TO REDUCE OR NOT TO REDUCE : EVIDENCE FROM SENĆOTEN STORYTELLING

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1. INTRODUCTION

It is a well-known fact that articulatory, and consequently acoustic, events are compressed in fluent speech; a process known as 'reduction' (Johnson 2004). Research has shown that when it comes to reduction, not all segments are equally affected; for example when reduction occurs at fast speech rates, effects are often greater on vowels than on consonants (Gay 1981). This paper reports on a preliminary investigation of reduction in the speech of a single fluent SENĆOŦEN speaker. The focus is on /vowel-ʔ-ə/ vs. other /vowel-ʔ-vowel/ sequences; we show that while the former reduce to a single lengthened vowel, the latter do not. As a whole, results support previous claims that /ə/ in Salish is phonologically and phonetically distinct from full vowels (Czaykowska-Higgins & Kinkade 1998), and that reduction is sensitive to the particular vowels involved, affecting some but not others.

2. METHOD

The dataset for the study consisted of 130 words extracted from a SENĆOŦEN story told by a fluent speaker, recorded in the 1970s. These words fell into three sets, corresponding to three different kinds of sequences: Set 1 consisted of 58 /vʔə/ sequences; of these, 52 were /eʔə/, hence the focus on these sequences in the acoustic analysis (see below). Set 2 consisted of 12 other /vʔv/ sequences; as is clear from the token count, these occurred relatively rarely in the story. Set 3 consisted of 60 tokens of /e/; these provided a baseline against which to compare the acoustic properties of /eʔə/. Table 1 provides a summary of the dataset.

Table 1. Tokens analyzed (target sequence in bold)

Set	Sequence	#	Example	Gloss
Set 1	/eʔə/	52	/l**eʔə**/	'there'
	/iʔə/	3	/netʃt**iʔəs**/	'different
	/ɑʔə/	3	/q^{w}**ɑʔə**ŋ/	'water'
Set 2	/eʔi/	8	/tʃ**eʔi**/	'work'
	/eʔu/	2	/j**eʔu**/	'went'
	/iʔe/	2	/t**iʔe**/	'this'
Set 3	/e/	60	/məqsten/	'everything'

The dataset included a number of words which were repeated multiple times (e.g. seven of the eight /eʔi/ sequences are from different repetitions of the word /tʃeʔi/ 'work'). Multiple repetitions of a single word were treated as separate items in the qualitative analysis (3.1) because there was no easy way of averaging across them; in the quantitative analysis (3.2), they were aggregated and treated as a single item, as long as they were consistent in terms of stress and position (see 3.2 below for details).

3. RESULTS

3.1 Qualitative analysis

All /vʔv/ sequences (58 /vʔə/ and 12 other /vʔv/) were first transcribed based on auditory analysis, to determine (impressionistically) to what extent they were reduced. Table 2 summarizes the results.

Table 2. Transcriptions by sequence type

Set	Sequence	Transcription (#)	**Most common**
Set 1 /vʔə/ (58)	/eʔə/ (52)	[eː] (47); [e] (1); [eʔə] (2)	**[vː]**
	/iʔə/ (3)	[ije] (2); [eː] (1)	
	/ɑʔə/ (3)	[ɑː] (2); [aʔə] (1)	
Set 2 /vʔv/ (12)	/eʔi/ (8)	[eʔeɪ̈] (7); [eɪ̈] (1)	**[vʔv]** or **[vjv]**
	/eʔu/ (2)	[eju]	
	/iʔe/ (2)	[iː] (1); [ije] (1)	

In general, transcriptions reflect the fact that /vʔə/ tends to reduce to [vː] while other /vʔv/ sequences tend either not to reduce, or to reduce to [vjv]; the latter case is interesting and may have to do with the phonological status of /ʔ/ in these words (underlying vs. derived from glottalized /j'/), but will not be further discussed here. Focusing on /vʔə/ vs. other /vʔv/ sequences, it is interesting to note that while the seven repetitions of /tʃeʔi/ ('work') *do* seem to reduce to varying degrees, none of them reduce to the extent that they lose the glottal stop entirely, as do the vast majority of /vʔə/ sequences.

3.2 Quantitative analysis

Based on the finding that /vʔə/ tends to reduce to [vː], a subset of these sequences - /eʔə/ ones - were analyzed in Praat in terms of: a) duration, b) vowel quality (F1 and F2 at 25% and 75% into the vowel), and c) glottalization (jitter, spectral tilt, amplitude dip, and pitch dip during the target

interval). Acoustic analysis was limited to /eʔə/ sequences for two reasons: 1) they were by far the most common /vʔə/ sequence and so provided a unified set for analysis, and 2) the resulting [e:] could easily be compared to the underlying SENĆOTEN /e/ vowel, which also occurred relatively frequently in the story. As mentioned above, the set of words used in this study included a number of repetitions. As it turned out, the 60 /e/ tokens came from a much more varied set of words than did the 52 /eʔə/ tokens, which were extracted from a relatively small set of frequently repeated function words. Repetitions were aggregated only if stress (stressed vs. unstressed) and position (final vs. non-final) were consistent, leading to the analysis of 50 /e/ items and 22 /eʔə/ items. A series of two-factor between-items ANOVAs was used to investigate acoustic differences between underlying /eʔə/ and /e/; the two factors were sequence (/e/ vs. /eʔə/) and position (final vs. non-final). Position was included because the correlates of phonemic glottalization are sometimes confounded with those of prosodic (utterance-final) position.

The primary difference between /eʔə/ and /e/ was in term of duration: the main effect of sequence was significant $F(1, 71) = 50.38$; $p < 0.001$), with /eʔə/ almost twice as long (238ms) as /e/ (130ms). The effect of position was not significant, and neither was the interaction. This durational difference confirmed the auditory analysis (see 3.1), in which /eʔə/ was transcribed as [e:] and /e/ as [e].

Although less salient auditorily, /eʔə/ and /e/ also differed in vowel quality, particularly in terms of F2: /eʔə/ had a significantly lower F2 than did /e/ at both 25% ($F(1,71 = 10.10$, $p < 0.01$) and 75% ($F(1,71 = 16.73$, $p < 0.001$) into the vowel - see Figure 2. F1 was significantly higher in /eʔə/ than in /e/ only at 25% into the vowel ($F(1,71 = 4.09$, $p < 0.05$). Together, F1 and F2 values indicate that /eʔə/ is more retracted and slightly lower than /e/. Interestingly, both /eʔə/ and /e/ are realized in the range of [ɛ] (Kent & Read 2002), a lower and laxer version of the mid-front vowel previously documented in SENĆOTEN (Montler 1986).

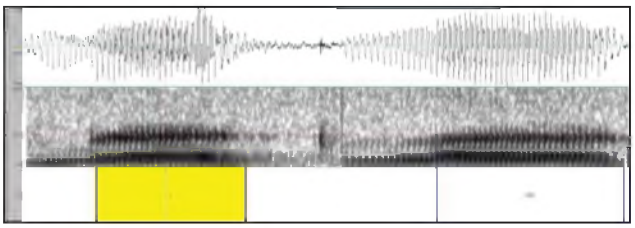

Figure 2. /e/ in /net/ 'name' vs. /eʔə/ in /leʔə/ 'there' (/e/ is shaded).

There was little consistent evidence of any underlying glottalization in /eʔə/ sequences. Of the acoustic measurements taken, only pitch and amplitude dips showed effects. These were calculated by subtracting the minimum pitch/amplitude from the maximum within the target interval (/e/ or /eʔə/). For both pitch and amplitude, there was an interaction between sequence and position, with dips significantly greater in /eʔə/ than in /e/ in utterance final position only (pitch: $F(1,20) = 14.43$, $p<0.01$; amplitude: $F(1,20) = 11.65$, $p<0.01$). Table 3 summarizes these results.

Table 3. Pitch and amplitude dips

Sequence	Pitch dip (Hz)	Amplitude dip (dB)
/e/	29 (14)	8 (3)
/eʔə/	33 (20)	9 (2)

4. DISCUSSION

Overall, results showed two things: 1) /vʔə/ sequences tended to reduce to [v:] while other /vʔv/ sequences did not; 2) reduced /eʔə/ sequences were distinguishable from underlying /e/ in duration and to a lesser extent in vowel quality, but not (consistently) in degree of glottalization. The pronunciation of /vʔə/ as [v:] can be viewed as a more extreme version of "schwa assimilation across glottal stop", which has previously been reported in SENĆOŦEN (Montler 1986, p. 29). The fact that /eʔə/ sequences exhibited greater reduction effects than other /vʔv/ sequences, and also that they showed greater dips in pitch and amplitude utterance-finally than did /e/ is possibly related to the fact that /eʔə/ sequences were extracted primarily from function words, whereas other /vʔv/ sequences and /e/ were extracted from a more varied set of words. It may be the case that function words are more prone to a range of prosodic effects than are content words, a tendency that could prove useful as a diagnostic for teasing apart different word classes in Salish languages (Czaykowska-Higgins & Kinkade 1998).

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