Phrase boundary effects in /t/ duration and aspiration in Nłe?kepmxcin (Thompson River Salish)*

Karsten A. Koch
University of Alberta

Abstract: Consonant inventories and substantial obstruent clusters in Salishan languages like Nłe?kepmxcin can obscure potential F0 cues to prosodic phrase boundaries, such as boundary tones, or declination reset. By using phonetic analysis, I test the hypothesis that consonant duration and aspiration behaviour differs phrase internally as opposed to in phrase final positions. I show that the final voiceless alveolar stop /t/ of the 1pl marker /kt/ is longer when phrase final than phrase internal. Additionally, /t/ is longer at an i-phrase boundary than at a p-phrase boundary. In terms of aspiration, phrase final /t/ tokens have aspiration that is greater in duration and with an earlier intensity peak, though this appears to be a property only of i-phrase and not p-phrase boundaries.

Keywords: prosody, phrasing, aspiration, Nłe?kepmxcin, Salishan

1 Introduction

The Salish languages of the Pacific Northwest of North America are well known for their rich consonantal inventories, widespread glottalization, and lengthy obstruent clusters (e.g. Bagemihl 1991; Kinkade 1992; Shaw 2002). Because obstruents are well known to affect the pitch of adjacent resonants (e.g. Brown and Thompson 2006 on Upriver Halkomelem Salish), it can be difficult to measure potential F0 cues to prosodic phrasing, such as boundary tones and declination reset, in Salish languages. In this paper, I explore an alternative phonetic cue to prosodic phrasing in Nłe?kepmxcin (Thompson River Salish), one that in fact takes advantage of the widespread distribution of obstruents. Koch (2010) proposed that the final /t/ of the 1st person plural marker /kt/ is aspirated in phrase-final position, but not phrase-internally. In this paper, I test this prediction by comparing /kt/ /in phrase-final versus phrase internal positions, on a range of phonetic measures, including consonant and aspiration duration, and aspiration intensity. The tests were done on intransitive clauses (since these use the subject agreement marker /kt/).

Results indicate that there is no difference on the morpheme internal /k/ of the 1pl /kt/ across different positions, but the final /t/ of the /kt/ 1pl is reliably longer in duration when phrase final (in both phonological phrases, or p-phrases,

* I am indebted to consultants Flora Ehrhardt and Patricia McKay, without whom this research would not be possible. This research has been supported by Jacobs and Kinkade Research Grants from the Whatcom Museum Foundation, Bellingham, WA; and by NSERC, SSHRC, and DAAD research fellowships.
Contact info: karstenak@hotmail.com

In Papers for the International Conference on Salish and Neighbouring Languages 50,
University of British Columbia Working Papers in Linguistics 40,
Natalie Weber, Erin Guntly, Zoe Lam, and Sihwei Chen (eds.), 2015.

and intonational phrase, or i-phrases). In addition, i-phrase final /t/ has aspiration that is greater in duration and intensity than both p-phrase final and phrase internal /t/.

Results are discussed in terms of how phonological phrasing aligns with properties of syntax, and properties of information structure. While verbs and auxiliaries are phrased together, intransitive verbs and oblique arguments or adjunct phrases appear to be phrased in separate p-phrases. As for the transitive clauses with VSO order that were investigated, these appear to have verb, subject and object phrased in independent p-phrases.

2 Background

I begin with some background on Nłeʔkepmxcin, then move on to some general background on phrasing and consonant cues to phrase boundaries, reviewing some related prior research in Nłeʔkepmxcin, other Salishan languages, and cross-linguistically.

2.1 General properties of Nłeʔkepmxcin

Nłeʔkepmxcin (Kroeber 1997; Thompson and Thompson 1992, 1996) is one of 23 Salish languages (Czaykowska-Higgins and Kinkade 1998; Kinkade 1992; Kroeber 1999; for some general overviews of Salishan). It is spoken in the southwest of British Columbia, and is severely endangered, with no more than a few hundred elderly speakers remaining. The phonemic inventory is given in Table 1.

Table 1 Phonemic inventory (adapted from Thompson and Thompson 1992)

CONSONANTS	labial	alveolar	alveo-palatal	velar	uvular	pharyn-geal	glottal
Stops	p	t		k k^w	q q^w		ʔ
Ejectives	ṗ	t’		ḳ $ḳ^w$	q̓ $q̓^w$		
Lateral Eject.		ƛ̓					
Nasal	m	n					
Glottalized	ṁ	ṅ					
Affricates		c̣ [ts]	c [tʃ]				
Ejective		c̓ [ts’]					
Fricatives		ṣ [s]	s [ʃ]	x x^w	x̣ $x̣^w$		h
Lateral		ɬ					
Approximant	(w)	z	y [j]	w		ʕ $ʕ^w$	
Lateral		l					
Glottalized	(ẇ)	ż	ẏ	ẇ		ʕ’ $ʕ’^w$	
Glott. Lateral		l’					

VOWELS	front	central	back
high	i	ɨ	u
mid	e	ə ə̓	o
low		a	

Like all Salish languages, Thompson Salish is predicate-initial. The typical order is Verb-Subject-Object-Adjunct, though post-predicative verb order is in practice quite flexible. Predicates are obligatorily inflected for transitivity and subject/object agreement markers (see Thompson and Thompson 1992). Second position clitics (2CL) follow the first prosodic word. DPs are obligatorily marked with determiners. A transitive sentence is shown in (1).[1]

(1) Verb 2CL Subject Object
kən-t-Ø-és =xe? e=skíxze?-kt e=sínci?-kt.
help-TR-3O-3S =DEM DET=mother-1PL.POSS DET=brother-1PL.POSS
'Our mother helped our brother.'

Example (1) also shows two cases of the 1pl marker /kt/, in this case as a possessive suffix; /kt/ will be the object of phonetic analysis in section 3. The 1pl marker /kt/ can appear in one of two guises: either as an affix, or as a clitic. Following Davis (2000) on the *Clitic Mobility Criterion*, the affix always attaches to the same syntactic word form, regardless of general word order. The clitic, on the other hand, is "mobile" relative to its host, and will attach as a second position clitic, whatever the syntactic status of the first prosodic word in its phrase.

The affix/clitic distinction in Nłe?kepmxcin correlates with different semantic/syntactic uses of the 1pl marker. To mark nominal possession, as in 'our brother' and 'our mother' in (1), /kt/ always attaches to the possessed noun, and is thus an affix, and not a second position clitic. For example, in (2), the nominal is preceded by an adjective, yet the possessive marker (here the 3rd person possessor *-s*) still affixes to the nominal 'dog'. and not the preceding adjective. Thus, adding more structure to the nominal phrase, like a preceding adjective, has no effect on where the possessive affix surfaces: its position is fixed to the noun.

[1] Abbreviations in the glosses are based on Thompson and Thompson 1992, 1996, Kroeber 1997: '-' = affix, '=' = clitic, CLEFT = cleft predicate, COMP = complementizer, CnCl = conjunctive subject clitic, DEM = demonstrative, DET = determiner, DRV = directive transitivizer, EMPH = emphatic (independent pronoun), EVID = evidential, FUT = future, IMPF = imperfective, INCL = indicative subject clitic, INTRANS = intransitive, LINK = link marker (predicate modification), LOC = locative, NOM = nominalizer, O, OBJ = object, OBL = oblique, PERS = 'persistent' marker, PL = plural, POSS = possessive (affix), POCL = possessive subject clitic, S, SUBJ = subject, SG = singular, SUBJ.GAP = subject gap suffix, TRANS, TR = transitivizer, TS = transitive subject.

(2) e=stíptept te=sqáqχaʔ-s
DET=black LINK=dog-3POSS
'his black dog'

The second use of /kt/ is as an intransitive subject agreement marker in indicative or nominalized clauses. Intransitive predicates may be followed by oblique arguments (3), and in cases of a 1pl subject, are inflected with the 1pl subject clitic (on subject marking, see Davis 1999, 2000; Hoard 1971; Koch 2009; Kroeber 1999; Newman 1979, 1980). In this case, /kt/ is a second position clitic, and attaches to whatever is the first prosodic word in its attachment domain, rather than to a fixed host. In example (3), the 1pl indicative subject clitic *=kt* follows the verb, while in (4) it follows the initial auxiliary. Thus, this /kt/ is "mobile" and is not fixed to the verb. In (5), we see the /kt/ possessive clitic attaching to the imperfective auxiliary, the first prosodic word in a nominalized clause, and not to the verb *q^{w}ac* '(get) warm'.

(3) Verb 2CL Oblique
wʔxə́m =kt te=swíte.
have =1PL.INCL OBL=sweater
'We have sweaters.'

(4) Aux 2CL Aux Verb
x^{w}úy̓ =kt nés téw-cn-me.
FUT =1PL.INCL go buy-mouth-INTRANS
'We're going to go grocery shopping.'

(5) Aux 2CL Verb
…ʔé k=s=wʔéx =kt q^{w}ác
…and COMP=NOM=IMPF =1PL.POCL warm
'…so we could stay warm.' [787d''']

2.2 Prosodic phrasing background

There has been little previous research on properties of prosodic phrasing in the language: the grammar mentions a few general pitch cues (Thompson and Thompson 1992:24), while Egesdal (1984) details some general rhythmic properties of narratives, again only impressionistically. Koch (2008, 2011) showed that intonational phrases were right-headed, as indicated by the prosodic prominence of vowels, and phrase-final vowels showed a significant final lengthening effect. In the present study, it is hypothesized that consonants at phrase final edges will also undergo a lengthening effect, similar to vowels. In this paper, I will be referring to phonological phrases (p-phrase) and intonational phrases (i-phrases) in the prosodic hierarchy of Nespor and Vogel (1986, also Hayes 1989). The labels p-phrase and i-phrase are not universally used (e.g. minor phrase and major phrase are other similar terms – Selkirk and Kratzer 2007); for the purposes of the present study, what is important is that I will

provide evidence for two phrasal categories above and beyond words and clitic groups in Nłe?kepmxcin.

Looking across the Salish language family more generally, there again has been much work on prosodic categories below the level of phrases (e.g. Czaykowska-Higgins 1993, 1998; Shaw 2002; Thompson and Thompson 1992, etc.), but comparatively little at the phrasal level. A notable exception, Beck (1996, 1999) identifies the following indicators of p-phrase status in Lushootseed Salish (see also Beck and Bennett 2007):

(6) Characteristics of phonological phrases in Lushootseed Salish (Beck 1999)
   a. set off by 50-100 ms pause in careful speech
   b. lack phonological interaction (i.e. assimilation, etc.) across p-phrase boundaries
   c. contain a single phonological word with an amplitude peak plus clitics and affixes

In the present study, I primarily focus on how (6c) plays out in Nłe?kepmxcin, and test whether p-phrases in Nłe?kepmxcin can extend beyond single words. In this regard, I show that the verbal complex (auxiliaries plus main verb) are parsed as a single p-phrase, even though auxiliaries are prosodic words since they attract second position clitics. Thus, auxiliary-verb sequences contain two prosodic words, but only one phrase. I also make some remarks about complex noun phrases, suggesting they may also be parsed as single phonological phrases.

In addition, Beck (1999) notes that intonational phrases in Lushootseed are characterized by a steady fall in F0, with a declination reset at the start of each i-phrase. In Okanagan Salish, prosodic boundaries are also marked by pauses, F0 fall, and reset or partial reset of declination across phrasal boundaries (Barthmaier 2004). Finally, recent work by Caldecott (2009) shows that prosodic phrases are right-headed in St'át'imcets Salish; Koch (2008) finds that Thompson Salish, too, has rightmost nuclear stress and right-headed phonological-phrases. The present study does not directly address declination effects in F0, since it looks at consonants.

2.3 Consonant production background

In terms of prior related research on consonants in Nłe?kepmxcin, Thompson and Thompson (1992:4) note that stops are "somewhat aspirated before a spirant" and regularly aspirated "before another stop," while in "syllable final position, [stops] are strongly aspirated." These observations led Koch (2010) to examine stop aspiration as a possible cue for phrasal boundaries. Specifically, Koch (2010) looked at some cases of the voiceless alveolar stop /t/ in the 1pl marker /kt/, proposing that it was aspirated in phrase final but not phrase internal positions; however, the study used a small set of data, was limited to aspiration (presence or absence), and did not do a phonetic analysis across a larger data set.

Cross-linguistically, consonants have been shown to have phonetic properties that are plausibly the phonological realization of phrase edge boundaries. Butcher and Harrington (2003a, 2003b) showed that /p/ in onset position in Warlpiri focus phrases had increased duration. In Blackfoot, a laryngeal feature marks phrase final positions, including the devoicing of vowels, and aspiration of phrase final consonants (Frantz 2009, Windsor and Cobler 2013). Niebuhr (2008) showed that, in German, utterance final /t/ aspiration differed in duration and intensity depending on the accompanying tonal contour: in other words, while tonal contours are a type of phrasal property usually thought of as realized on vowels, the consonant aspiration also played a role in indicating phrasal type in German. Results of these studies motivate the hypothesis that aspiration duration and intensity may mark final phrase boundaries in Nłeʔkepmxcin.

Considering Salishan consonant articulation more broadly, the present study will be of interest to other work that has examined various aspect of consonant production across other Salishan languages. Esling and colleagues laryngoscopically examined properties of glottal stops, glottalized resonants and pharyngeals, including in Nłeʔkepmxcin (Carlson et al. 2004; Esling et al. 2002); the present study provides acoustic phonetic information on laryngeal properties (aspiration) of the voiceless stops /k/ and /t/. Bessell (1997, 1998) examined co-articulation effects of vowels on consonants in St'át'imcets, a related Interior Salish language. J.H. Davis (2005) showed that pre-vocalic glides in Comox often attract primary stress, usually thought of as a property of vowels, which are usually described as prosodic heads of syllables and phrases; in terms of the present study, this motivates looking at consonants for other phonetic markers of phrase position and phrase type (here, duration and aspiration). Looking at guttural glides in St'át'imcets, Shahin (2003) also showed a phonological conditioning on consonant production, in that pharyngeal occurrences happen with labialization, while uvular forms were found elsewhere; the present paper proposes that voiceless stop production in Nłeʔkepmxcin is also phonologically conditioned, by phrasal boundaries.

Because the present study involves /kt/, a two-consonant form that additionally followed other root consonants, all forms occur in consonant clusters, and will be of interest to studies that have examined consonant cluster properties in other Salish languages (e.g. Hoard 1978, Bagemihl 1991 on Nuxalk; Bianco 1996 for Cowichan; Shaw 2002 for hən'q'əmin'əm'; Marinakis 2004 for Upriver Halq'eméylem). Finally, while phrasal distinctions have not received much attention, Van Eijk (2001) examined word, clitic and sentence distinctions in St'át'imcets (Lillooet Salish); here I look for phonetic evidence for phrasal groupings.

2.4 Predictions based on Koch (2010)

In Koch (2010), the following were proposed to constitute phrasal boundaries. Auxiliaries and verbs form a single phrase, while arguments and adjuncts are

phrased separately from the verbal complex. Thus, /kt/ in (7)–(10) are proposed to be phrase internal. In (7) to (9), we have clitic instances of /kt/ (as per the Clitic Mobility Criterion discussed in 2.1). In (10), we find an instance of the possessor affix /kt/.

(7) ( )$_{\text{i-phrase}}$ [VP internal clitic /kt/]
( )$_{\text{p-phrase}}$
x$^{\text{w}}$úy̓=**kt** nés téw-cn-me.
FUT=1PL.INCL go buy-mouth-INTRANS
'We're going to go grocery shopping.'

(8) ( )$_{\text{i-phrase}}$ [Sentence final clitic /kt/
( )$_{\text{p-phrase}}$ with additional clitic after it]
nan'ék'=**kt**=nuk$^{\text{w}}$.
get.nutrition=1PL.INCL=EVID
'We got nutrition.' [F_P599a-1]

(9) ( )$_{\text{i-ph}}$ [DP internal clitic /kt/, in
( )$_{\text{p-phr}}$ prenominal relative clause]
… n=e=s=cúw=**kt** nmímł.
… in=DET=NOM=work=1PL.POCL 1PL.EMPH
'… for our work.' [F_P644a]

(10) ( )$_{\text{i-phrase}}$ [DP internal affix /kt/]
( )$_{\text{p-phrase}}$
… e=spzúʔ-**kt** nmímł.
… DET=animal-1PL.POSS 1PL.EMPH
'… our animal.' [F_P769a-2]

On the other hand, /kt/ in (11)–(15) are proposed to be phrase final, and thus show greater duration and aspiration.

(11) ( )$_{\text{i-phrase}}$ [Sentence final clitic /kt/]
( )$_{\text{p-phrase}}$
… t=e=s=máq'=**kt**.
… OBL=DET=NOM=full=1PL.POCL
'… because we're full.' [F_P704v-3]

(12) ( )$_{\text{i-phrase}}$ [Sentence and DP final
( )$_{\text{p-phrase}}$ affix /kt/]
… ʔeł łe=ʔímec-**kt**.
… and DET=grandchild-1PL.POSS
'… and our grandchildren.' [F_P375e-1]

(13) [DP final affix /kt/]

( )i-phrase
( )p-phrase ( )p-phrase
cúkʷ=ƛ̓uʔ nmímɬ e=púṣ-**kt** e=ʔém'c-n-xʷ.
finish=PERS 1PL.EMPH DET=cat-1PL.POSS COMP=feed-DRV-3O.2SG.TS
'Our cat was the only one you fed.' [F_P769b]

(14) [VP final clitic /kt/ followed by adjunct]

( )i-phrase
( )p-ph ( )p-phrase ( )p-phrase
yé' e=s=n-ʕʷóy'**t**=**kt** ɬ=sítist.
good COMP=NOM=LOC-sleep=1PL.POCL DET=night
'We slept good last night.' [F_P181f-1]

(15) [VP final clitic /kt/ followed by oblique]

( )i-phrase
( )p-ph ( )p-phrase
wʔxə́m=**kt** te=swíte.
have=1PL.INCL OBL=sweater
'We have sweaters.' [F_P046]

Note that the present study also allows us to test whether i-phrase final /kt/ has different phonetic properties than p-phrase final /kt/ that is not also i-phrase final at the end of a breath group). This would provide evidence for an intonational phrase (i-phrase), above the p-phrase level, thus resulting in the two levels of phrasing indicated in the above examples. For example, in (14), there are three p-phrases but only one i-phrase; *=kt* is in final position of the second p-phrase, but is not i-phrase final. In addition, the study looks at both the clitic /kt/ (*=kt*) and the affix /kt/ (*-kt*), allowing us to see whether this distinction has any effect on production of /k/ and /t/ in the two cases.

3 Methodology

The 1pl marker /kt/ was chosen for analysis because, in addition to consisting of two voiceless stops, it was expected to occur relatively often. Moreover, as an enclitic or suffix, /kt/ would occupy right edge positions as well as internal positions. Instances of /kt/ were collected from the author's corpus of recordings made over the course of three years of fieldwork. The data are from fieldwork with two speakers of the ƛ̓ə̓ḍemcín (Lytton) dialect of Nłeʔkepmxcin. Speakers were recorded on separate channels using a digital audio recorder and individual microphones. The forms examined in this paper all stem from a single breath group (where the breath group corresponds to the intonational phrase in the prosodic hierarchy). Examples come from both elicited examples, as well as spontaneous discourse generated via a range of methodologies (see Caldecott and Koch 2014).

Using Praat (Boersma and Weenink 2013), individual utterances were extracted from master recordings and saved as individual wav files. Using textgrids, consonant and aspiration lengths were marked for /k/ and /t/ in each example. In total, 580 tokens were analyzed. This included 290 tokens of complete consonant durations (phrase final /k/ = 72, phrase internal /k/ = 73, phrase final /t/ = 72, phrase internal /t/ = 73) and 290 tokens of aspiration (phrase final /k/ aspiration = 72, phrase internal /k/ aspiration = 73, phrase final /t/ aspiration = 72, phrase internal /t/ aspiration = 73). However, 5 tokens of phrase internal /t/ yielded no aspiration values because there was no noticeable consonant release and aspiration frication present.

Automated scripts were used to measure overall consonant duration (ms), and the following aspects of consonant aspiration: duration (ms), maximum intensity (dB), and the time point during the aspiration at which the maximum intensity occurred (both as an absolute value in ms, and as a percentage of the overall duration of aspiration). Where there was no aspiration at all, this was noted; if there was no complete /t/ closure (but continuous aspiration from the preceding /k/), this was also noted.

(16) Acoustic phonetic measurements made
  a. entire /k/ and /t/ consonants:
    • duration (ms)
  b. /k/ aspiration and /t/ aspiration:
    • duration (ms)
    • maximum intensity (dB)
    • time of maximum intensity (ms)
    • time of maximum intensity as percentage of overall aspiration duration (%)
    • absence of aspiration
    • absence of complete /t/ closure

In addition to descriptive statistics, independent samples t-tests were used to conduct the inferential statistical tests. Where necessary, the t-tests were conducted for unequal variances after inspection of F values in Levene's Test for Equality of Variances, with degrees of freedom adjusted as needed. Because of the number of comparisons performed (20), the significant p-value was adjusted downward to 0.0025.

4 Results

I begin by reporting results for overall consonant duration, and then move on to results for aspiration. I use the following abbreviations: sd = standard deviation, n = number of observations, df = degrees of freedom, t = t-value of the

independent samples t-test, d = Cohen's d (effect size measure)[2]. In the tables, significant results are marked with a *.

Because /k/ values are always clitic or affix internal, being the first phoneme of the 1pl marker /kt/, they serve as a type of control: phrase edge effects are expected for /t/ but not for /k/ (or, at least, to be much stronger for /t/ than for /k/).

4.1 Overall consonant duration

In terms of the overall duration of the consonants across all conditions, the duration of /k/ (mean=132.67ms, sd=30.69ms, n=145) and /t/ (mean=118.41ms, sd=74.87ms, n=145) did not differ significantly (t=2.121, df=288, p=0.035).

Turning to the two conditions of interest, /k/ duration when /kt/ was in phrase internal position (mean=127.28ms, sd=29.56ms, n=73) and phrase final position (mean=138.13ms, sd=31.04ms, n=72) did not differ significantly (t=2.156, df=143, p=0.033). Although phrase final /k/ trended in the expected direction and was slightly longer in duration, the effect size was also small (*d*=0.36). On the other hand, /t/ duration in phrase internal position was significantly shorter (mean=75.91ms, sd=33.16ms, n=73) than /t/ duration in phrase final position (mean=161.50ms, sd=80.71ms, n=72), as the t-test showed (t=8.330, df=94.036, p<0.001). These results are summarized in Table 2.

Table 2 /k/ and /t/ duration in phrase internal and phrase final positions

		/k/ duration (ms)	/t/ duration (ms)
Phrase internal	Mean	127.28	75.91
	sd	29.56	33.16
Phrase final	Mean	138.13	161.50
	sd	31.04	80.71
F test	*F*	0.001	65.289
	p	0.971	<0.001*
t-test	*t*	2.156	8.330
	df	143	94.036
	p	0.033	<0.001*
Effect size	*d*	0.36	1.72

Because the phrase-final condition included phrase boundaries that were both i-phrase and p-phrase final, or only p-phrase final, it was hypothesized that these two phrase final positions may have different consonant productions. A difference here would be indicative of /t/ production being affected by being at a p-phrase versus i-phrase boundary. A /t/ produced at an i-phrase boundary was expected to be longest; /t/ at a p-phrase but not i-phrase boundary was expected

[2] The standard interpretation of the effect size for Cohen's *d* is 0.2 for a small effect size, 0.5 for a medium effect size, and 0.8 and more for a large effect size (Cohen 1988).

to be medial in duration; while phrase-internal /t/ was expected to be shortest. Thus, the tokens in the phrase final condition were split into two groups.

Pairwise comparisons of the groups were consistent with this hypothesis. In the table below, i-phrase final tokens are numbered 1, tokens that are only p-phrase final are numbered 2, while the unaltered phrase internal group is labelled 3. The tokens of i-phrase final /t/ were longest in duration (mean=217.92ms, sd=59.77ms, n=39); /t/ at p-phrase final position were of medial duration (mean=94.82ms, sd=41.82ms; n=33); and phrase internal /t/ productions were of shortest duration (mean=75.91ms, sd=33.16ms, n=73). T-tests showed that i-phrase final /t/ was significantly longer than p-phrase final /t/ ($t=7.081$, $df=69.377$, $p<0.001$), but p-phrase final /t/ was approaching but did not reach significance in comparison to phrase internal /t/ ($t=2.603$, $df=97$, $p=0.011$), though the effect size was a medium one here ($d=0.49$). These results are summarized in the table below.

Table 3 /t/ duration in i-phrase final, p-phrase final and phrase internal positions

		/t/ duration (ms)
1 i-phrase final	Mean	217.92
	sd	59.77
2 p-phrase final	Mean	94.82
	sd	41.82
3 phrase internal	Mean	75.91
	sd	33.16
F test 1-2	*F*	8.761
	p	0.004
t-test 1-2	*t*	10.237
	df	67.755
	p	<0.001*
Effect size 1-2	*d*	2.49
F test 2-3	*F*	0.076
	p	0.783
t-test 2-3	*t*	2.500
	df	104
	p	0.014
Effect size 2-3	*d*	0.49

Finally, I examined whether i-phrase final clitic *=kt* showed differing durations of /t/ than i-phrase final affix *–kt*. While the affixal /t/ was slightly shorter (mean=203.23ms, sd=58.57ms, n=9) than the clitic /t/ (mean=222.32ms, sd=60.40ms, n=30), the difference was not significant (p=0.408). This suggests that i-phrase final affix and clitic /kt/ are not pronounced differently, despite different morphosyntactic status.

4.2 Aspiration duration and intensity

Aspiration of /k/ and /t/ were measured for duration, maximum intensity, time of maximum intensity, and percentage time of maximum intensity as a measure of the overall duration of intensity (this last measure was undertaken because duration of aspiration varied, so absolute time may not have been an accurate measure of the time of the intensity peak).

For /k/, there were no significant differences in the duration or maximum intensity for aspiration values. This suggests that the clitic or affix internal position of /k/ in the 1pl marker /kt/ meant that its production was not significantly affected by the position of /kt/ relative to a phrase boundary. However, the percentage time of the aspiration maximum did differ significantly in the two conditions, with phrase final /k/ aspiration occurring earlier (mean= 32% of the total aspiration duration) than phrase internal /k/ aspiration (mean=47.18%). This is a possible cue to phrase final status that is realized on the 1pl internal /k/ of /kt/, and was a mid to large effect size (d=-0.66).

Table 4 /k/ aspiration results in phrase final versus phrase internal /kt/

		duration (ms)	maximum intensity (dB)	time (ms) of max. intensity	% time of max. intensity
Phrase internal	Mean	73.10	56.47	32.46	47.18
	sd	25.83	5.43	21.74	28.03
Phrase final	Mean	78.91	55.54	25.52	32.00
	sd	22.87	3.82	20.23	20.02
F test	*F*	4.145	6.461	1.209	14.732
	p	0.044	0.012	0.273	<0.001
t-test	*t*	1.434	-1.187	-1.982	-3.740
	df	141.377	127.389	142	128.475
	p	0.154	0.237	0.049	<0.001*
Effect size	*d*	0.24	-0.21	-0.33	-0.66

Turning to /t/ aspiration in Table 5, its duration was significantly shorter (t=7.816, df=78.754, p<0.0001) in phrase internal positions (mean=27.04, sd=15.51, n=68) than in phrase final positions (mean=89.34ms, sd=65.85ms, n=72). The difference in maximum intensity was also significant (t=-3.162, df=138, p=0.002); interestingly, phrase internal /t/ aspiration showed on average over 3dB greater maximum intensity (mean=59.81dB, sd=6.23dB) than phrase final aspiration (mean=56.74dB, sd=5.21dB), a point I will return to in the discussion. Finally, the percentage time of the maximum aspiration intensity was, as for /k/ aspiration, later in phrase internal positions (mean=65.73%,

sd=23.95%, n=68) than in phrase final positions (mean=47.32%, sd=32.17%, n=72), a difference that was significant (t=-3.873, df=130.975, p<0.0001).

Table 5 /t/ aspiration in phrase final versus phrase internal positions

		duration (ms)	maximum intensity (dB)	time (ms) of max. intensity	% time of max. intensity
Phrase internal	Mean	27.04	59.81	18.24	65.73
	sd	15.51	6.23	10.69	23.95
Phrase final	Mean	89.34	56.74	31.46	47.23
	sd	65.85	5.21	40.28	32.17
F test	*F*	138.436	3.171	13.686	19.403
	p	<0.001	0.077	<0.001	<0.001
t-test	*t*	7.816	-3.162	2.685	-3.873
	df	78.754	138	81.502	130.975
	p	<0.001*	0.002*	0.009	<0.001*
Effect size	*d*	1.76	-0.54	0.59	-0.68

In addition, there were 5 phrase internal tokens of /t/ for which there was no release or aspiration of any sort apparent in the waveform and spectrogram (hence the n of 68 rather than 73 for this analysis), while there were an additional 5 tokens where there was no complete closure for /t/, but rather continuous aspiration carrying over from the production of the preceding /k/. Thus, 10/73 tokens in phrase internal position /t/ (13.70%) lacked either aspiration or closure. No tokens in the phrase final data set lacked closure or aspiration. This suggests that lack of complete closure or lack of any aspiration may be a phrase internal but not phrase final consonant characteristic.

Finally, in terms of consonant duration, we saw that p-phrase final /t/ occupied a position between i-phrase final /t/ and phrase internal /t/. In terms of aspiration measures, as shown in Table 6, i-phrase final /t/ aspiration was significantly different from p-phrase final /t/ aspiration in terms of duration, maximum intensity and the percentage time of the maximum aspiration intensity. However, p-phrase final tokens patterned with the phrase internal /t/ tokens, and showed no significant differences from phrase internal /t/ in terms of aspiration measures: even though p-phrase final aspiration duration was slightly longer on average than phrase internal aspiration duration, the effect size was relatively small (d=0.29). This suggests that increased aspiration duration is primarily a marker of i-phrase boundaries. However, it should be again noted that phrase internal /t/ tokens did sometimes lack aspiration or closure altogether, something that was not observed in p-phrase final /t/ tokens.

Table 6 /t/ aspiration for i-phrase final, p-phrase final and phrase internal /t/

		duration (ms)	maximum intensity (dB)	time (ms) of max. intensity	% time of max. intensity
1 i-phrase final	Mean	136.86	54.52	40.75	28.88
	sd	49.61	3.32	52.51	28.22
2 p-phrase final	Mean	33.18	59.38	20.47	68.92
	sd	26.36	5.82	9.77	21.34
3 phrase internal	Mean	27.04	59.81	18.24	65.73
	sd	15.51	6.23	10.69	23.95
F test 1-2	*F*	13.908	9.06	18.279	2.217
	p	<0.001	0.004	<0.001	0.141
t-test 1-2	*t*	11.300	-4.244	2.365	-6.688
	df	59.697	48.954	41.093	70
	p	<0.001*	<0.001*	0.023	<0.001*
Effect size 1-2	*d*	2.93	-1.21	0.74	-1.60
F test 2-3	*F*	0.449	0.432	0.027	0.753
	p	0.504	0.512	0.871	0.393
t-test 2-3	*t*	1.501	-0.334	1.009	0.650
	df	104	99	99	99
	p	0.136	0.739	0.315	0.517
Effect size 2-3	*d*	0.29	-0.07	0.20	0.13

5 Discussion

The phonetic analysis reported above tested whether there was any evidence for different consonant duration and aspiration measures depending on phrasal position. The consonants examined were /k/ and /t/ in the 1pl marker /kt/, and these were measured for overall duration; aspiration duration; and maximum aspiration intensity and timing. Tokens that were, based on Koch (2010), claimed to be phrase final and phrase internal were analysed. In addition, the present study conducted an additional post-hoc comparison, splitting the phrase final group into two: those tokens expected to be i-phrase final versus strictly p-phrase final.

5.1 Consonant duration

The results showed that consonant duration was a reliable indicator of phrase final position, with longer duration of /t/ in phrase final than phrase internal positions. Moreover, /t/ at a final i-phrase boundary was longer than /t/ at a final p-phrase boundary, which in turn was longer than phrase internal /t/ (though the latter difference was not quite significant, this may have been because of smaller numbers of observations once the phrase-final group was split into two; the effect size was a medium one, d=0.49). This provides evidence for two

categories of phrasal groupings (here labelled i-phrase and p-phrase), which are above the level of the clitic group. For example, repeating example (7) below as (17) but adding a level for the clitic group, we see that this differs from the p-phrase and i-phrase: tokens of /kt/ after initial auxiliaries had significantly shorter /t/, not being at a p-phrase boundary.

(17) ( )$_{\text{i-phrase}}$ [VP internal clitic /kt/]
( )$_{\text{p-phrase}}$
( )$_{\text{cl-group}}$
x$^{\text{w}}$úẏ=**kt** nés téw-cn-me.
FUT=1PL.INCL go buy-mouth-INTRANS
'We're going to go grocery shopping.'

In these cases of complex verbal predicates, with one or more auxiliaries in addition to the main verb, the first auxiliary attracts the second position clitics. This shows us that auxiliaries count as prosodic words. Yet, in Nłe?kepmxcin, the p-phrase is built around a larger unit that includes more than one prosodic word, unlike Lushootseed (Beck 1999). Entire verbal predicates appear to form a single p-phrase.

Similar results were found for affixal /kt/ in complex nominal predicates. For example, in (18), the 1pl emphatic pronoun is a separate prosodic word from *puṣ* 'cat', yet these /kt/ similarly showed acoustic properties different from the group hypothesized to be phrase final. This again suggests a single p-phrase mapping to the syntactic DP (Determiner Phrase) 'our cat'.

(18) ( )$_{\text{i-phrase}}$ [DP internal affix /kt/]
( )$_{\text{p-phrase}}$
… e=púṣ-**kt** nmímł.
… DET=cat-1PL.POSS 1PL.EMPH
'… our cat.' [F_P769a-4]

The lengthening effects found for /t/ in phrase final positions are in line with previous findings (Koch 2008, 2011) that there is significant final lengthening of vowels in Nłe?kepmxcin, showing that phrasal lengthening also includes at least some consonants. Interestingly, /k/ duration was not significantly different when /kt/ was phrase-internal versus phrase-final (though the overall pattern was as expected, with phrase final /k/ tokens about 10ms longer, on average, than phrase internal tokens). This suggests that consonants not at clitic or affix boundaries are not affected here. Moreoever, /kt/ as a possessive affix and as an agreement clitic showed the same effects for duration increase at phrase-final positions, suggesting the surface phonological string was not sensitive to morphosyntactic status for this measure of pronunciation.

5.2 Aspiration

Turning to aspiration, this measure also distinguished /kt/ production in different phrasal positions, though in a different way from overall consonant duration. The phrase final group /t/ had aspiration that was longer, and with an earlier intensity peak in terms of where the peak occurred as a percentage of overall aspiration duration. /k/ aspiration also showed an earlier intensity peak for phrase final tokens of /kt/. Overall, phonologically, this suggests phonological aspiration of /t/ in phrase final but not phrase internal positions. The /k/ of the 1pl /kt/ marker, on the other hand, was aspirated in all positions.

When the phrase final group was split into i-phrase and p-phrase final subgroups, it was shown that the aspiration measures were relevant for i-phrase final /t/ only, and not for p-phrase final /t/. This suggests that aspiration cues are greater at i-phrase but not p-phrase boundaries, while overall /t/ duration is the primary marker of a final p-phrase boundary. However, there are a few other indicators that suggest p-phrase and phrase internal /t/ tokens were differently marked even for aspiration measures: only /t/ tokens in the phrase internal group sometimes lacked aspiration or /t/ closure altogether, something that was not observed for p-phrase final group. Overall, then, aspiration measures were consistent with the proposal that both i-phrases and p-phrases are relevant for consonant production in Nłe?kepmxcin.

Interestingly, the maximum intensity of /t/ aspiration showed a higher mean in phrase internal positions. This is somewhat surprising if these tokens are meant to be phonologically unaspirated. When the sound files were coded, /t/ aspiration was marked when there was any indication of a release in the waveform or any indication of high frequency aspiration in the spectrogram. Even a phonologically unaspirated /t/ will create some release burst. The higher maximum intensity could well be a product of two factors. First, these release bursts were much shorter in duration, allowing for a higher absolute intensity (that is, if energy was measured over the entire release burst, it would be far higher in the phrase final position, something already reflected in the duration difference of aspiration). Secondly, the phrase internal /kt/ tokens occurred earlier in the breath group, so the absolute higher value of intensity could just be a factor of occurring earlier in the declination group.

5.3 On some misalignment of phonological and syntactic phrases

An additional reason why the acoustic properties of p-phrase final /kt/ were not found to be as distinct from phrase internal /kt/ (as opposed to i-phrase final /kt/) is likely due to a misalignment of the syntax-prosody interface in some instances. At least some cases of p-phrase final /kt/ were followed by additional clitic material, but from a different syntactic phrase. It appears that principles of syllabification (preferably making the /t/ an onset with a following resonant clitic, for example) conspire to add additional phonological material after a /kt/ that is syntactic phrase final. This removes the /t/ by one segment from the p-

phrase boundary, and also makes it an onset (which are less or perhaps phonologically unaspirated – Thompson and Thompson 1992:4), thus reducing the duration and aspiration values for some of the p-phrase internal /kt/ data.

For example, in (19), there are two adjuncts, a Preposition Phrase *ne citx*^{w} 'at our hours' and a temporal clause *e kriṣməṣ us* 'at Christmas' (more literally: 'when it was Christmas'). Syntactically, the first is a PP (Preposition Phrase) and the second a CP (Complementizer Phrase). The CP is introduced by the complementizer *e*, a morphosyntactic proclitic.

(19) [PP] [CP]
n=e=cítx^{w}-kt e=kríṣməṣ=us.
in=DET=house-1PL.POSS COMP=Christmas=3CNCL
'… at our house at Christmas.' [F_P055a]

However, in the actual phonological parse, this morphosyntactic proclitic seems to phonologically encliticize after the /kt/ in the preceding syntactic unit. This is shown in (20). The effect is to make the /t/ of /kt/ an onset, rather than a coda at the end of the p-phrase. The preference for onsets overrides the alignment of the syntactic and phonological units. The CP is thus split across two phonological phrases: the *e* encliticizes onto the initial p-phrase, while the remainder of the CP is in its own p-phrase.

(20) [PP] [CP]
( )i-phrase
( )p-phrase ( )p-phrase
n=e=cítx^{w}-kt **=e** kríṣməṣ=us.
in=DET=house-1PL.POSS =COMP Christmas=3CNCL
'… at our house at Christmas.' [F_P055a]

Thus, unsurprisingly, phonological phrasing principles can override syntactic phrasing in at least some cases. Another instance like this is shown in (22) below.

5.4 Corrective focus phrasing

It is worth mentioning some additional interesting cases of /kt/. In a language where some lexical items (such as /kt/ for 'we' or 'our') are expressed through a phonetic form consisting solely of consonants, we may wonder how they are emphasized, such as in corrective focus contexts. In many languages like English, focus marking is realized through additional prosodic prominence on the focused constituent, and this additional pitch, intensity and duration is most noticeable on vowels and other resonants. How would one mark emphasis on purely consonantal material (moreover: purely voiceless obstruents), like /kt/, or would one mark it at all? Example (21) shows a case in which the speaker marks meta-linguistic corrective focus on /kt/, after the preceding speaker uses a different person marker. She corrects the form to /kt/, and does so by

emphasizing the aspiration on both consonants involved, and inserting a phrase boundary after /kt/.

(21) ( )$_{\text{i-phrase}}$
( )$_{\text{p-phrase}}$ ( )$_{\text{p-phrase}}$
… ʔé k=s=wʔéx=kt táns ….
… and COMP=NOM=IMPF=1PL.PoCl dance ….
'… and [WE]$_{\text{FOCUS}}$ had to dance ….' [787d'''-3]

Both /k/ and /t/ in the /kt/ of (21) have longer duration than the averages reported in tables 2–3 (168.11ms for [k], 270.9ms for [t]). /t/ also has aspiration that is longer (163.61ms) and louder (60.73dB maximum intensity) than the phrase-final average, while the aspiration intensity peak also occurs earlier than average (at 8.66% of the aspiration duration). Finally, /t/ aspiration is followed by approximately 170ms of silence until the release of the /t/ of *tans*. This suggests that the speaker uses a p-phrase boundary after /kt/ to mark corrective focus on /kt/ here (normally, auxiliaries and verbs are parsed in the same phrase).

Interestingly, I have only documented cases of corrective focus that show this sort of marking; new information focus (as in answering a wh-question), selective focus or contrastive focus don't seem to employ this strategy. Instead, the preferred strategy is to cleft the 1pl independent emphatic pronoun *nmimł* to mark focus (Koch 2008). In (22) and (23), *nmimł* occurs in the focus domain following the 'only' cleft predicate *cuk*^{w}, and the 'persistent' particle *ƛ̓uʔ* which gives an 'only' meaning (Koch and Zimmermann 2010). While the first example also contains a /kt/ in the initial focus domain, the second example has only the independent emphatic pronoun *nmimł* in the focus domain after the cleft predicate.

(22) ( )$_{\text{i-phrase}}$
( )$_{\text{p-phrase}}$ ( )$_{\text{p-phrase}}$
cúk^{w}=ƛ̓uʔ nmímł e=púṣ-**kt** =e ʔém'c-n-x^{w}.
CLEFT=PERS 1PL.EMPH DET=cat-1PL.POSS =COMP feed-DRV-3O.2SG.TS
'[Our]$_{\text{FOCUS}}$ cat was the only one you fed.' [F_P769b]
(more literally: 'It was only [our]$_{\text{FOCUS}}$ cat that you fed.')

(23) ( )$_{\text{p-phrase}}$ ( )$_{\text{p-phrase}}$
cúk^{w}=ƛ̓uʔ nmímł e=ʔéx kən-t-éy-s ʔéx
CLEFT=PERS 1PL.EMPH COMP=IMPF help-TR-1PL.O.-3TS
( )$_{\text{p-phrase}}$
e=sk^{w}úzeʔ-kt te=ƛ̓uʔsqáyx^{w}.
DET=offspring-1PL.POSS LINK=man
'[We]$_{\text{FOCUS}}$ are the only ones that get help from our son.' [F_P767d]
(more literally: 'It is only [us] that get help from our son.' (other people don't get help from their sons))

Notice that example (22) is another instance of the sort of syntactic and phonological misalignment discussed in section 5.3. The initial *e* complementizer in the cleft clause *e ʔem'cnx*^{w} 'that you fed,' generally understood as a morphosyntactic proclitic (*e*=) on the following clausal material, instead appears to be parsed as an enclitic (=*e*) in the preceding p-phrase. This is evident since it is lengthened, followed by a short pause, and has no declination reset. As an enclitic on /kt/, the =*e* enables the /t/ of /kt/ to become an onset, thus reducing the aspiration values of /t/ here.

5.5 Phonological parsing of verbs and arguments

The present study, because the /kt/ clitic is an intransitive verb agreement marker, was limited primarily to intransitive clauses. It was argued that intransitive verbs (plus any additional auxiliaries) form one p-phrase, while oblique arguments or adjuncts form another. Koch (2010), as well as the present study, looked at some cases of the possessive affix /kt/ at the end of arguments in transitive clauses, showing that these pattern with phrase final /kt/, and the phonetic results support this view. This suggests that verbs and arguments are parsed into separate p-phrases in Nłeʔkepmxcin, in both transitive and intransitive clauses. Cross-linguistically, this parsing is claimed to be less typical; for example, in English and many other languages, verb and object are typically parsed into one phonological phrase, while the subject is realized in a separate p-phrase (Chomsky 1971; Gussenhoven 1983; Jackendoff 1972; Kahnemuyipour 2004; Selkirk 1995; Selkirk and Kratzer 2007). In a language with underlying transitive V-S-O-Adjunct order, verb and object are split by the subject (where it is expressed), so verb and object are not adjacent. In these cases, either the verb and all arguments must be parsed together, or, as seems to be the case in Nłeʔkepmxcin, Lushootseed (Beck 1999), and Okanagan (Barthmaier 2004), the verb is parsed separately from all arguments. There are other languages where verbs and arguments are parsed into separate phonological phrases. Outside the Salish language family, Hayes and Lahiri (1991, on Bengali), Schafer and Jun (2002, on Korean), and Nespor and Sandler (1999, on Israeli Sign Language), also argue for parsing of verb and arguments into individual p-phrases (see also Ishihara 2007: 147–148, ex. 17b, for such parses of some Japanese sentences). This raises interesting questions as to which syntactic units in Nłeʔkepmxcin correspond to the prosodic units p-phrase and i-phrase, which (apart from the comments on some syntax-phonology misalignments made above) I will for the moment leave to further research.

6 Conclusion

This paper used a consonant-oriented test to probe phrasal boundary cues of Nłeʔkepmxcin clauses. By examining the voiceless stops /k/ and /t/ in the 1pl marker /kt/, I showed that phrase final /t/ is greater in duration, and that this duration is greater at i-phrase boundaries that at p-phrase boundaries. The

aspiration of /t/ phrase finally was longer, and both /k/ and /t/ aspiration had an earlier intensity peak (as measured as a percentage of the overall aspiration duration). On closer inspection, these aspiration cues appeared to be a property of only i-phrase final /t/. P-phrase final /t/ aspiration did still differ from phrase internal /t/, in that only that latter was sometimes completely unaspirated or lacked complete closure during its production.

The results show that consonants can be investigated for reliable cues to phrasal boundaries, good news for the consonant heavy Salish languages. A future investigation might investigate the production of the glottal stop, which frequently ends clitic groups in the demonstrative *xeʔ*.

On a final note, the results show a pattern of aspiration that is roughly opposite to that of English voiceless stops. While English voiceless stops are strongly aspirated as solitary onsets of stressed syllables, Nłeʔkepmxcin stops are strongly aspirated phrase finally as codas (Thompson and Thompson 1992). This is a useful tip for second language learners: aspirate those final stops.

References

Bagemihl, Bruce. (1991). Syllable structure in Bella Coola. *Linguistic Inquiry* 22:589–646.

Barthmeier, Paul. (2004). Intonation units in Okanagan. In Donna B. Gerdts and Lisa Matthewson, eds. *Studies in Salish linguistics in honor of M. Dale Kinkade.* Missoula: University of Montana Occasional Papers in Linguistics 17. 30–42.

Beck, David. (1996). Some notes on phonological phrasing in Lushootseed. *Toronto Working Papers in Linguistics* 15(2):37–60.

Beck, David. (1999). Words and prosodic phrasing in Lushootseed. In T. Alan Hall and Ursula Kleinhenz, eds. *Studies on the Phonological Word*. Amsterdam: Benjamins. 23–46.

Beck, David, and David Bennett. (2007). Extending the prosodic hierarchy: evidence from Lushootseed narrative. *Northwest Journal of Linguistics* 1(1):1–34.

Bessell, Nicola J. (1997). St'át'imcets vowels and consonants: a phonetic study. *ICSNL 32*: 64–85, Port Angeles.

Bessell, Nicola J. (1998). Local and non-local consonant vowel interaction in Interior Salish. *Phonology* 15:1–40.

Bianco, Violet M. (1996). *The Role of Sonority in the Prosody of Cowichan*. M.A. thesis, University of Victoria.

Boersma, Paul, and David Weenink. (2013). Praat: Doing phonetics by computer. Computer Program. Version 5.3.53.

Butcher, Andrew, and Jonathan Harrington. (2003a). An instrumental analysis of focus and juncture in Warlpiri. In M. Sole, D. Recasens, and J. Romero, eds. *Proceedings of the 15th International Congress of Phonetic Sciences*. Barcelona. 321–324.

Butcher, Andrew, and Jonathan Harrington. (2003b). An acoustic and articulatory analysis of focus and the word/morpheme boundary distinction in Warlpiri. In S. Palethorpe and M. Tabain, eds. *Proceedings of the 6th International Seminar on Speech Production*. Sydney. 19–24.

Brown, Jason, and James Thompson. (2006). Criteria for tonality: The case of Upriver Halkomelem. In Shannon T. Bischoff, Lynnika Butler, Peter Norquest, and Daniel Siddiqi, eds. *MIT Working Papers on Endangered and Lesser Known Languages: Studies in Salishan.* 113–126.

Caldecott, Marion. (2009). *Non-Exhaustive Parsing: Phonetic and Phonological Evidence from St'át'imcets*. Ph.D. dissertation, University of British Columbia.

Caldecott, Marion, and Karsten A. Koch. (2014). Using mixed media tools for eliciting and mobilizing linguistic data in indigenous languages. *Language Documentation and Conservation* 8:209–240.

Carlson, Barry F., John H. Esling, and Jimmy G. Harris. (2004). A laryngoscopic phonetic study of Nlaka'pamux (Thompson) Salish glottal stop, glottalized resonants, and pharyngeals. In Donna B. Gerdts and Lisa Matthewson, eds. *Studies in Salish linguistics in honor of M. Dale Kinkade.* Missoula: University of Montana Occasional Papers in Linguistics 17. 58–71.

Chomsky, Noam. (1971). Deep structure, surface structure, and semantic interpretation. In D.D. Steinberg and L.A. Jakobovits, eds. *Semantics: An Interdisciplinary Reader in Philosophy, Linguistics, and Psychology.* Cambridge: Cambridge University Press. 183–216.

Cohen, Jacob. (1988). *Statistical Power Analysis For the Behavioral Sciences.* 2nd ed. Hillsdale, NJ: Lawrence Earlbaum Associates.

Czaykowska-Higgins, Ewa. (1993). Cyclicity and stress in Moses-Columbia Salish (Nxa'amxcín). *Natural Language and Linguistic Theory* 11:197–278.

Czaykowska-Higgins, Ewa. (1998). The morphological and phonological constituent structure of words in Moses-Columbia Salish (Nxa'amxcín). In E. Czaykowska-Higgins and M.D. Kinkade, eds. 1998. *Salish Languages and Linguistics*. Berlin: Mouton de Gruyter. 153–196.

Czaykowska-Higgins, Ewa, and M. Dale Kinkade, eds. (1998). *Salish Languages and Linguistics: Theoretical and Descriptive Perspectives*. *Trends in Linguistics: Studies and Monographs 107*. Berlin: Mouton de Gruyter.

Davis, Henry. (1999). Subject inflection in Salish. In Marion Caldecott, Suzanne Gessner, and E. Kim, eds. *Current Research on Language and Linguistics*. Vancouver: UBC Working Papers in Linguistics 1. 181–240.

Davis, Henry. (2000). Remarks on Proto-Salish subject inflection. *International Journal of American Linguistics* 66:499–520.

Davis, John H. (2005). High consonants, articulatory transitions, and nonhigh vowels in Comox.' In Jason Brown, Masaru Kiyota, and Tyler Peterson, eds. *Papers for ICSNL 40*. Vancouver: UBCWPL 16. 89–97.

Egesdal, Steven M. (1984). *Stylized Characters' Speech in Thompson Salish Narrative.* Ph.D. dissertation, University of Hawaii.

Esling, John H., Barry F. Carlson, and Jimmy G. Harris. (2002). A laryngoscopic phonetic study of Nootka and Salish glottal stop, glottalized resonants, and pharyngeals. SSILA/LSA annual meeting, San Francisco.

Frantz, Donald G. (2009). *Blackfoot grammar*. 2nd ed. Toronto: University of Toronto Press.

Gussenhoven, Carlos. (1983). Testing the reality of focus domains. *Language and Speech* 26:61–80.

Hayes, Bruce. (1989). The prosodic hierarchy in meter. In P. Kiparsky and G. Youmans, eds. *Phonetics and Phonology, Vol 1: Rhythm and Meter.* San Diego: Academic Press. 201–260.

Hayes, Bruce, and Aditi Lahiri. (1991). Bengali intonational phonology. *Natural Language & Linguistic Theory* 9: 47–96.

Hoard, James E. (1971). Problems in Proto-Salish pronoun reconstruction. *Sacramento Anthropological Society Papers* 11: 70–90.

Hoard, James E. (1978). Syllabication in Northwest Indian Languages, with remarks on the nature of syllabic stops and affricates.' In Alan Bell and Joan Bybee, eds. *Syllables and Segments* Amsterdam: North Holland.

Ishihara, Shinichiro. (2007). Major phrase, focus intonation, multiple spell-out. *The Linguistic Review* (2–3):137–167.

Jackendoff, Ray. (1972). *Semantic Interpretation in Generative Grammar*. Cambridge, MA: MIT Press.

Kahnemuyipour, Arsalan. (2004). *The Syntax of Sentential Stress.* Ph.D. dissertation, University of Toronto.

Kinkade, M. Dale. (1992). Salishan languages. In William Bright, ed. *International Encyclopedia of Linguistics*. New York: Oxford University Press. 359–362.

Koch, Karsten A. (2008). *Intonation and Focus in Nłe?kepmxcin (Thompson River Salish).* Ph.D. dissertation, University of British Columbia.

Koch, Karsten A. (2009). Innovative double subject marking in Nłeʔkepmxcin (Thompson River Salish). *Northwest Journal of Linguistics* 3(4):1–23.

Koch, Karsten A. (2010). Some properties of prosodic phrases in Thompson Salish. In Stefanie Jannedy and Melanie Weirich, eds. *Papers from the Linguistics Laboratory (ZAS Papers in Linguistics 52)*. Berlin: ZASPiL. 141–158.

Koch, Karsten A. (2011). A phonetic study of intonation and focus in Nłeʔkepmxcin. In Sonia Frota, Pilar Prieto, and Gorka Elordieta, eds. *Prosodic Categories: Production, Perception and Comprehension*. Dordrecht: Springer. 111–144.

Koch, Karsten A., and Malte Zimmermann. (2010). Focus sensitive operators in Nłeʔkepmxcin (Thompson River Salish). In Martin Prinzhorn, Viola Schmitt and Sarah Zobel, eds. *Proceedings of Sinn und Bedeutung 14*. Vienna: Universität Wien Institut für Sprachwissenschaft. 237-255.

Kroeber, Paul. (1997). Relativization in Thompson Salish. *Anthropological Linguistics* 39(3):376–422.

Kroeber, Paul. (1999). *The Salish Language Family: Reconstructing Syntax.* Lincoln: University of Nebraska Press.

Marinakis, Aliki. (2004). A preliminary description of consonant clusters in Upriver Halq'eméylem.' In Jason Brown and Tyler Peterson, eds. *Papers for ICSNL 39.* Vancouver: UBCWPL 14. 283–302.

Nespor, Marina, and Wendy Sandler. (1999). Prosody in Israeli Sign Language. *Language and Speech* 42:143–176.

Newman, Stanley. (1979). A history of the Salish possessive and subject forms. *International Journal of American Linguistics* 45:207–223.

Newman, Stanley. (1980). Functional changes in the Salish pronominal system. *International Journal of American Linguistics* 46:155–167.

Niebuhr, Oliver. (2008). Coding of intonational meanings beyond F0: Evidence from utterance-final /t/ aspiration in German. *Journal of the Acoustical Society of America* 124(2):1252–1263.

Schafer, A.J., and Sun-Ah Jun. (2002). Effects of accentual phrasing on adjective interpretation in Korean. In M. Nakayama, ed. *East Asian Language Processing*. Stanford: CSLI. 223–255.

Selkirk, Elizabeth. (1995). Sentence prosody: Intonation, stress and phrasing. In J. Goldsmith, ed. *The Handbook of Phonological Theory.* Cambridge, MA: Blackwell. 550–569.

Selkirk, Elizabeth, and Angelika Kratzer. (2007). Phase theory and prosodic spellout: The case of verbs. *The Linguistic Review* 24(2-3):93–135.

Shahin, Kimary N. (2003). The uvular/pharyngeal allophones of the St'át'imcets (Lillooet) gutturals: a phonetic study. In Jason Brown and Michelle Kalmar, eds. *Papers for ICSNL 38*. Vancouver: *UBCWPL* 11. 207–214.

Shaw, Patricia. (2002). On the edge: obstruent clusters in Salish. In Leora Bar-el, Linda Watt, and Ian Wilson, eds. *Proceedings of WSCLA 7*. Vancouver: UBCWPL 10. 119–136.

Thompson, Laurence C., and M. Terry Thompson. (1992). *The Thompson Language*. Missoula: University of Montana Occasional Papers in Linguistics 8.

Thompson, Laurence C., and M. Terry Thompson. (1996). *Thompson River Salish Dictionary*. Missoula: University of Montana Occasional Papers in Linguistics 12.

Van Eijk, Jan P. (2001). Word, clitic and sentence in Lillooet. In S. Gessner, S. Oh, and K. Shiobara, eds. *Proceedings of WSCLA 5*. Vancouver: *UBCWPL* 5. 119–122.

Windsor, Joseph, and Jessi Cobler. (2013). A unified analysis of three phrase-final phenomenon in Blackfoot. Poster presented at CLA 2013: Meeting of the Canadian Linguistics Association 2013, Special Session on Reclaiming Canada's Indigenous Languages, Victoria.