Dorsal Consonant Harmony in Truku Seediq[*]

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Seediq is a Formosan language belonging to the Atayalic subgroup (Li 1981).
This paper reports a (morpho-)phonological process called dorsal consonant
harmony found in the language with the data based on the Truku dialect. Two
contrastive segments—voiceless velar stop /k/ and voiceless uvular stop /q/—are
involved, and the latter is derived in morphophonemic contexts. This process
operates not only between morpheme boundaries, but also within morpheme roots,
showing that the */k…q/ sequence is unattested, and only very few /q…k/
sequences are found. However, with the introduction of a rule which changes
labials to velars in word-final position, this root-internal restriction is gradually
loosened (cf. Li 1980). An observation of the data also reveals that hetero-
morphemic alternation of dorsal consonant harmony involves both derivational
and inflectional prefixes; hence it is controlled by fixed right-to-left directionality.
Theoretically speaking, this assimilation process is considered as a non-local
correspondence rather than a spreading of the dorsal feature [high] or [retracted
tongue root] (cf. Hansson 2001), since the intervening oral segments are transparent
to the operation without any opacity effect, i.e. the intervening vowels are lowered
only if immediately adjacent to a uvular. A theoretical interpretation is provided
following the model of contrastive hierarchy in phonology (Dresher 2003,
Mackenzie 2005) and feature specifications of both segments, suggesting that the
segment /q/ in this language possesses double domination (McCarthy 1994) in both
oral and pharyngeal cavities, thus enforcing the harmony of a hetero-morphemic
/k/ in order to ease production difficulties. A similar morpheme-internal harmony
is also mentioned in other Atayalic dialects such as Squliq and Skikun (Li 1980). A
diachronic implication gained from this observation is that dorsal consonant
harmony is probably a pan-Atayalic phenomenon.

Key words: dorsal consonant harmony, Truku Seediq, feature, contrastive hierarchy

1. Introduction

This paper reports a (morpho-)phonological process called dorsal consonant
harmony found in Seediq, a Formosan language belonging to the Atayalic subgroup (Li

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1980). The data presented in this paper is based on the Truku dialect, collected mainly in Hsiu-lin Township, Hualien County. As one of the three dialects in Seediq (with the other two as Tkdaya and Toda), the Truku dialect is mostly spoken in Hualien County with a population of around 20,000.[1] Although linguistically similar, native speakers tend to identify themselves as *Truku* rather than *Seediq*. The word *seediq* as a noun in the dialect means 'people who are outsiders, the others', whereas in Tkdaya it simply means 'people' and is also the self-designation.

Dorsal consonant harmony is a type of consonant harmony that involves dorsal consonants such as velar and uvular segments, in this case /k/ and /q/. 'Harmony' in phonology refers to a kind of assimilation in which a segment affects another distant segment with similar features.

In his cross-linguistic study of consonant harmony, Hansson (2001) considers dorsal consonant harmony as seemingly rare, while sibilant harmony is the most common. Therefore, it is significant that such a process is found in a Formosan language, which provides another example for theoretical discussion in phonology and typology.

The rest of the paper is organized as follows. Section 2 gives a brief introduction of the phonemic inventory in Truku Seediq. Section 3 provides a review of the process from a diachronic perspective. In §4 the data demonstrating dorsal consonant harmony found in this dialect are presented, along with the observations. In §5 similar cases discussed in Hansson (2001) are reviewed in order to obtain the typological characteristics for dorsal consonant harmony. The theoretical interpretations regarding directionality effect and motivation are discussed in §6, which is then followed by a conclusion.

2. The phonemic inventory in Truku Seediq

So far there has been little phonological description in Truku Seediq apart from Tsukida (2005), who provides a brief but well-noted introduction, including phonological alternations, yet without mentioning the interaction between /k/ and /q/. Yang

[1] This figure is based on a census conducted by The Council of Indigenous Peoples, Executive Yuan, in December 2005.

(1976) and Li (1991)'s descriptions are mainly based on the Tkdaya dialect (Paran village, i.e. Wu-she in Nantou County). As Tsukida (2005:291) mentions, there exists phonological differences among the dialects. For example, the palatalization of /t/ and /d/ before the high front vowel occurs in Truku but not in the other dialects. On the other hand, the vowel deletion rule (i.e. V → Ø/___$C^n\acute{V}$) described in Li (1991) and reported not to take place in Truku by Tsukida (2005:291) actually occurs: I have collected the following examples: *utux* 'god, spirit' > *tux-an* 'at the god's place'; *usa da* 'has gone' > *sa-a=ku da.* 'I am going', in which the initial vowel *u* is deleted in the derived forms in both examples. See also Li (1982).

The orthography of the Truku dialect adopts the letters *c* and *j* to stand for the voiceless palatal affricate [ts][2] and the voiced palatal stop [ɟ], respectively, in order to note the exact pronunciation. As an introduction, the phonemic inventory in Truku Seediq is presented as follows (Tsukida 2005:292).

Table 1: Truku consonants

		Labial	Alveolar	Palatal	Velar	Uvular	Glottal
Stops	voiceless	p	t		k	q	ʔ
	voiced	b	d				
Fricative	voiceless		s		x		h
	voiced				ɣ		
Nasal		m	n		ŋ		
Lateral			l				
Tap			ɾ				
Glide		w		j			

Table 2: Truku vowels

	Front/unrounded	Back/rounded
High	i	u
	ə	
Low	a	

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[2] Tsukida (2005) seems to suggest that the phonemic status of the voiceless affricate [ts] is undetermined as it is parenthesized in her paper. Though it occurs mostly before [i] and [j], it is also found in interjections and loanwords. One reviewer kindly points out that the segment [ts] is also derived from /t/ before [s], as in /t-saman-an/ [tsəsəmánan] 'at dawn', further suggesting its allophonic status.

Since our topic concerns the dorsal consonants, their phonemic status merits a note here. The following (near) minimal pairs show that the two segments are contrastive: *quyux* 'rain' / *kuyuh* 'woman'; *rəkruk* 'blackerned ash' / *rəqruq* 'Formosan bulbul, Pycnonotus taivanus Styan*'; *rəbuk* 'be tired'; *rəbuq* 'hole (in a road or mountain)'. Diachronically *k in Proto-Atyalic is assimilated to [q] in the Seediq dialects due to the following /h/ or /ʔ/ in the root (Li 1981:247-248). For example, *kuhiŋ PA > *quhiŋ* (Toda); *kuhiŋ* (Squliq) 'head louse'; *kitə-hur PA > *qtə-hur* (Inago, Toda), *qt-huy* (Squliq), *kit-hu* (Mayrinax) 'fat'.

In this paper the data is transcribed by using the International Phonetic Alphabet (IPA), yet in the gloss Truku orthography for proper names is used wherever necessary. Since the vowels are often reduced if unstressed, they are omitted in phonemic transcription. The following table shows the correspondence between the different symbols in IPA and the orthography.

Table 3:	phoneme	(allo)phone	orthography
	/t/	[ts]	c
	/d/	[ɟ]	j
	/ɣ/	[ɣ]	g
	/ŋ/	[ŋ]	ng
	/ɾ/	[ɾ]	r
	/j/	[j]	y
	/ə/	[ə]	e

3. Literature review: a diachronic perspective

A similar phenomenon to the topic is mentioned by Li (1980) in the Atayalic dialects—Squliq and Skikun—which also show dorsal consonant harmony in the names of the dialects themselves. In his study of the phonological rules of Atayalic dialects, Li (1980:376) states that 'assimilation of consonants took place largely in Squliq or Skikun, rather than in Cʔuliʔ or Mayrinax'. The consonants involve nasals (though only partially assimilated in Squliq) and dorsal consonants /k/ and /q/. The data Li presents show morpheme-internal harmony, which he considers as assimilation from a diachronic perspective. See the following data from Li (1980:377):

(1)	Squliq	Skikun	Cʔuliʔ	Mayrinax	Gloss
	mquriq	mquriq	mkuriʔ	kumriq	'steal'
	mqbaq	tqbaq	makbaʔ	makibaq	'learn'
	qhoniq	qhoniq	kahawniʔ	kahuniq	'tree'
	qthuy	qthuy	katahuy	kithuy	'fat, not thin'

Li considers that the direction of diachronic assimilation is from /k/ to /q/, as shown in PAn *kaʔən 'eat' > qaniq (in Squliq and Skikun). Following this line of thought, we can see from the data that Mayrinax did not undergo this assimilatory change, so that the sequence /k…q/ still remains morpheme-internally, whereas the cognates in Squliq and Skikun have undergone dorsal consonant harmony.

As for Truku Seediq, it is found that tautomorphemic sequences such as /q…k/ and /k…q/ are rarely attested. There are few examples of the former, however, while the latter sequence /k…q/ is unattested so far. My data collection shows the following five examples with the sequence /q…k/:

(2) Verbs with /q…k/ sequence

Root/stem	AF-form	Imperative	Gloss
qaɣuk	q-m-aɣuk	qɣup-i	scoop up (e.g. millets, corns)
qaɾik	q-m-aɾik	qɾib-i	cut with scissors
qatak	q-m-atak	qtap-i	stand with both legs open
qəɾak	q-m-ɾak	qɾap-i	hug, grab, catch
qudak	q-m-dak	qdap-i	(rain, wind, fire) diminish

In Seediq there is a morphophonemic alternation between labial and velar consonants at the word-final position (Yang 1976, Li 1977, 1991, Tsukida 2005), namely, p, b, m → k, ŋ /____#. This rule suggests that the underlying form is the labial, either /p/ or /b/, and the velar consonant [k] is derived word-finally. The introduction of this rule seems to loosen the morpheme-internal restriction on identical dorsal segments, allowing the /q…k/ sequence to occur.

So far as this alternation is concerned, Li (1980:379) reports that 'Skikun is in the process of changing labials to velars word-finally. All labials in the word-final position tend to become velars, especially in the speech of younger speakers.' Therefore, from a diachronic perspective Truku Seediq might have also undergone a similar change (cf. Yang 1976, Li 1980, 1981).

This can be evidenced by the verb *qəɾak* which has a free variant *qəɾap* 'grasp, grab' as shown in (3). However, one of my informants considers that the form *q<m>ɾap* sounds better than *q<m>ɾak*.

(3) qəɾap
    a. nii=ku   q<m>ɾap   ɾudux.
        PROG=1SG.NOM   <AF>catch   chicken
        'I am catching chickens.'

b. q<n>ɾap-an   tama   ka   ɾudux   nii.
   <PERF>catch-LF   Father NOM   chicken this
   'This chicken was what Father has caught.'

The morpheme-internal sequence of /k…q/ is so far unattested in Truku Seediq. This sequence is attested in Mayrinax, as shown in (1). Being the most conservative dialect in the Atayalic group, Mayrinax retains many archaic features (Li 1981, 1995).

4. Hetero-morphemic data

Apart from morpheme-internal consonant harmony between the velar /k/ and the uvular /q/, there are hetero-morphemic data which involve prefixation and reduplication. See the following examples:

(4) The prefix /m-k-/ (with nouns)   'from…'
     a. /m-k-quɣan/   [məqəqóɣan]   'from Qowgan village'
     b. /m-k-dɣijaq/   [məqədəɣíjaq]   'from the mountains'
 cf. c. /m-k-tkidiɣ/   [məkətəkíɟiɣ]   'from Tkijig village'
     d. /m-k-bsəŋan/   [məkəbəsə́ŋan]   'from Bsngan village'
     e. /m-k-ɣsiluŋ/   [məkəɣəsíluŋ]   'from the seashore'

(5) The prefix /k-/ (with stative verbs)[3]
     a. /m-k-siqa/   [məqəsíqa]   'mutually shy and embarrassed'
         m-k-siqa   balaj ka   jabuŋ   ni   umin.
         RECP-STA-shy   very   NOM   Yabung and   Umin
         'Yabung and Umin are embarrassed with each other.'
     b. /k-siqa/   [qəsíqa]   'be self-aware; be self-conscious; be polite'
         k-siqa   nanak   uda-su.
         STA-shy   self   behavior-2SG.GEN
         'You should behave yourself.'
     c. /p-k-siqa/   [pəqəsíqa]   'cause to be embarrassed'
         /p-p-k-k-siqa/ [pəpəqəqəsíqa]   'cause to be very embarrassed'
         p~p-k~k-siqa   dhəjaan   ka   s-rəŋaw-su.
         RED~CAU-RED~STA-shy   3PL.OBL   NOM   RF-say-2SG.GEN
         'What you said caused them to be very embarrassed.'

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[3] The following are the abbreviations used in this paper which are not included in the Leipzig Glossing Rules (http://www.eva.mpg.de/lingua/resources/glossing-rules.php): AF=actor focus; RED=reduplicant; RF=referential focus; STA=stative verb.

(6) The prefixes /k-n-/ (with stative verbs)   '(nominalization)'
    a. /k-n-bilaq/   [qəmbílaq]   'smallness'
    b. /k-n-qthuɾ-an/   [qənqətəhóɾan]   'fatness'
    c. /k-n-sədiq-an/   [qənsəɟíqan]   'beauty'
    d. /k-n-p-s-qaɾas/   [qəmpəsəqáɾas] 'much praise'
cf. e. /k-n-paɾu/   [kəmpáɾu]   'largeness'
    f. /k-n-malu/   [kənmálu]   'goodness'
    g. /k-n-hlawax/   [kənhəláwax]   'slimness'

(7) The prefix /k-n-/ (with personal names/human nouns) 'having the quality of (someone, a person)'
    a. /k-n-ɾubiq/   [qənɾúbiˀq]   'being like Rubiq'
    b. /k-n-laqi/   [qənláqᵉi]   'being like a child'
cf. c. /k-n-ɾabaj/   [kənɾábaj]   'being like Rabay'
    d. /k-n-ɾibix/   [kənɾíbix]   'being like Ribix'

An observation from the data above reveals the following points: First, as the distribution of /k-n-/ [qən], [qəm], and /m-k-/ [məqə] is predictable, the underlying dorsal segment in the prefixes should be /k/, which is then phonetically realized as [q] if the stem or the base contains the segment /q/.[4]

Secondly, it follows that dorsal consonant harmony in Truku Seediq presents an instance of fixed right-to-left directionality (cf. Hansson 2001). Hansson's (2001:176) survey of consonant harmony in languages suggests that 'anticipatory (right-to-left) assimilation is the norm for consonant harmony processes'. It appears that dorsal consonant harmony in this language falls into this category of the default directionality. More details are discussed in §6.1.

Thirdly, these data show that dorsal consonant harmony is operated across the morpheme boundary. The operation is long-distant, as the derived [q] and the triggering /q/ in the root are not necessarily adjacent. Sometimes they are, as in /m-k-quɣan/ [məqəqóɣan], while in /kn-ɾubiq/ [qənɾúbiˀq] they occur at both ends. This long-distance assimilation suggests that the intervening segments are transparent to this operation since the vowels are not affected. In /m-k-quɣan/ [məqəqóɣan] the vowel [u] is lowered to [o] due to the adjacent [q], thus it is local assimilation. On the other hand, the vowel [u] in /kn-ɾubiq/ [qənɾúbiˀq] is not affected by the assimilation, otherwise it should also be lowered.

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4 It is apparent that based on the data, /k/ is realized as [q] in dorsal consonant harmony, yet this is not a contradiction of their phonemic status as both /k/ and /q/. It needs pointing out that phonetic realization should be treated differently from phonemic contrast. The segment [q] is an allophone of /k/ due to this rule application (cf. Dresher 2003).

As Hansson (2001:94) notes, 'dorsal consonant harmony violates strict locality, in that it enforces agreement in [RTR] (Retracted Tongue Root) (or [–high]) across an intervening string of consonants and vowels, without spreading the feature to those intervening segments'. This suggests that dorsal consonant harmony should be regarded as non-local correspondence (cf. McCarthy 2007); unlike nasal harmony where the targeted segments are all nasalized through feature spreading (cf. Walker 2000). See more detailed discussion in §6.

5. Typological characteristics of dorsal consonant harmony

Consonant harmony is defined as 'any assimilatory effect of one consonant on another consonant, or assimilatory co-occurrence restriction holding between two consonants, where (a) the two consonants are separated by a string of segmental material consisting of at the very least a vowel; and (b) intervening segments, in particular vowels, are not audibly affected by the assimilating property' (Hansson 2001:4). Following this definition, the alternation between the velar [k] and the uvular [q] in Truku Seediq applies to both situations. The domain of the operation is confined at word-level, either tauto- or hetero-morphemic.

In the survey, Hansson (2001) cites from MacKay (1999) who mentions those cases found in the Totonacan language family spoken in Mexico. Several facts about dorsal consonant harmony in Misantla Totonac are listed below:

(8)   Misantla Totonac (data from MacKay 1999, cited in Hansson 2001:88)
    a.   Harmony alternation in body-part prefixes /-ka:k-/, /maka-/
        /min-ka̲:k-paqa̲ʔ/   [míɴqáqpaχέʔ]   'your shoulder'
        /min-ka̲:k-tʃa̲:-ni/   [míŋká̲:ktʃa̲:n]   'you shoulder' [sic!]
        /ut maka-ʃqat/   [ʔút maqáʃqét]   's/he scratches X (with hand)'
    b.   Harmony in other derivational prefixes /maka-/, /lak-/
        /maka-ɬuqwan-la(ɬ)/   [maqaɬɔ́qwaɬ]   's/he tired X'
        /lak-tʃanqʃ/   [láχtʃáɴχʃ]   's/he chops (bones)'
    c.   No harmony in inflectional prefixes
        /ik-lak-tsa̲qa̲/   [ʔikláqtsa̲qa̲]   'I chew X' (*[ʔiqláqtsa̲qa̲])
    d.   No left-to-right harmony
        /squ-kuhu-la(ɬ)/   [sqɔkɔ́hɔɬ]   'It was smoked' (*[sqɔqɔ́hɔɬ])

Another similar case is in Tlachichilco Tepehua which also shows sensitivity to derivational prefixes. See the following data:

(9)   Tlachichilco Tepehua (data from Watters 1988, cited in Hansson 2001:91)

  a. Harmony alternations in derivational prefixes

   /mak-tʃaqʼaː-j/ [maqtʃaʔaːj] 'X washes hands (impf.)'

   /ʔuks-laqtsʼin/ [ʔoqslaqtsʼin] 'look at Y across surface'

   /lak-tʃiqʼi-ɬ/ [laqtʃeʔeɬ] 'X broke them (perf.)'

  cf. /mak-tʃaː-j/ [maktʃaːj] 'X claps; X cooks [tortillas] (impf.)'

   /ʔuks-kʼatsaː/ [ʔukskʼatsaː] 'feel, experience sensation'

   /lak-huniː-ɬ/ [lakhuniːɬ] 'X told them (perf.)'

  b. No harmony in inflectional prefixes

   /k-ʼaqtaj-ni-ɬ/ [kʼaqtajniɬ] 'I began (perf.)' (*[qʼaqtajniɬ])

   /kin-ʔaqs-a/ [kiʔaqsa] 'it's tight on me' (*[qiʔaqsa])

What is fundamental is that the cases of dorsal consonant harmony exhibit similar features as those found in Truku Seediq. It can thus be suggested that for dorsal consonant harmony, the following characteristics seem to be found across languages:

(10)   Typological characteristics for dorsal consonant harmony

  a. The domain of the application is both root-level and stem-level.

  b. The feature related to dorsal consonant harmony does not spread locally.

  c. The prefixes involved with dorsal consonant harmony are mostly derivational.[5]

6. Theoretical interpretations

Based on the typological characteristics, this section attempts to provide theoretical interpretation towards the issues on directionality effect and motivation of dorsal consonant harmony. The discussion on motivation is also linked with the phonological contrast of the two consonants /k/ and /q/ in Truku Seediq. These issues are addressed from phonetic, phonological, as well as psycholinguistic perspectives.

6.1 Directionality effect

Adopting Baković's (2000) analysis of vowel harmony systems, Hansson (2001) puts forward two types of directionality effect in consonant harmony systems: stem control and absolute directionality.

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[5]   This typological characteristic states a tendency, though dorsal consonant harmony in Truku Seediq is also applied to inflectional prefixes, as discussed in the following section.

Stem-controlled consonant harmony is sensitive to the distinction between derivational and inflectional affixes. As the cases in Misantla Totonac (MacKay 1999) and Tlachichilco Tepehua (Watters 1988) have shown, harmony does not apply to inflectional prefixes because the stem determines whether harmony is operated towards certain affixes.

Another effect of stem control is bidirectional harmony when both prefixes and suffixes are present. This is exemplified by the following data in Kera where voicing harmony affects both the prefix and the suffix.

(11) Stem-controlled voicing harmony in Kera (data from Ebert 1979, cited in Hansson 2001:186)
   a. /k-dʒar-kaŋ/   [gə-dʒar-gaŋ]   'colorful (coll.)'
   b. /k-dʒir-ki/   [gi-dʒir-gi]   'colorful (masc.)'

With absolute directionality, harmony is operated either from right-to-left or left-to-right, regardless of the morphemic properties in between. Sibilant harmony in Ineseño (Applegate 1972, cited in Hansson 2001:189) is a case in point. In Ineseño the sibilant in the suffixes harmonizes from right to left any preceding sibilants that come along. See the following examples:

(12) Absolute right-to-left directionality in Ineseño:
   a. /s-api-tʃʰo-it/   [ʃ-api-tʃʰol-it]   'I have a stroke of good luck'
   b. /s-api-tʃʰo-us/   [s-api-tsʰol-us]   'he has a stroke of good luck'
   c. /s-api-tʃʰo-us-waʃ/   [ʃ-api-tʃʰo-uʃ-waʃ]   'he had a stroke of good luck'
   d. /ha-s-xintila-waʃ/   [ha-ʃ-xintila-waʃ]   'his former Indian name'
   e. /s-iʃ-tiʃi-jep-us/   [s-is-tisi-jep-us]   'they show him'

As these examples clearly show, it is the rightmost sibilant that targets the preceding sibilants and determines their feature qualities, thus an alveolar harmonizes the preceding sibilants to be alveolar, or a palatal harmonizes the preceding sibilants to be palatal.

Based on the hetero-morphemic data in Truku Seediq, dorsal consonant harmony appears to be operating from right to left, with the morpheme-internal /q/ harmonizing the velar stop in the prefix. However, it is necessary to clarify whether this effect is due to stem control or absolute directionality. Three criteria are taken into account: first, evidence from the comparative data in the other genetically-related dialects; secondly, whether the harmony process distinguishes inflectional from derivational affixes; and finally, whether the harmony is found to be bidirectional. As the following table shows, if the harmony is sensitive to derivational affixes or if bi-directionality is found, then it

is stem-controlled. Alternatively, diachronic data may shed light on the factor which triggers the operation.

(13)   Criteria for directionality effect in consonant harmony

	stem/root control	fixed directionality
inflectional vs. derivational	+	−
bi-directionality	+	−

Morpheme-internal restriction suggests that directionality of dorsal consonant harmony in Truku Seediq is right-to-left. As stated earlier in §2, so far the */k…q/ sequence is not attested in this dialect,[6] while only very few examples of /q…k/ roots are found. It is noted that the word-final [k] in the /q…k/ sequence is derived from /p/ or /b/. If harmony is operated due to stem control, such a sequence should not have existed.

It appears that dorsal consonant harmony in Truku Seediq does not make a distinction between derivational and inflectional prefixes,[7] unlike those cases in Tlachichilco Tepehua and Misantla Totonac. The following data show that in the negative construction with the negator *ini*, the stative verb following *ini* must be a non-finite form with the prefix /k-/ attaching to the stem (Tsukida 2005). The prefix is changed to [q] if there is a uvular stop within the domain of the harmony. See the following examples:

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[6] In Li's (1998) comparative study on the Atayalic dialects in I-Lan, the sequence */k…q/ is not found in the wordlist in the appendix. Wherever in some dialects there is /q/ (e.g. in Squliq subgroup), in the others it corresponds to /ʔ/ if preceded by /k/ (in Cʔoleʔ subgroup). For example, Skikun *tqbaq* corresponds to Pyahaw *tkbaʔ* 'ask' and Syanuh *qsuqiʔ* to Ryuhiŋ *kcuʔiʔ* 'late'. Also, though the /q…k/ sequence is found in some dialects, it corresponds to the /k…(ʔ or k)/ sequence in the other. For instance, Pyanan, Lmuan, *qmatak* ~ Kulu, Ryuhiŋ, Mtlaŋan *kmataʔ* 'eat raw'; Kubaboo *qmatak* ~ Knŋyan *kmatak*, Pyahaw *kmarap*, Kulu *ʔmatak* 'cut'. These examples suggest that the sequence */k…q/ is avoided in these dialects.

[7] I would like to thank one of the reviewers for pointing this out. Although the distinction between derivation and inflection in Formosan languages is still in dispute (cf. Starosta 2002), this paper follows Payne's (1997) criteria for distinguishing derivation from inflection. Based on Payne (1997:26), 'inflection vs. derivation is less a distinction than a continuum. Some operations fall in between the prototypical extremes.' Overall, inflectional operations do not change the lexical category of the word and tend to occur outside derivational affixes. Also, inflectional affixes are required by grammatical constructions as well as more productive than derivational ones (cf. Bybee 1985). As the examples in (14) have shown, the prefix *kə-* is treated as inflectional. It must attach to a stative verb in the negative construction beginning with *ini.* It occurs at the left of the infix *-m-*, which indicates future.

(14) Dorsal consonant harmony with the prefix /k-/ to [q]

    a. /naqih/ [náqᵉih] 'be bad' > /k-naqih/ [qə-náqᵉih] 'be bad'

       ini   k-naqih   ka   dɾui.

       NEG   STA-bad   NOM   car

       'The car is not damaged.'

    b. /m-huqil/   [məhóqᵉil]   'be dead'

       /k-m-huqil/   [qəmhóqᵉil]   'about to die'

       /k-m-p-huqil/ [qəmpəhóqᵉil]   'want to kill'

       ini=nami   k<m>p-huqil   səədiq.

       NEG=1PL.EXCL.NOM   STA<FUT>CAU-die   people

       'We don't want to kill people.'

    c. /m-taqi/   [mə-táqᵉi]   'to sleep'

       ini   taqi   ka   laqi   nii.

       NEG   sleep   NOM   child   this

       'This child does not sleep (still awake).'

       /k-m-taqi/   [qəmtáqᵉi]   'want to sleep'

       ini=ku   k<m>taqi.

       NEG=1SG.NOM   STA<FUT>sleep

       'I don't want to sleep.'

There is no strong evidence showing that harmony is bidirectional, as in Truku Seediq there is no such suffix with a uvular segment that is affected by the process. Therefore, the argument for dorsal consonant harmony being caused by stem control is rather weak.[8]

The diachronic comparative data also shed light on the issue. For example, Li (1981:279) reconstructs the word 'bird' as *kabah-niq 'bird' in Proto-Atayalic, which is reflected in Squliq and Skikun as *qh-niq*, in Mayrinax as *kabah-niq*, and in Truku Seediq as *qbhəniʔ*. Also, *kahu-niq 'tree' (Li 1981:295) is reflected in Mayrinax as *kahu-niq*, in Skikun as *qhu-niq*, and in Truku Seediq as *qhuniʔ*. In Truku Seediq the harmony must have occurred before the word-final *q changed to /ʔ/. It appears that the fossilized suffix /-niq/ triggered dorsal consonant harmony, which operated diachronically from right to left in Squliq and Skikun. The same situation must have occurred in Truku Seediq. Therefore, from a pan-Atayalic point of view, dorsal consonant harmony in

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[8] Dorsal consonant harmony in Truku Seediq has no effect on enclitics. See the following example:

    s-ɾahuq=ku   paah   babaw.

    RF-loose=1SG.NOM   from   above

    'I fell because of loosening from above.'

these dialects seems attributed to the effect of fixed directionality, i.e. in this case from right to left.

6.2 Motivation

Motivation for consonant harmony has its root in phonetics. In Truku Seediq the /k…q/ sequence is so far unattested, while there are few /q…k/ sequences. Acoustically, the former sequence appears to contradict the direction of pulmonic airstream since the outgoing air always encounters the uvula before the velum. Similarly, Rose & Walker (2004) mention that production and perception difficulties arise when similar but different consonants occur in an utterance. Such difficulties can also be seen from tongue twisters such as {*She sells sea shells by the seashore.*}. Speech errors in general utterances and tongue twisters also reveal that there is a tendency to improve processing ease 'by overriding differences between the consonants and making some or all of their properties match' (ibid.:489). These 'production-based pressures' motivate the formal agreement between similar segments. Therefore, they conclude that a correspondence relation between similar segments is constructed in speakers' grammar.

From a psycholinguistic perspective, it is proposed that consonant harmony is associated with speech planning (Hansson 2001, Walker 2006). Previous research has demonstrated that during production speech is planned in advance (see Fromkin & Ratner 1998 and the references cited therein). Hansson (2001) proposes that in consonant harmony the constraint ANTICIPATE[F] also comes into play. Given the directionality of dorsal consonant harmony as right-to-left, speech processing tends to involve anticipation rather than perseveration.

Walker (2006) distinguishes two situations of segmental interaction related to consonant harmony: genuinely non-local interactions and covertly local interactions. The major difference lies in whether the intervening segments participate in the process. For genuinely non-local interactions the intervening segments are transparent to the process, i.e. unaffected by the process, whereas for covertly local interactions the intervening segments appear to be transparent due to lack of perceptibility of the feature.

Segmental transparency can be considered an instance of a derivational opacity effect (Walker 2000). For example, nasal harmony is a covertly local interaction because the feature is continuously extended over an adjacent sound sequence. The process also affects the intervening obstruents, yet they remain oral because of a constraint which prohibits nasalized obstruents. Since dorsal consonant harmony is considered as a genuinely non-local interaction (Hansson 2001, Walker 2006), the drive which enforces agreement between the interacting segments in such a process should be different from that of covertly local interactions which gain similarity through feature-spreading.

Within an Optimality-theoretical framework (Prince & Smolensky 2004), Hansson (2001) proposes the constraint family CORR-CC as the drive which motivates consonant harmony, and considers that the distinctive feature for dorsal consonant harmony is [RTR] (Retracted Tongue Root). He suggests that IDENT[RTR]-CC dominates the constraint ranking so that the non-uvular segment is realized as [+RTR], hence uvular.

Rose & Walker (2004) propose that the participant segments in consonant harmony share a certain degree of similarity, which motivates a correspondence relation, reminiscent of Correspondence Theory by McCarthy & Prince (1995, 1999). This correspondence relation is configured as the modal of ABC (AGREEMENT BY CORRESPONDENCE, as shown below),[9] which also encompasses both MSCs (MORPHEME STRUCTURE CONSTRAINTS) and alternations, a phenomenon termed as LONG DISTANCE CORRESPONDENCE AGREEMENT (LDCA). The correspondence relation is established by co-indexing. No feature links across the intervening segments is posited because they are considered neutral. This is also echoed by McCarthy (2007) who provides sibilant harmony in Chumash as evidence to argue for segmental correspondence in long-distance consonant assimilation.

(15) ABC configuration (Rose & Walker 2004:476)

$$C_x \quad V \quad C_x \quad V$$
$$\mid \qquad \quad \mid$$
$$[\alpha F] \quad \ [\alpha F]$$
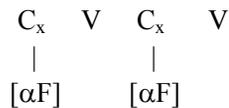
Indeed, for consonant harmony to occur, the interacting segments must be intrinsically similar in major features to start with (Hansson 2001, Rose & Walker 2004). To measure similarity, Rose & Walker (2004) propose a 'similarity-based correspondence hierarchy' as follows:

(16) Similarity-based correspondence hierarchy (Rose & Walker 2004:491), using
      voicing agreement as illustration
      CORR-T↔T   » CORR-T↔D   » CORR-K↔T   » CORR-K↔D
      'identical stops'   'same place'   'same voicing'   'any oral stops'
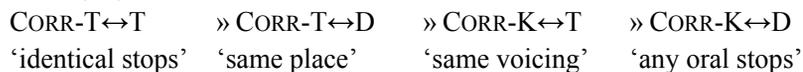
This ranking implies that 'the more similar the pair of consonants, the higher ranked the requirement that they correspond' (ibid.:491), so that the nature of gradient similarity can be captured. Rose & Walker (2004) assume that these correspondence constraints are universal, and languages with consonant agreement differ in their ranking of these constraints vis-à-vis faithfulness constraints such as IDENT-CC (FEATURE).

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[9] Rose & Walker (2004) use 'agreement' rather than 'harmony' to describe the cases showing LDCA.

For instance, under the ABC configuration Rose & Walker (2004:501) analyze root-internal co-occurrence restriction on laryngeal features in Chaha and Bolivian Aymara, and reach the following factorial typology:

(17) Chaha
      CORR-T'↔T » CORR-K'↔T » IDENT-IO(cg), IDENT-OI(cg)

(18) Bolivian Aymara
      CORR-T^h↔T » IDENT-IO(sg), IDENT-OI(sg) » CORR-K^h↔T

That is, both languages require MSC constraints on roots with stops of the same laryngeal features [constricted glottis] and [separated glottis]. But Bolivian Aymara differs from Chaha in that heterorganic stops are exempted from this requirement; hence CORR-K^h↔T is ranked below faithfulness constraints.

Contrary to the similarity-based argument proposed by Rose & Walker (2004) is the approach of contrastive hierarchy (Jakobson & Halle 1956, Dresher 2003),[10] which is elaborated by Mackenzie (2005) on consonant harmony. The central claim of this approach is to consider similarity as depending on featural specifications which are 'influenced by the system of contrasts in a given language' (ibid.:170). Therefore, instead of considering the level of similarity as universal, this approach regards that the motivation for two segments to interact in consonant harmony is the underlying contrasts in the phonemic inventory of a given language. This contrast-based approach for consonant harmony views similarities between segments as language-specific properties. The contrastive hierarchy for an inventory can vary from language to language, depending on the phonological processes a language exhibits.

Mackenzie (2005) argues that similarity between participating segments in consonant harmony is determined by contrastive features in a language. A case study of consonant harmony in Bumo Izon is presented to demonstrate that contrastive features play a role in a phonological process such as consonant harmony. Bumo Izon (Efere 2001) exhibits a co-occurrence restriction of plosive and implosive stops in a morpheme. The implosive /ɓ/ and /ɗ/ cannot co-occur with the plosives /b/ and /d/ in any combination morpheme-internally, as shown in (19). However, the labiovelar implosive /ɠɓ/ and the velar plosive /g/ is free from this restriction, as shown in (20).

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[10] Dresher (2003:47) argues for using feature hierarchy to determine contrastiveness by 'ordering features into a hierarchy, and splitting the inventory by successive divisions until all phonemes have been distinguished'.

(19)　Bumo Izon (Efere 2001, citing from Mackenzie 2005:173)
　　a.　búbú　　　　'rub (powder in face)'
　　b.　bídέ　　　　'cloth'
　　c.　ɓúɓaɪ　　　　'yesterday'
　　d.　ɗɔ́:ɗɔ́:　　　　'cold'
　　e.　ɗáɓá　　　　'swamp'

(20)　Bumo Izon (Efere 2001, citing from Mackenzie 2005:173)
　　a.　igódó　　　　'padlock'
　　b.　ɗúgó　　　　'to pursue'
　　c.　ɓúgí　　　　'to wring (hand)'
　　d.　ɡ͡báɓu　　　　'crack (of a stick breaking)'
　　e.　ɡ͡bódaɡ͡bóda　　'(rain) hard'

A look at Bumo Izon stop inventory shows that the voiced velar and labiovelars stops do not have voiceless homorganic counterparts which contrast in the plosive/implosive distinction. Mackenzie (2005) proposes the ordering [labial] > [dorsal] > [voice] > [glottis] for feature specification of the stop series.

First of all, the feature [labial] distinguishes the labial segments /ɓ, p, b, kp, ɡ͡b/ from the non-labial segments /t, k, d, g, ɗ/. Secondly, the feature [dorsal] divides labial segments /kp, ɡ͡b/ ([+labial, +dorsal]) from /p, b, ɓ/ ([+labial, –dorsal]), and non-labial segments /k, g/ from /t, d, ɗ/. Later, the feature [voice] further distinguishes voiced segment /ɡ͡b/ from voiceless segments /kp/ under [+labial, +dorsal], and /ɓ/ from /p/ under [+labial, –dorsal]. It also distinguishes /g/ from /k/ under [–labial, +dorsal], and /d, ɗ/ from /t/ under [–labial, –dorsal]. Finally, the voiced implosives /ɓ, ɗ/ are distinguished from /b, d/ by the feature [glottis].

This hierarchy stresses two points. First, those participating segments /ɓ, ɗ, b, d/ in consonant harmony are contrastively specified by [glottis] following the proposed feature order. Secondly, the segments /ɡ͡b/ and /g/ lack the [glottis] counterparts and thus are exempted from co-occurrence restriction of plosive/implosive distinction in consonant harmony. Mackenzie (2005:175) thus argues that 'asymmetrical inventories like that of Bumo Izon highlight the importance of determining which features are contrastive', and that the approach of similarity fails to show 'how /b/ and /d/ are more similar to one another than /g/ and /ɗ/' (cf. Hansson 2001).

6.3 Proposal

Following the discussion above, this paper considers the approach of contrastive hierarchy more powerful in describing and interpreting phonological processes in a

given language. This approach is adopted in this paper to interpret both dorsal consonant harmony and the morphophonemic alternation of bilabial and velar plosives in the imperative paradigm.

The inventory of obstruents (as in Table 1) in Truku Seediq show that [voice] contrasts in labial, alveolar, and dorsal segments, but not in pharyngeal ones. It follows that the underlying phonological contrast is built on the feature [pharyngeal], which divides the whole set of plosive inventory into two groups, i.e. [+pharyngeal] and [−pharyngeal] (hence [oral]). Among the oral plosives, only the segment /k/ lacks its voiced partner, thus the feature [dorsal] divides the oral plosives into two groups. This leaves the non-dorsal segments, which are distinguished by the feature [labial] rather than [coronal] for two reasons: First, the bilabial segments interact with the dorsal segments for the alternation in the imperative paradigm, and secondly, both labials and velars are peripheral segments and share the feature [grave] as opposed to dentals and palatals which are featured [acute] (Jakobson & Halle 1975). Finally, the feature [voice] specifies each non-dorsal plosive. The diagram is shown as follows:

(21) Contrastive hierarchy in Truku Seediq plosive inventory

p, b, t, d, k, q, ʔ

[−pharyngeal] ([+oral])   [+pharyngeal]
p, b, t, d, k   q, ʔ

[−dorsal]   [+dorsal]   [+dorsal]   [−dorsal]
p, b, t, d   k   q   ʔ

[+labial]   [−labial]
p, b   t, d

[−voiced] [+voiced] [−voiced] [+voiced]
p   b   t   d
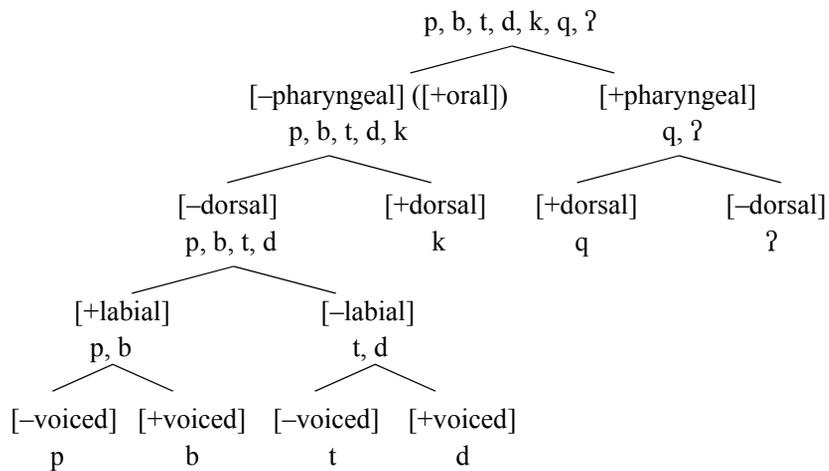
This diagram shows the feature ranking of [pharyngeal] > [dorsal] > [labial] > [voiced] in Truku Seediq in order to fully specify each segment. The notion of feature dominance can also be employed here. It can be seen that the segments [k] and [q] contrast in [pharyngeal] feature, which dominates the [dorsal] feature, so that the two segments are similar in being [dorsal] but differ in being [±pharyngeal]. The segment [q] thus shares both places [pharyngeal] and [dorsal]. This diagram highlights the assumption that Truku Seediq makes the distinction between [oral] and [pharyngeal] features in its phonemic inventory.

This diagram also recalls McCarthy's (1994) treatment of Arabic gutturals. Given that the uvula sits at the boundary between tongue back and tongue root, the uvular stop [q] is perceived as having characteristics of being oral and pharyngeal, as shown in the following structure:

(22) The Place node for the uvular stop [q]

```
                      Place
                      /\
            Oral        Pharyngeal
             |              |
          [dorsal]      [pharyngeal]
```
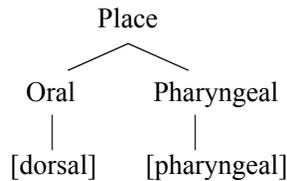
This phenomenon of 'double domination' (Kenstowicz 1994:459) probably renders the segment [q] some power to realize its closest but contrastive segment [k] as identical. This can be considered as the inner drive from the underlying system to activate the agreement between the two segments, hence the dorsal consonant harmony in the language.

In this way, we may be able to explain the reason why in dorsal consonant harmony it is usually the uvular which assimilates the velar but not the other way round. Following the contrastive hierarchy in (21), we claim that consonant harmony is subject to the feature hierarchy within the phonemic system in a language. Therefore, it is the more dominant feature which has the power to realize the underlying segments of the dominated feature to be its identical, while simultaneously exercising the correspondence relation.

The diagram in (21) also provides a new interpretation for the labial and velar alternations in Seediq imperatives (Yang 1976, Li 1977, 1991, and Tsukida 2005). Recall the rule mentioned in §3 that the labials /p, b/ and /m/ in the imperative paradigm are realized as their equivalent velars [k] and [ŋ] in word-final position. The diagram reflects that the feature [dorsal] dominates [labial], so that the contrast in the system triggers the underlying labials to be realized as the only legitimate dorsal segment [k] within the [–pharyngeal] domain whenever the suitable phonological context applies.

7. Concluding remarks

In this paper the phonological process termed dorsal consonant harmony found in Truku Seediq is reported, showing that the underlying velar segment /k/ in prefixes is realized as [q] whenever there is a uvular /q/ in the stem. This alternation of velar to uvular is discussed from historical, phonological, and psycholinguistic perspectives.

A diachronic implication gained from this paper is that dorsal consonant harmony is probably a pan-Atayalic phenomenon. Li's (1980, 1981) data reveal that tauto-morphemic restriction on identical dorsal segments is seen in some Atayalic dialects such as Squliq and Skikun. A comparison of the data in four dialects—Squliq, Skikun, Cʔuliʔ, and Mayrinax (Li 1980) shows that the direction of sound change is from velar [k] to uvular [q], implying that dorsal consonant harmony is a later development. This is also parallel to the directionality of synchronic assimilation.

Dorsal consonant harmony in Truku Seediq is considered as non-local assimilation, sharing similar typological features with the cases presented in Hansson (2001). From a theoretical point of view, two approaches regarding motivation of consonant harmony are discussed. The similarity-based approach is based on Hansson (2001), Rose & Walker (2004), and McCarthy (2007), who regard consonant harmony as being triggered by similarity shared among the participating segments, which in turn motivates the correspondence relation. Alternatively, the contrast-based approach is advocated by Dresher (2003) and Mackenzie (2005), who consider that similarity is a language-specific property and may vary from language to language. It is the underlying contrast in a given language that determines similarity between the interacting segments for a phonological process.

Following the discussion, this paper adopts the contrast-based approach not only to interpret dorsal consonant harmony but also to account for the other phonological processes exhibited in Truku Seediq. First of all, this paper attempts to explain the reason why in dorsal consonant harmony it is usually the velar that is realized as the uvular, rather than the other way round. The feature ranking of [pharyngeal] > [dorsal] > [labial] > [voice] shown in (21) is proposed to reflect the underlying contrast system of the Truku phonemic inventory. The dominant features exercise the constraint to impose their counterpart to be identical, thus the velar /k/ is realized as [q] whenever there is a /q/ within the domain of the operation.

Secondly, the feature hierarchy (21) also provides a new interpretation for the morphophonemic alternation between labial and velar stops in the imperative paradigm. Given the feature ranking of [dorsal] dominating [labial], the underlying labials /p, b/ and /m/ are surfaced as the velars [k] and [ŋ], respectively. Since there is no contrastive voiced velar plosive, the voiced bilabial /b/ is still realized as [k] word-finally for the alternation in the imperative paradigm.

In conclusion, this paper reports dorsal consonant harmony in Truku Seediq and provides a discussion of the comparative data among the Atayalic dialects as well as a theoretical interpretation. Dorsal consonant harmony is a rare phonological phenomenon (Hansson 2001), thus it is significant for our understanding in Formosan phonology to identify this process in the Atayalic dialects. This phonological process is viewed as

non-local assimilation and triggered by fixed directionality from right to left. Its operation is motivated by the ease of production and the underlying contrastive hierarchy of feature ranking which drives the interacting segments [k] and [q] towards a surface correspondence.

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賽德克太魯閣語舌根子音一致律

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　　賽德克語乃是屬於台灣南島語中的泰雅語群 (Li 1981)。本文報導賽德克語的舌根子音一致律，以太魯閣方言爲主要語料。該音韻規則牽涉到兩個音段──無聲軟顎阻塞音 [k] 及無聲小舌阻塞音 [q]，後者會在詞音位的環境下衍生出來。這個規則不僅發生在詞素界線之間，亦發生在詞根內部。因此 */k…q/ 這樣的音序排列不存在。而少數 /q…k/ 音序的例子則顯示詞根內部的限制由於字尾唇音變成軟顎音的規則而逐漸放鬆 (cf. Li 1980)。從語料的觀察中可以看出 (1) 舌根子音一致律在不同詞素間的轉變牽涉到衍生及屈折詞綴；(2) 其運作的方向性乃是固定地從右至左。就理論的角度而言，由於介於其間的口腔音段對這個規則沒有反應，此同化規則因此被視爲非局部對應 (non-local correspondence)，而非經由舌根特徵如 [高] 或 [舌根收縮] 的傳遞 (cf. Hansson 2001) 所造成的，例如介於其間的高母音只有在小舌音附近才會變爲中母音。本文從音韻學中對比層次 (contrastive hierarchy) 的模式 (Dresher 2003, Mackenzie 2005) 提供理論上的解讀，並以特徵標記 (feature specification) 分析這兩個音段。小舌音 /q/ 在這個規則中同時具有口腔音及咽喉音的雙重優勢 (McCarthy 1994)，因此促使不同詞素中的 /k/ 變成 [q] 以減輕發音上的困難。類似的詞素內部一致律亦發生在其他泰雅語方言如賽考利克以及四季 (Li 1980)。本文研究提供歷時性的推論，即舌根子音一致律可能是一種普遍存在於泰雅語的現象。

關鍵詞：舌根子音一致律，賽德克太魯閣語，特徵，對比層次