An acoustic study of schwa production in two St'át'imcets varieties

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Acoustic tokens of St'át'imcets words with CC clusters were examined to determine the nature of schwa production in two Lower St'át'imcets varieties: Lower St'át'imcets and 'Lower Lower St'át'imcets'. The data were produced by three speakers. CCs in word-initial, word-internal and word-final position were analysed. For each position, obstruent-resonant, obstruent-obstruent, resonant-obstruent, and resonant-resonant CCs were examined. Excrescent schwa was produced very infrequently. Epenthetic schwa was produced more frequently by the Lower Lower St'át'imcets speakers. For all speakers, its production showed low tolerance for C-resonant clusters.

1 Introduction[1]

In Salish languages, schwa is typically inserted in words to break up consonant clusters (Kinkade 1993, 1998, Willett & Czaykowska-Higgins 1995, Shaw 2002). Speakers of St'át'imcets (Lillooet) Salish can differ in production of schwa; van Eijk (1997) describes the difference as idiolectal. This paper reports the findings of an acoustic study of schwa production in two Lower St'át'imcets varieties: Lower St'át'imcets (LS), and 'Lower Lower St'át'imcets' (LLS). LS is spoken around Mt. Currie, B.C. LLS is spoken around Samahquam, Skatin (Skookumchuck), Port Douglas and Mission, B.C.[2] The aim was to determine the nature of schwa production in these two varieties.

2 Data and procedure

The present study examined two-consonant clusters (CC) in three prosodic positions: word-initial (complex onset) as in *pɬuɬ* 'thick (layer or

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[2]LS and LLS are typically grouped as one dialect (LS) (e.g., van Eijk 1997), although LLS is reported by its speakers as being distinct. The nature and extent of the distinction is unclear. The present study identifies a difference between the two varieties based on data from three speakers.

cloth)', word-internal (coda-onset) as in *kí?.ki?* 'blue jay', and word-final (complex coda) as in *ma?ʕ'* '(breaking) daylight'. For each position, four types of CC were distinguished: obstruent-resonant (KR), as in *twan* 'salmon berry', obstruent-obstruent (KK), as in *pɬuɬ*, resonant-obstruent (RK), as in *?caw'sxn* 'kneecap', and resonant-resonant (RR), as in *zháka?* 'right hand'. The carrier words for the tokens which were analysed are presented in Table 1.[3] (The same number of words were not analysed for each category due to lack of data.)

Table 1. Carrier words for CC tokens

a. word-initial

KR	KK	RK	RR
ɬʕʷilx 'to jump'	*ptixʷn* 'to spit'	*nc'ip'* 'cold liquid'	*zhaɬníw't* 'right side of body'
twan 'salmon berry'	*kʷtamc* 'husband'	*nqapc* 'west wind'	*zháka?* 'right hand'
pzúza? 'bird'	*sqaxʷ* 'broken'	*?caw'sxn* 'kneecap'	*ʕʷlulm'x* 'to set a grass fire'
tmixʷ 'earth, land, soil, weather'	*pɬuɬ* 'thick (layer or cloth)'		*zwatn* 'to know s.t., s.o.'
klési 'crazy'	*sqáža?* 'dog'		*wnáxʷƛ'u?* 'true'
c'wan 'wind-dried fish'	*tqiw* 'horse'		*mɬụ xʷxn* 'to sprain one's hand'
žʷ?ạz 'no, not'	*c'qáža?* 'horse'		*mɬú́ xʷaka?* 'to sprain one's ankle'
kʷ/i? 'green, yelow'	*ƛ'pa?* 'marrow'		*ʕʷlin* 'stomach, belly'
žzom 'big'	*sq'it* 'day'		
qʷjic 'rabbit'			

b. word-internal

KR	KK	RK	RR
k'ʷík'ʷna? 'a little bit, a few'	*lp'aɬkʷúna?* 'cured salmon eggs'	*mím'sa?* 'flat, thin'	*qʷʕʷpálwa s* 'pants falling down'
skíxza? 'mother'	*wnáxʷƛ'u?* 'true'	*kí?ki?* 'blue jay'	*hú?maɬ* 'bye'
ciclúsa? 'fresh fruit'	*k'ížxal* 'to fry'	*žʷúmqa?* 'salmon head'	*kahál'ha* 'just born'

[3]English glosses of St'át'imcets words are from van Eijk (1985). For forms not in that dictionary, the glosses are as provided by my consultants.

Table 1. Carrier words for CC tokens (cont.)

b. word-internal (cont.)

KR	KK	RK	RR
tạ́knam 'to knit'	*ʔíqʷxal* 'to scale a fish'	*pálxal* 'to spread berries out to dry'	*ʔúxʷalmixʷ* 'person, human being, Indian'
zhaɬníw't 'right side of body'	*cúɬxit* 'to point s.t. out to s.o.'	*k'iʔxáls* 'to pick s.o. up to pass him to s.o. else'	*ƛ'ạlanín'was* 'to get bit on the side'
	ʔáx̌ʷxal 'to dig'	*pílcam'* 'to widen s.t.'	
	ƛákkan 'I'm going on my way'	*ƛ'ạ́lqinus* 'to get bit on the head'	
	xʷíc'xit 'to give s.t. to s.o.'	*kanɬíʕɬkana*[4] 'I swallowed s.t. the wrong way'	
	tạ́kta 'doctor'		

c. word-final

KR	KK	RK	RR
caqm 'Saskatoon berry'	*n'án'atxʷ* 'morning'	*ɬʕʷilx* 'to jump'	*maʔʕ'* '(breaking) daylight'
suqn 'to skin a (big) animal'	*cqʷciqʷc* 'red mouth'	*zapíw's* 'Sunday'	*xʷnaʔm* 'Indian doctor, shaman'
xʷitn 'to whistle'	*kʷikʷs* 'small'	*k'ímal'c* 'ice'	*nahn* 'to name s.o., tr.'
xʷíxʷitn 'to keep whistling'	*ƛ'aqc* 'sound carries'	*zhaɬníw't* 'right side of body'	*k'iʔn* 'to pick s.o. up and put him in one's lap'
ƛ'aɬm 'salt'	*matq* 'to walk, go on foot'	*naʔq* to rot, get rotten'	*kạ́ln* 'candle'
p'aq'm 'to bloom'	*ptakʷɬ* 'legend'	*c'man'k* 'guts'	
ptixʷn 'to spit'	*xʷakʷkʷ* 'heart, feelings, mind'	*x̌mank* 'heavy'	
	zaxt 'long'	*kʷtamc* 'husband'	
	piyháɬxʷ 'beer parlour'	*q'ʷq'ʷuʔɬ* 'bone'	

[4]For this form, the *nɬ* cluster was analysed.

The acoustic data were provided by AA, a 63-year-old female speaker of LS, and two male speakers of LLS, LC, aged 55, and HD, aged 52. Two tokens of each word were recorded from each speaker in a sound booth using a Marantz P40 tape-recorder and professional quality microphone. The forms were loaded onto computer at 22.05 kHz sampling rate and analysed using *Multi-Speech 3700*®. The waveform and wideband spectrogram of each word were examined to determine the presence or absence of schwa in the position of interest in each word. Presence was indicated by amplitude and periodicity in the waveform and spectrogram, and schwa formants in the spectrogram. For example, Figure 1 shows presence of schwa between the two Cs of the complex coda of *x̌mank* 'heavy' for speaker HD. Figure 2 shows absence of schwa between the same Cs in a second token of the same word for the same speaker. (The *n* was produced as *n'* in the second token.) Schwa presence was confirmed by audio play of the waveform segment. A total of 522 tokens of CC clusters were analysed, from 2 tokens of 87 carrier words for each of the three speakers.

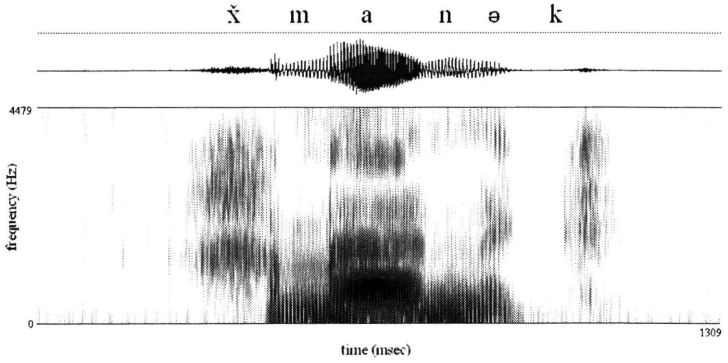

Figure 1. Waveform and wideband spectrogram of *x̌mank* [x̌mánək] 'heavy' (speaker: HD)

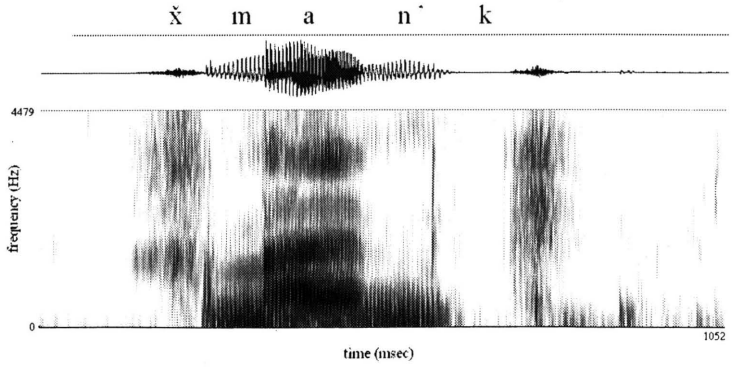

Figure 2. Waveform and wideband spectrogram of *x̌mank* [x̌man'k] 'heavy' (speaker: HD)

The duration of each schwa was measured from the waveform and wideband spectrogram, based on visual placement of the cursor at schwa beginning and end points. The duration of each schwa was identified as the average of those two measurements.

3 Findings

A total of 174 schwas were produced. Table 2 shows the percentage of schwa insertion for each category of CC cluster, per speaker. (See the Appendix for the raw scores.) The findings for all three speakers as a group, based on the data in Table 2, are summarised in Table 3. Note first that the word-internal CCs are not prosodic clusters, since they are syllabified as [C.C]. Schwas inserted in word-internal CCs are not required for syllabification of the CC; they are excrescent schwas, i.e., transitional vocoids (Willett & Czaykowska-Higgins 1995, Shaw 1996). Tables 2 and 3 show that excrescent schwa was not frequent in the data analysed for this study. It was produced primarily in word-internal KR clusters and variably so across the three speakers.

The mean duration of the schwas inserted in the word-internal clusters is 48 msec (standard deviation: 15). For all other schwas it is 71 msec (standard deviation: 23). Based on the findings of Shahin & Blake (2004), who found excrescent schwa to be shorter than epenthetic schwa in St'át'imcets, the shorter duration of the schwas inserted in word-internal clusters supports our analysis of them as excrescent.

Table 2. Percentage of schwa insertion per speaker

	word-initial				word-internal				word-final			
speaker	KR	KK	RK	RR	KR	KK	RK	RR	KR	KK	RK	RR
AA	50	11	33	81	10	11	0	0	71	11	0	100
LC	60	11	33	81	60	0	0	0	100	11	0	100
HD	60	11	66	88	20	0	0	0	86	11	17	100

Table 3. Schwa insertion for all three speakers as a group

a. word-initial

KR	KK	RK	RR
~ half the time	very infrequent	variable	very frequent

b.word-internal

KR	KK	RK	RR
variable	very infrequent	never	never

c. word-final

KR	KK	RK	RR
very frequent	very infrequent	very infrequent	always

To focus on language- or dialect-specific occurrence of schwa, our attention is on the word-initial and word-final CCs, for which inserted schwas are phonologically epenthetic. Table 3 shows very frequent overall production of schwa in word-initial and word-final consonant-resonant clusters (KR and RR) for all three speakers. This avoidance of CR has been noted especially for word-final position by van Eijk (1997). In the present data 85.9% (140/163) of schwa epenthesis occurred in CRs.

Table 4 shows the raw score and percentage of overall schwa epenthesis for each speaker (number of schwas produced in word-initial and word-final CCs/total number of word-initial and word-final CCs). We see that the LLS speakers produced more epenthetic schwas than the LS speaker.

Table 4. Raw score and percentage of overall schwa epenthesis per speaker

speaker	raw score	%
AA	49/120	40.8
LC	55/120	45.8
HD	59/120	49.2

Table 5 summarises the frequency of schwa epenthesis in the two St'át'imcets varieties based on Table 2. It shows that in word-initial RK, the LS speaker produced schwa infrequently, whereas the LLS speakers as a group produced it with variable frequency. However, Table 2 shows that LLS LC speaker produced it infrequently in this position and LLS speaker HD produced it frequently. In word-final RK, the LS speaker never produced schwa, but the LLS speakers as a group produced it very infrequently. From Table 2 we see that LC never produced it in this position and HD produced it very infrequently. Thus, the data do not show differences in schwa epenthesis per CC type across the two St'át'imcets varieties.

Table 5. Schwa epenthesis per St'át'imcets variety

a. word-initial

variety	KR	KK	RK	RR
LS	~ half the time	very infrequent	infrequent	very frequent
LLS	~ half the time	very infrequent	variable	very frequent

b. word-final

variety	KR	KK	RK	RR
LS	very frequent	very infrequent	never	always
LLS	very frequent	very infrequent	very infrequent	always

4 Conclusion

This study found variable but overall very infrequent production of excrescent schwa across data from two St'át'imcets varieties. It also found very frequent production of epenthetic schwa in consonant-resonant clusters. More overall production of epenthetic schwa was found in the Lower Lower St'át'imcets data than the Lower St'át'imcets data. Further work should test if this holds true across data from more speakers. Further work could examine Upper St'át'imcets data, as previous study suggests that schwa epenthesis differs between Upper St'át'imcets and the Lower or Lower Lower varieties (Shahin 2002:206). It could also investigate sensitivity to place of articulation documented for CR clusters by van Eijk (1997:256). Finally, more detailed study could examine CCC clusters, and whether St'át'imcets schwa is sensitive to fine distinctions in manner of articulation or to morphological domain, as found by Shaw (2002) for hən'q'əmin'əm' (Musqueam) Salish.

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Appendix

Raw scores of schwa insertion per speaker

a. word-initial

speaker	KR/20 tokens	KK/18 tokens	RK/6 tokens	RR/16 tokens
AA	10	2	2	13
LC	12	2	2	13
HD	12	2	4	14

b. word-internal

speaker	KR/10 tokens	KK/18 tokens	RK/16 tokens	RR/10 tokens
AA	1	2	0	0
LC	6	0	0	0
HD	2	0	0	0

c. word-final

speaker	KR/14 tokens	KK/18 tokens	RK/18 tokens	RR/10 tokens
AA	10	2	0	10
LC	14	2	0	10
HD	12	2	3	10

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