimal pair /g||àm|/ “like” /g||àm|/ “carry on the shoulder slantwise” spoken by (1) NOS, (2) HLS and (3) TSB, respectively. F1 and F2 are indicated with arrows.
Figure 4.5 Diphthongization of /ʊ/. Spectrograms of the minimal pair, /g!uí/ “snare rope” (in the left panel) and /g!uí/ “bully” (in the right panel), spoken by speaker NOS are shown for comparison between /u/ [u] and /y/ [wa].
Figure 4.5 illustrates /y/ compared with /u/ by using a minimal pair /g!uí/ “snare rope” and /g!uí/ “bully”. Unlike the left-hand panel showing relatively level F1 and F2 in /u/, the right-hand panel shows that the vowel /y/ involves a remarkable raising of F1 and F2 toward the end of /y/. This formant raising of F1 and F2 is in common with that seen above for /g/. This acoustic feature of pharyngealization is probably enhanced by the lip movement in case of the rounded pharyngealized vowel.

4.6 Distributional constraints on vowels

Finally, this section describes two types of distributional constraints concerning C-V co-occurrence found in G|ui. One type constrains the occurrence of pharyngealized vowels, and the other type concerns the Back Vowel Constraint, under which term Traill (1985: 89-92) first described this phenomenon for !Xóô.

4.6.1 Constraints on pharyngealized vowels

There are two constraints involving pharyngealized vowels, as abbreviated in (1) and (2).

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>*C’V</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>*CqV</td>
<td></td>
</tr>
</tbody>
</table>

C’ stands for an ejective consonant whether it is an ejective click, a single ejective non-click, or an ejective cluster offset. Cq stands for a uvular consonant whether it occurs as a single non-click uvular consonant or as a cluster offset. V stands for a pharyngealized vowel.

The constraint in (1) rules out the sequence of an ejective and a pharyngealized vowel. If this constraint is assumed to be phonetically motivated, it might presumably reflect the coarticulatory difficulty of the increasing pharyngeal pressure involved in C’ and the pharyngeal constriction involved in V. It is suggestive that (1) does not apply to the sequence of a click cluster with the glottal plosive offset, i.e. /k|ʔ/, /k!ʔ/, /k#ʔ/ or /k||ʔ/, followed by a pharyngealized vowel, there being fourteen words with such a sequence (note that these click clusters do not involve the increasing pharyngeal pressure required
for ejective sounds). A similar constraint is involved in a set of C-V constraints attested in !Xôô (Traill 1985: 92). At this stage, however, it is not known whether there are any languages with C’V sequences in the world’s languages. In order to test the adequacy of this phonetic explanation, a wide-ranging cross-linguistic investigation concerning C’V sequences must be conducted in future research.

The constraint in (2) disallows the sequence of a uvular consonant and a pharyngealized vowel. This constraint implies that the distinction between pharyngealized and non-pharyngealized vowels is neutralized after the uvular sound, and the unmarked non-pharyngealized vowel occurs in this context. This neutralization may presumably be explained by the acoustic effect that the pharyngealization and the uvular sound have in common, namely the raising of the first formant of the vowel. Figure 4.6 illustrates the acoustic feature shared by the uvular consonants and the pharyngealized vowels. Compared with the vowel /a/ following a non-uvular consonant in (1), the pharyngealized vowel /a/ in (2), and the vowel /a/ following a uvular consonant in (3) have the raised first formant. The F1 value in the middle of the vowel is about 700 Hz for (1), about 990 Hz for (2), and about 950 Hz for (3). The pharyngealization of the vowel in (2) and the co-articulatory effect of the uvular sound in (3) similarly raise the first formant. This acoustic effect may be responsible for making the difference between V and V less distinct.

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Figure 4.6 Spectrograms of the three words (1) /g||âm/ “like”, (2) /g||âm/ “carry on the shoulder slantwise” and (3) /k||âm/ “slimy” pronounced by NOS. The first formant (F1) is indicated with arrows.
4.6.2 The Back Vowel Constraint in G\ui

In G\ui there is a set of two constraints concerning the occurrence of \[-back\] vowels. It is observed that a \[-back\] vowel does not occur immediately following a uvular consonant, as abbreviated in (3), or immediately following an apical (i.e. alveolar or lateral) click, as abbreviated in (4).

\[
\begin{align*}
(3) \quad & \ast Cq \backslash V[-\text{back}] \\
(4) \quad & \ast \backslash V[-\text{back}] 
\end{align*}
\]

Note that Cq represents a non-click uvular consonant, i.e. /q q' q'\chi/ \chi/, whether it occurs as an independent consonant or as a cluster offset. Here, V[-back] stands for a \[-back\] vowel, i.e. /i e ï/, and “\backslash” stands for an apical click (whether simple or complex).

This set of two constraints can be regarded as the realization of the so-called Back Vowel Constraint, which can be found in other Khoisan languages, such as !Xóô (Traill 1985) and , Ju’hoansi (Miller-Okhuizen 2000). In this section, I first deal with (3) and (4) separately so that the phonetic properties of (4) may be transparent, and then compare the set of (3) and (4) with the varieties of the Back Vowel Constraint attested in !Xóô and Ju’hoansi.

It should be emphasized that constraint (3) also applies when Cq is the offset of a consonant cluster (whether the cluster is of a click cluster or a non-click cluster, i.e. /\chi/,
/\ts\chi/, /\t\chi/ or /\tsq\chi/). This observation is important when I discuss the phonological interpretation of clicks and their accompaniments in Chapter 5.

Constraint (4) states that a \[-back\] vowel cannot immediately follow an apical click. This does not apply to a \[-back\] vowel immediately following a laminal (i.e. dental or palatal) click. In fact, there are about 120 words with a laminal click immediately followed by a \[-back\] vowel in G\ui. It would therefore be expected that constraint (4) reflects the phonetic nature of the anterior closure of apical (as opposed to laminal) click articulation.
Figure 4.7 Tongue positions for the suction cavities of the four clicks in !Xôô prior to the release (shaded area) with the tongue positions of the vowels [i e a] superimposed. (Based on Figure 27 in Traill 1985:115.)

Figure 4.8 Spectrograms of four words illustrating click-vowel transitions, pronounced by speaker NOS. The words are /kʰáá/ “lose”, /kǁáá/ “black korhaan”, /kǂáá/ “fill a hole”, /káá/ “skin (verb)”.

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As described in Section 3.3.2.2 in Chapter 3, the release of the anterior closure in the apical clicks involves more lowered tongue-front and tongue-middle parts than in the production of the laminal clicks. Figure 4.7 shows the tongue shape of the four clicks prior to the anterior release with the tongue shapes of the vowels [i], [e] and [a] in !Xóõ (taken from Traill 1985: 115, Figure 27). As described in Traill (1985: 116), in the suction for the apical clicks, the front and middle parts of the tongue are away from the tongue positions for [i] and [e], whereas the tongue positions for the laminal clicks are near those for [i] and [e].

It can be assumed that the tongue positions for the four clicks in Gǀui are essentially the same as in !Xóõ. The difference in tongue position between the apical and the laminal clicks in Gǀui is reflected in spectrograms of four Gǀui words shown in Figure 4.8. Each of the words has /k!/ /k]/ /k+! or /k]/ as the initial consonant, which is followed by the vowel /a/. A clear difference between the first two words with the apical clicks and the other two words with the laminal clicks is in the formant transitions of the vowel.

The apical clicks in (1) and (2) do not show clear F1 lowering or F2 raising, and the transitions are relatively short (about 45 ms). This indicates that the tongue position immediately after the release of the apical clicks is similar to the [+back] vowel /a/. In contrast, the laminal clicks in (3) and (4) show remarkable F1 lowering (with the locuses around 300 Hz and 400 Hz, respectively) and F2 raising (with the locuses around 1900 Hz and 1600 Hz, respectively), and the transitions are relatively long (about 60-80 ms). This indicates that the tongue positions immediately after the release of the laminal clicks are relatively similar to those of front vowels. In summary, in the production of apical clicks, the front and middle parts of the tongue are lowered to the extent that the articulation of the following front vowels would be less easy. This relative articulatory difficulty may be reflected in constraint (4).

As mentioned earlier in this section, with the term of the Back Vowel Constraint (henceforth BVC), Traill (1985) proposed a single constraint in !Xóõ that partly overlaps with constraints (3) and (4) in Gǀui. He claimed that the BVC is valid for all Khoisan languages given certain language-specific amendments (Traill 1985: 91). It is
therefore interesting to examine how the BVC can be applicable to G\ui.

In \Xo\o, the vowel following a [+back] consonant must be a [+back] vowel, as he schematically expressed as (5) (Traill 1985: 90).

\[
\begin{array}{ll}
\text{If:} & \text{C1} & \text{V1} \\
& [+\text{back}] & \\
\text{then:} & \text{C1} & \text{V1} \\
& [+\text{back}] & [+\text{back}] \\
\end{array}
\]

The BVC summarized in (5) is natural in the sense that C1 and V1 share the same feature [+back]. To compare (3) and (4), however, I re-state the constraint in (5) in a different form as in (6). Note that V[−back] in (6) stands for a [−back] vowel as in (3) and (4).

\[
\begin{array}{ll}
\text{(6) } & * \text{C}[+\text{back}] & \text{V[−back]} \\
\end{array}
\]

C[+back] in (6), i.e. the [+back] consonants, include non-click velar consonants, uvular consonants (Cq), and all the clicks, according to Traill (1985: 123, 206). A comparison of the set of constraints in (3) and (4) with the constraint in (6) reveals that the difference between them is in the behavior of the non-click velar consonants (henceforth indicated as “Ck”) and the laminal clicks of the non-cluster series (henceforth indicated as “/\#”). The constraint in (6) implies that neither Ck nor /\# can be immediately followed by a [−back] vowel. In contrast, the set of constraints in (3) and (4) implies that both /\# and Ck can be immediately followed by a [−back] vowel. G\ui has seventeen words with Ck followed by a [−back] vowel and about 120 words with /\# followed by a [−back] vowel, as exemplified in (7).
(7)

/kù/  “today-past (tense marker)”
/kè/  “because (conjunction)”
/kérē/  “turn”
/kêñ/  “song”
/kéé/  “wildebeest”
/kébá/  “carry/wear on the head”
/kññ/  “call”
/kñéé/  “ear”
/kñébû/  “bundle”

It is important that there is no evidence to regard the [−back] vowel following the [+back] consonant in these words as deriving from an underlyingly [+back] vowel: these [−back] vowels do not alternate with any [+back] vowels in G|ui morphology. In G|ui, therefore, the BVC cannot be applicable to either /÷/ or Ck, and can only be applicable to the cases in (3) and (4). As long as /÷/ and Ck are underlyingly specified as [+back], the BVC stated in terms of (5) does not work out for G|ui as such, and requires an additional sub-classification of the [+back] consonants into two classes, i.e. the class to which the BVC applies and the one to which it does not. In the remainder of this chapter, in order to explore the sub-classification of the [+back] consonants, I deal with another variety of the BVC attested in Ju|’hoansi by Miller-Ockhuizen (2000). In discussing the characteristics of G|ui in the variation of the BVC in the three Khoisan languages, I hypothesize an implicational hierarchy of the [+back] consonants in terms of the BVC.

Miller-Ockhuizen’s (2000: 313-315) description of the BVC of Ju|’hoansi can be summarized as follows: the BVC cannot be applicable to /÷/ but is applicable to Ck, !/∥ and Cq. Table 4.5 compares the three varieties of the BVC found in !Xóõ, Ju|’oansi and G|ui. As shown in this table, the difference among the three varieties of the BVC concerns the behavior of !/ divided by Ck.
Table 4.5 A cross-linguistic comparison of the BVC. Cq stands for the uvular consonants; “!/||” stands for the apical clicks; Ck stands for the non-click velar consonants; “+/|” stands for the laminal clicks; “+” indicates that the BVC applies, and “−” indicates it does not; “+/−” indicates that the BVC applies with substantial exceptions

|       | Cq   | !/|| | Ck   | +/− |
|-------|------|------|------|-----|
| !Xôô  | +    | +    | +    | +/− |
| Jul’hoansi | + | +    | +    | −   |
| Glui  | +    | +    | +/−  | −   |

Miller-Ockhuizen (2000: 313) accounts for the observation that +/| is not subject to the BVC in Jul’hoansi by interpreting laminal clicks as “front” (implying [−back]) clicks as opposed to “back” clicks (i.e. apical clicks). Since her proposed classification of “front clicks” vs. “back clicks” is not merely language-specific to Jul’hoansi, she further attempts to extend this idea to the interpretation of !Xôô. She lists sixteen !Xôô words in which +/| is followed by an underlyingly [−back] vowel as violations of the BVC, and argues that these sixteen words are sufficiently substantial to conclude that +/| is not subject to the BVC in !Xôô, either (pp.311-312).

In Glui, there is a more substantial number (about 120) of words with +/| followed by an underlyingly [−back] vowel, and therefore this aspect agrees with Miller-Ockhuizen’s proposal. However, Glui has seventeen words with Ck followed by an underlyingly [−back] vowel. Note that Ck are regarded as back consonants (i.e. [+back] consonants) in Miller-Ockhuizen (ibid.). The seventeen words can be regarded as substantial to conclude that the BVC does not apply to Ck. As long as Ck are regarded as back consonants, the classification of the “front vs. back” clicks is not adequate for stating the BVC in Glui.

The comparison of the BVC between the three languages has revealed that there are three classes in the [+back] consonants that show cross-linguistically different applicability of the BVC. As shown in Table 4.5, Cq and !/|| are subject to the BVC in all three languages, Ck is subject to the BVC in !Xôô and Jul’hoansi, but it is partially subject to that in Glui (seventeen exceptions), and +/| is partially subject to the BVC.
only in !Xóô (sixteen exceptions according to Miller-Ockhuizen (ibid.)). From this observation, I hypothesize that there is an implicational hierarchy of [+back] consonants in terms of applicability of the BVC, as illustrated in (8).

\[
\begin{array}{ccc}
(8) & \text{Cq and } /\|/ > \text{Ck} > /\#
\end{array}
\]

This hierarchy expresses an implicational relationship among the three classes, namely if /\# is at least partially subject to the BVC, then the other classes are all subject to the BVC, and if Ck is at least partially subject to the BVC, then Cq and /\| are subject to the BVC. In this sense, Cq and /\| is higher in the hierarchy than the other two classes, and Ck is higher than /\#.

In order to test this hypothesis, a wide-ranging Khoisan cross-linguistic investigation will have to be conducted in a future study. At this stage, my preliminary research has shown that in G|ana (the Kalahari Khoe language genetically closest to G|iui), neither Ck nor /\# is fully subject to the BVC, while Cq and /\| are fully subject to it, just like the case in G|iui, and that judging from notations of the entries in Visser’s (2001) dictionary, Naro (another Non-Khoekhoe Khoe language) seems to have the same type of BVC as Ju|’oansi, with three exceptional words with Ck followed by V[[-back]] (pp. 28, 35 and 41). These observations agree with the hypothesized hierarchy in (8).

The three classes seen in (8) also suggests that the so-called Back Vowel Constraint is not necessarily naturally stated in terms of the feature [+back]. A residual problem is how to interpret the three classes of the consonants seen in (8) in terms of phonological features. This will be a topic for future research.

4.7 Chapter summary
In this chapter, I have dealt with the essential aspects of G|iui vowels. The topics include identifications of vowel phonemes, their classification in terms of features, descriptions of their important phonetic details, and two types of distributional constraints on vowels, i.e. a set of two constraints on pharyngealized vowels, and another set of two constraints on back vowels, which is a realization of the so-called
Back Vowel Constraint found widely in other Khoisan languages.

It should be pointed out here that the two types of constraints both involve the class abbreviated to Cq. The definition of Cq, namely the uvular consonants /q qʰ qʼ qχ/ χ/, whether they occur as single consonants or as cluster offsets, is based on my interpretation of non-click stop clusters and click clusters as sequences of plain stops/clicks followed by uvular or glottal consonants (see Chapter 3). Under a different interpretation, therefore, the vowel constraints would be stated in a different manner. This point will be relevant to a discussion of phonological interpretations of clicks and their accompaniments in the next chapter.