A preliminary study of intonation in Kwak'wala

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This paper presents a preliminary study of intonation in Kwak'wala, a northern Wakashan language spoken on northern Vancouver Island and adjoining mainland British Columbia. While there are an increasing number of studies of intonation in neighboring Salish languages (Caldecott 2009, Jacobs 2007, Koch 2008, Oberg 2007), intonation in Wakashan languages has been understudied (Hofmann 1984) and there is no previous study of intonation in Kwak'wala. This paper first discusses word stress, prosodic structure, and default intonation. Then, it examines an aspect of the semantics-phonology interface: deaccentuation of discourse-given material in the post-focus domain.

1 Introduction

Intonation refers to the linguistically structured distribution of suprasegmental features, particularly tonal features, at the phrase and sentence levels. This study takes the Autosegmental-Metrical (AM) theory of intonational phonology (Liberman 1975, Pierrehumbert 1980, Ladd 2008) as an analytical framework. In this theory, the intonation of an utterance is represented by a sequence of tonal features: pitch accent and edge tone. Pitch accent is associated with a prominent position or a stressed syllable within a prosodic category and edge tone is associated with an edge of a prosodic category. A basic tenet of AM theory is a clear distinction between stress and pitch accent. Stress is an abstract property of individual syllables, which is determined by various principles of prosodic organization, while pitch accent is a prominence-lending pitch movement. Metrical theories of stress assume a hierarchically organized prosodic structure and the projection of stress from a lower-level prosodic category to a higher-level prosodic category (Liberman and Prince 1977, Halle and Vergnaud 1987, Hayes 1995). AM theory takes a higher-level prosodic category and assigns a pitch accent to a stressed syllable within the category or an edge tone to an edge of the category. Therefore, in order to understand the intonation of a given language, we need to understand its stress system and prosodic structure.

Semantic inputs also play an important role in intonational phonology. It is known that focus and information structure affect intonation (Ladd 1980). For example, in-situ focus is marked by pitch prominence in English. Cross-linguistically, however, connection between focus and pitch prominence is not

universal (Zerbian 2006). For example, it has been reported that there is no connection between focus and intonation in Nɬeʔkepmxcin (Koch 2008). Discourse-givenness, on the other hand, may be marked by deaccentuation in English. Cross-linguistically, however, the deaccentuation of discourse-given material is not universal (Ladd 1990, 2008).

The goal of this paper is to present a systematic description of intonation in Kwak'wala. The outline of the paper is as follows. In section 2, I present an analysis of prosodic structure and default intonation. In section 3, I examine an aspect of the semantics-phonology interface. Particularly, I examine the deaccentuation of discourse-given material in the post-focus domain.

2 Prosodic structure in Kwak'wala

Prosodic structure is a hierarchically organized structure of prosodic categories. This study follows a widely accepted model of prosodic structure originally proposed by Selkirk (1986, 1995a). This model assumes a set of cross-linguistically well-attested prosodic categories (1).

(1) Utterance
Intonational phrase
Phonological phrase
Prosodic word
Foot
Syllable

In the literature, there is disagreement on the number and the labeling of categories between prosodic word and intonational phrase. For example, it has been proposed that Japanese has two types of phonological phrase: an accentual phrase that serves as the domain of accentuation and an intermediate phrase that serves as the domain of catathesis (Beckman and Pierrehumbert 1986). Beckman and Pierrehumbert (1986) argue that the distinction is applicable to English but the realization of the former category is less clear in English. One weakness of Beckman and Pierrehumbert's model is that it does not provide an explicit account of another crucial aspect of prosodic structure, the syntax-phonology interface.

Constituency of prosodic categories is defined in both the phonology and the syntax-phonology interface. In phonology, prosodic categories serve as the domain of various phonological events such as sandhi rules, phrasal stress, and accentuation. In the syntax-phonology interface, it is assumed that prosodic categories higher than the prosodic word are derived through a syntax-phonology mapping. Table 1 presents a set of cross-linguistically well-attested correspondence relations between prosodic categories and syntactic constituents. In the following subsections, first, I discuss word stress, then I discuss phonological phrasing.

Prosodic categories	Corresponding syntactic constituents
Intonational phrase (IPh)	Syntactic root node, Comma phrase
Phonological phrase (PPh) /Major phrase (MaP)	Maximal projection of lexical category (XP)
Phonological phrase (PPh) /Minor phrase (MiP)	Syntactically branching constituent
Prosodic word (PWd)	Morphosyntactic word

Table 1. Prosodic categories and corresponding syntactic constituents (Selkirk 2005:29)

2.1 Word prosody

2.1.1 Word stress

An analysis of Kwak'wala word stress proposed by Zec (1988, 1995) has gained a certain popularity in the phonological literature (Hayes 1995; Kirchner 2007, 2009; Struijke 1998). According to her analysis, primary stress falls on the leftmost syllable containing a long vowel or the rightmost syllable if there is no syllable containing a long vowel in the word. Despite its popularity, it has been pointed out that Zec's analysis crucially relies on the controversial assumption that vowel length is contrastive in Kwak'wala (Bach et al. 2005). Even though many studies assume that vowel length is contrastive in Kwak'wala (Bach 1975; Grubb 1969; Kirchner 2007, 2009; Struijke 1998; S. Wilson 1986; Zec 1988, 1995), no study has shown a minimal pair that clearly supports the assumption. Other studies claim that vowel length is not contrastive in Kwak'wala (Bach et al. 2005, Kalmar 2003).

Another issue is the treatment of schwa. Zec's analysis treats schwa as an inherently short (mono-moraic) vowel because of its unstressability. However, this treatment is driven by her analysis of the stress system and the controversial assumption on vowel length. Other studies claim that schwa is non-moraic in Kwak'wala based on a wider range of data (Bach et al. 2005, Kalmar 2003)[1]. For example, comparative data show that a syllable with a schwa nucleus in Kwak'wala corresponds to a syllable without a vocalic nucleus in Oowekyala, another northern Wakashan language. These data suggest that schwa in Kwak'wala diachronically developed from an epenthetic nucleus.

(2)	Oowekyala	Kwak'wala	
a.	k'^{w}s	k'^{w}əs	'light'
b.	ts'úɬm̩	ts'úɬəm	'black face'

[1] This argument follows the spirit of an analysis presented by Shaw et al. (1999) for the Musqueam Salish stress system. See references cited in Shaw et al. (1999) for a general discussion on the non-moraicity of schwa.

(Bach et al. 2005)

Lincoln and Rath (1980) even claim that in Kwak'wala synchronic phonology, a rhyme with a schwa nucleus and a plain sonorant coda is underlyingly a syllabic sonorant. According to their analysis, [ts'ú.ɬəm] above is underlyingly represented as /ts'ú.ɬm/ and the insertion of schwa is a phonetic realization.

Another related issue is sonorants. Kwak'wala has two types of sonorants, plain sonorants /m, n, l, y, w/ and glottalized sonorants /m', n', l', y', w'/, and it is known that a syllable with a schwa nucleus and a plain sonorant coda is stressable while a syllable with a schwa nucleus and a glottalized sonorant coda is not (Zec 1988, 1995). If we take the view that schwa is non-moraic, stressability depends on the quality of the coda sonorant. Gordon and Ladefoged (2001) characterize glottalized sonorants in Kwak'wala as creaky sonorants; i.e. they have a creaky portion in the first half of their production. Figure 1 shows the spectrogram of a plain sonorant /n/ in coda position following a schwa nucleus in /dən.χə.la/ 'singing'. The sonorant has a stable voicing throughout its production.

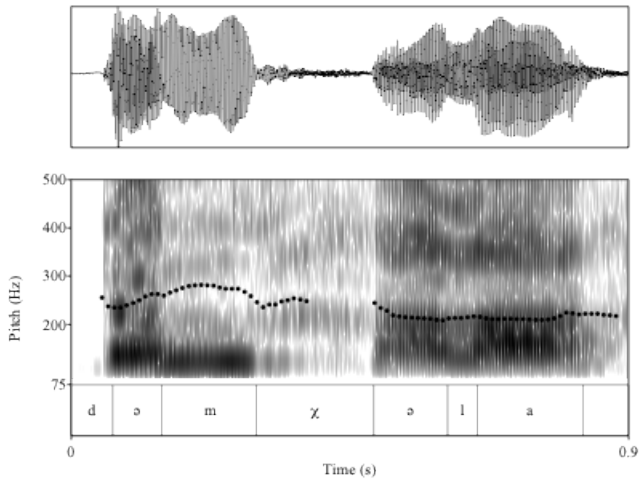

Figure 1. Plain sonorant /n/

Figure 2, in contrast, shows a glottalized sonorant /m'/ in coda position following a schwa nucleus in /ɢəm'.χo.la/ 'left-handed'. Note that the glottalized sonorant has a very weak voicing. Also note that in Figure 1 stress falls on the first syllable. Interestingly, the F0 peak of the stressed syllable is aligned with the coda sonorant rather than the schwa nucleus. This suggests that the sonorant coda, not the schwa nucleus, is serving as a tone-bearing unit, implying that plain sonorants are moraic but schwa is not.

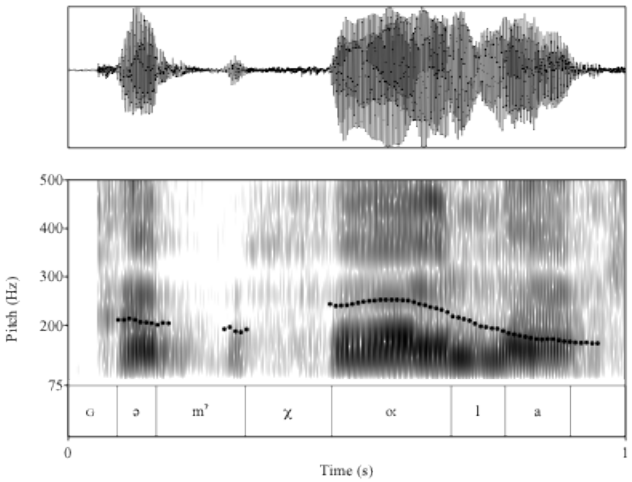

Figure 2. Glottalized sonorant /m'/

Another interesting point about sonorants is their distribution. In Kwak'wala, a syllable with a plain sonorant coda usually has a schwa nucleus. It has been observed that a syllable with a non-schwa nucleus and a plain sonorant coda is very rare. Moreover, when it occurs, it is only found in word final position (Bach et al. 2005, Kalmar 2003). If we take the view that both non-schwa nuclei and plain sonorant codas are moraic, there must be a strong tendency to avoid bi-moraic syllables in Kwak'wala words.

In sum, Kwak'wala stress system can be restated as follows. Stress falls on the leftmost moraic syllable or the rightmost syllable if there is no moraic syllable in the word. 'Moraic syllable' refers to a syllable with a non-schwa nucleus or a plain sonorant coda. In the latter case, the nucleus is usually a non-moraic schwa.

2.1.2 Acoustics of stress

There is no previous acoustic study of Kwak'wala word stress. Boas (1947) often transcribes stressed syllables with a long vowel. This suggests that a longer duration is an acoustic correlate of stress in Kwak'wala. Cross-linguistically, there are three major acoustic correlates of stress: intensity, duration and fundamental frequency (F0) (Lehiste 1970, Lieberman 1967). A stressed vowel is usually realized with a higher intensity, a longer duration, and a higher F0. Here, I present a small set of acoustic data to compare the phonetic realizations of stressed and unstressed vowels in Kwak'wala. Since pre-tonic unstressed vowels are always schwa, I compare stressed /a/ and post-tonic unstressed /a/. In order to obtain a well-controlled phonological context for the comparison, I used nouns with the instrumental suffix /-ayu/. This suffix attaches to various kinds of roots and derives nouns that refer to tools that are related to the activity expressed by the roots (Boas 1947). When it attaches to a

monosyllabic root with a non-schwa nucleus, stress falls on the root vowel (e.g. /sub-ayu/ → /sú.ba.yu/ ‘axe’). In contrast, when it attaches to a monosyllabic root with a schwa nucleus, stress falls on the suffix vowel (e.g. /k’ən-ayu/ → /k’ə.ná.yu/ ‘knitting needle’). Target words for the current analysis are the following four nouns.

Post-tonic /a/	Stressed /a/
súb**a**yu ‘axe’	k’ən**á**yu ‘knitting needle’
líb**a**yu ‘card’	kəb**á**yu ‘scissor’

Table 2. Target words

A native speaker of Kwak’wala produced these words in the phrase *ts’olasa X laχa Y* ‘Give X to Y’ four times. Recording was done as a part of a game in which the native speaker gives a command and a student performs the action to see if he or she understands the names of these items. The game included four other items that served as filler items. One potential problem of this method is the effect of a special intonation for command. A separate study is needed to verify the existence of such special intonation. Actual productions sometimes included an additional suffix on the target words, a visibility marker /-eχ/ or /–uχ/. The addition of an extra syllable potentially affects the duration of the target vowels. Figure 3 shows the spectrogram of /lí.ba.yu/ ‘card’ with a post-tonic unstressed /a/. Figure 4 shows the spectrogram of /kə.bá**.**yu/ ‘scissor’ with a stressed /a/.

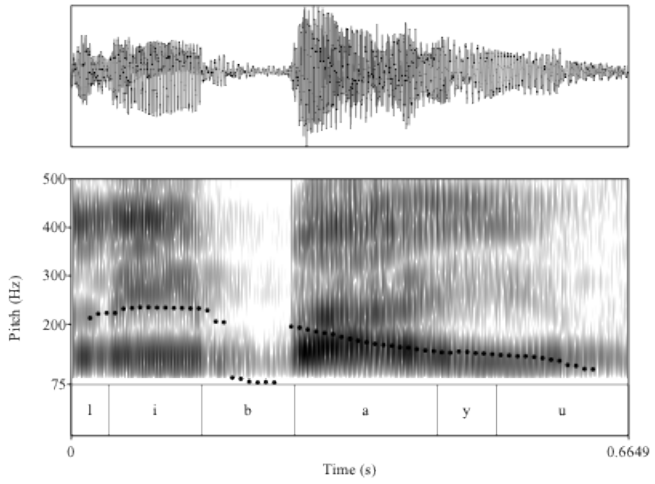

Figure 3. /lí.ba,yu/ with a post-tonic unstressed /a/

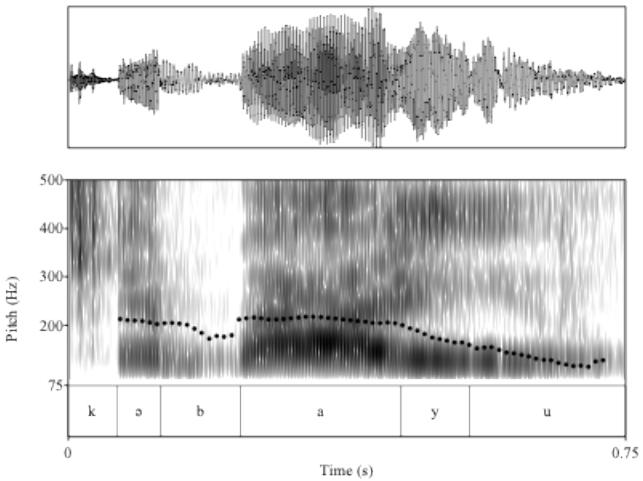

Figure 4. /kə.bá.yu/ ‘scissor’ with a stressed /a/

Duration, mean F0, and max F0 were measured at each target vowel with Praat (Boersma and Weenink 2011) and ProsodyPro (Xu 2005-2011). Mean F0 refers to the mean of 10 sample F0 values. Intensity was not taken into consideration because some tokens have an input audio level higher than recording level. The data are summarized in Table 3. Figure 5 shows the differences in the three measurements between post-tonic /a/ (V1 stress) and stressed /a/ (V2 stress).

	Duration (ms)	Mean F0(Hz)	Max F0 (Hz)	Tokens
Post-tonic /a/	149.02 (sd=18.34)	185.92 (sd=12)	209.38 (sd=14.23)	8
Stressed /a/	172.72 (sd=31.62)	208.98 (sd=6.67)	227.01 (sd=7.72)	8

Table 3. Acoustic measurements of post-tonic unstressed /a/ and stressed /a/

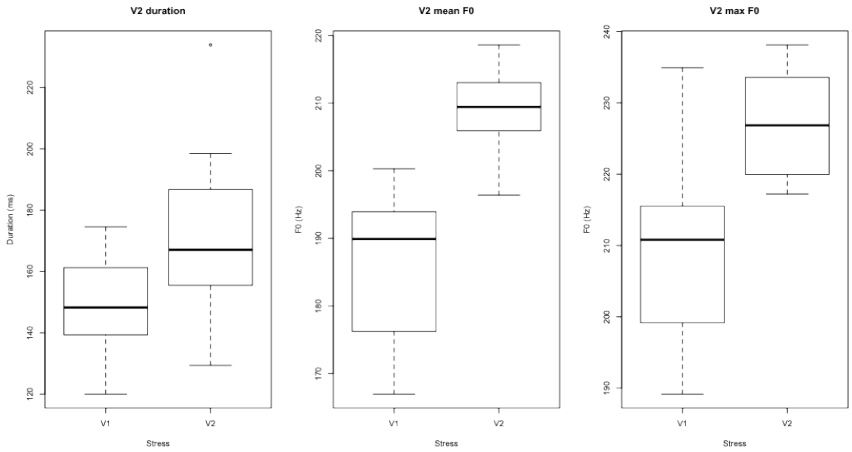

Figure 5. Acoustic differences between post-tonic unstressed /a/ and stressed /a/

In Figure 5, we can see that stressed /a/ is longer than post-tonic /a/. A two-sample t-test was performed and the result showed that the difference is weakly significant (t=1.83, df=11.23, p-value=0.09). We can also see that stressed /a/ has higher mean F0 and max F0 values than post-tonic /a/. Two-sample t-tests were performed and the results showed that the differences are significant (mean F0: t=4.75, df=10.94, p-value=0.0006, max F0: t=3.08, df=10.79, p-value=0.01). These results show that stressed vowels are realized with a longer duration and a higher F0 in Kwak'wala.

2.1.3 Footing

A remaining issue in Kwak'wala word prosody is footing. Some researchers claim that Kwak'wala foot structure is weight-sensitive iambic (Kirchner 2007, 2009; Struijke 1998; P. Wilson 1978; Zec 1988, 1995). Others claim that it is non-weight-sensitive trochaic (Kalmar 2003, S. Wilson 1986). One way to solve the issue is to analyze the pattern of secondary stress. Note that the discussion presented so far is concerned with primary stress. Unfortunately, the existent descriptions of secondary stress are inconsistent and unclear (Boas 1947; Grubb 1969, 1977). Hayes (1995) even ignores the issue of secondary stress and argues that Kwak'wala foot structure is unbounded; after the assignment of primary stress, the whole word is parsed as an unbounded foot. Here, I present a small set of data that support a trochaic analysis. Kwak'wala is known for its complicated system of reduplication. One type of reduplication that is relevant to the issue of footing is plural reduplication. For some nouns, plurality is marked by the reduplication of the initial consonant followed by /i/. An interesting observation is that the stressability of the reduplicant seems to be determined by the stress pattern of the base noun. Compare the following examples.

(3)	a.	bəgʷánəm	man	bí-bəgʷànəm	men
	b.	bábagʷəm	boy	bi-bábagʷəm	boys

In the case of /bí-bəgʷànəm/ where the base noun has initial unstressed syllable (/bəgʷánəm/), the reduplicant is stressed. In contrast, in the case of /bi-bábagʷəm/ where the base noun has initial stressed syllable (/bábagʷəm/), the reduplicant is not stressed. If we take a trochaic analysis, the former case can be explained by the formation of a new trochaic foot, (bí.bə).(gʷà.nəm), while the latter case can be explained by the violation of well-formed footing, *(bí).(bà.ba).gʷəm, or the unfaithful realization of the base stress, *(bí.ba).(bà.gʷəm). More study is needed to verify the validity of such an analysis. For now, I ignore the issue of footing and secondary stress.

2.2 Phonological phrasing

In the previous subsection, we discussed word stress. Now, the question is how word stress is projected to a higher prosodic category (phonological phrase) and how accentuation takes place. In this subsection, I present an analysis of phonological phrasing and default intonation in Kwak'wala. By default intonation, I mean the intonation of an all-discourse-new sentence without contrastive focus.

Phonological phrasing is at the core of syntax-phonology mapping. This study follows a well-accepted theory of syntax-phonology mapping, End-based theory (Selkirk 1986, 1995; Truckenbrodt 1999). In this theory, phonological phrasing, or the derivation of prosodic categories higher than the prosodic word, is formalized in terms of edge alignment between prosodic categories and syntactic constituents. Table 1 above shows cross-linguistically well-attested correspondence relations between prosodic categories and syntactic constituents[2].

One issue in syntax-phonology mapping in Kwak'wala is the treatment of clitics that introduce an apparent misalignment between the syntactic phase and the phonological phrase. Kwak'wala is known for its complicated system of deictic marking (Boas 1947, Anderson 2005, Chung 2007). These markers encode various semantic distinctions in different dimensions: case, location, determiner, visibility, and time. What is relevant to the current discussion is that case markers, locative markers, and determiners behave like enclitics; i.e. they are syntactically related to the material to their right but phonologically dependent on the material to their left. See the following example.

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[2] The current version of End-based theory is formalized within the framework of Optimality Theory. Thus, syntax-phonology mapping is explained as an interaction of mapping constraints that require the edge alignment of prosodic categories and syntactic constraints, prosodic structure well-formedness constraints, and syntactic constraints. In this study, I use an OT convention to label constraints. However, since this study is still at the stage of finding generalizations, I will not present a full OT analysis of phonological phrasing in Kwak'wala.

(4) həm'xʔíduχda bədíχa gʷəsú

həm-xʔid-uχ-da	bədi-χa	gʷəsu
eat-Rec.Past-Loc(near 2nd)-Det	cougar-Case(accusative)	pig

'The cougar (near 2nd person) ate a pig.'

The basic word order of the Kwak'wala sentence is VSO. In this example, the locative marker /-uχ/ and the determiner /-da/ of the subject noun are phonologically attached to the preceding verb. The case marker /-χa/ of the object noun is phonologically attached to the preceding subject noun. According to Zwicky (1985), clitics and their phonological host form a prosodic word. This is what Selkirk (1995a) calls 'internal clitics' (PPh[PWd[fnc,Lex]]) or 'affixal clitics' (PPh[PWd[fnc,PWd[Lex]]]).

The phonological dependency of Kwak'wala deictic markers on their phonological host is confirmed by the fact that they participate in various word-internal phonological events. For example, Anderson (2005) shows that deictic markers trigger word-internal epenthesis.

(5) duɢʷətɬ-s → duɢʷətɬts
'It was seen by him'

Anderson (2005:19)

In this example, the oblique case marker /s/ triggers the epenthesis of /t/ after the word final affricate /tɬ/. Another piece of evidence comes from word stress. Deictic markers can bear stress when it is necessary.

(6) n'əmúχda ból

n'əm-uχ-da	bol
one-Loc-Det	ball

'There is a ball.'

In this example, the numeral predicate /n'əm/ loses its stressability due to the resyllabification of its plain sonorant coda as the onset of the following syllable. As a result, stress falls on the deictic marker /-uχ/, which takes a part of the leftmost stressable syllable.

A remaining question is whether deictic markers should be treated as internal clitics or affixal clitics. Kwak'wala has a number of suffixes that trigger the modification of the stem; e.g. suffixes that trigger the expansion of the stem (Boas 1947; Kirchner 2007, 2009; Struijke 1998). As far as deictic markers are concerned, none of them triggers such a stem modification. This suggests that suffixation and cliticization may have different domains. If so, affixal clitics, with two recursive layers of prosodic word, would work better to account for the existence of two different domains. For now, I put the issue aside and take the internal clitic analysis for the sake of simplicity.

A problem arises when we build phonological phrases above prosodic words. Deictic markers are syntactically related to the material to their right, forming a syntactic constituent. At the same time, they are phonologically attached to the material to their left, forming a prosodic word. If we assume that the alignment of prosodic words and phonological phrases is strongly required, deictic markers introduce an apparent misalignment between syntactic constituents (XP) and phonological phrases (Figure 6).

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(                                        )IP
(                    )(          )(      )PPh
(                    )(          )(      )PWd
 həm'-xʔíd  -uχ-da   bədí  -χʷa   gʷəsú
[V          [XP          ][XP          ]]
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Figure 6. Misalignment between XP and PPh

One way to deal with this problem is to assume that the misalignment is an epiphenomenon of a requirement for the left-edge alignment of a prosodic word and a lexical category word, Align(PWd, L; Lex, L), and a requirement for the left-edge alignment of a phonological phrase and a lexical XP, Align(PPh, L; XP^{Lex}, L). This analysis follows the Lexical Category Condition in syntax-phonology mapping (Selkirk 1995a, Truckenbrodt 1999). According to the Lexical Category Condition, mapping constraints apply to lexical elements and their projections, but not to functional elements and their projections. This analysis predicts that in a basic VSO sentence the subject noun and the following clitics form a prosodic word and a phonological phrase, and the object noun forms a prosodic word and a phonological phrase. However, it leaves the phonological phrasing of the verb and the following clitics somewhat unclear. Align(PWd, L; Lex, L) predicts that the verb and the following clitics form a prosodic word. However, if we assume that VSO word order is derived through verb raising (c.f. Carnie 1995), Align(PPh, L; XP^{LEX}, L) does not apply to the verb because there is no lexical XP in this domain (Figure 7).

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(                                        )IP
                     (          )(      )PPh
(                   )(          )(      )PWd
 həm-xʔíd  -uχ-da   bədí  -χʷa   gʷəsú
[V          [XP     [NP ]][XP   [NP    ]]]
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Figure 7. Phonological phrasing with V raising

Alternatively, if we assume that VSO word order is derived through VP raising (c.f. Lee 2006), Align(PPh, L; XP^{Lex}, L) applies to the verb and forms a phonological phrase in this domain (Figure 8).

( )IP
( )( )( )PPh
( )( )( )PWd
həm-xʔíd -uχ-da bədí -χʷa gʷəsú
[[VP][XP [NP]][XP [NP]]]

Figure 8. Phonological phrasing with VP raising

As will be shown the next subsection, the accentuation of verbs shows an idiosyncrasy and it is possible that such an idiosyncrasy comes from a complexity involved in the phonological phrasing in the sentence-initial verb domain. However, a separate study is needed to understand the derivation of basic word order.

2.3 Default intonation

By default intonation, I mean the intonation of an all-discourse-new sentence without contrastive focus. In AM theory, intonation is represented by a string of tonal features: pitch accent and edge tone. Here, I present some acoustic data on default intonation in Kwak'wala. The data presented here are extremely limited and their analyses are impressionistic rather than strictly analytical. However, they at least give us a rough idea of what default intonation in Kwak'wala looks like.

Since pitch is a relative measure, I consider F0 prominence or excursion from a declination line rather than absolute F0 value. Declination is a gradual F0 lowering that takes place throughout the production of an utterance (Cohen and t'Hart 1967). It is largely due to the decrease in sub-glottal air pressure throughout the production (Collier 1975). Here, the declination line, a straight line that represents the rate of declination, is taken to be a reference to measure the degree of local F0 prominence at different points in the utterance (Pierrehumbert 1980; Liberman and Pierrehumbert 1984; Ladd 1984, 1993). There are various methods to calculate the declination line. One traditional method is to draw a line that connects peaks or valleys at both ends of an utterance based on a visual observation (Maeda 1976). However, it has been pointed out that visual observation has a danger of being too subjective. Lieberman et al. (1985) proposed a quantitative method that does not depend on visual observation. Their method uses a linear regression technique; i.e. the declination rate is determined from the slope value of the least squares regression line of all the F0 values of an utterance. This study adopts Lieberman et al.'s method.

10 time-normalized sample F0 values were measured at each vowel in a sentence. Then, all the F0 values were used to calculate the declination line of the sentence. There are two potential confounds that affect the measurement of F0: pitch perturbation and intrinsic pitch of vowels. Pitch perturbation here refers to the effect of pre-vocalic consonant types on the pitch of the following vowel. It is well known that vowels following voiced obstruents begin with a

relatively lower F0 than the same vowels following voiceless obstruents (Hombert 1975). The data examined here are not controlled in terms of per-vocalic context. To reduce the effect of pitch perturbation, consonant-vowel transitions were factored out of the analysis. However, determining where a transition ends is not an easy task. For the current analysis, I took the point where the vowel becomes relatively stable in terms of formant configuration and/or intensity as the end of a transition. Intrinsic pitch of vowels is the effect of vowel quality on pitch. It is known that high vowels have a higher F0 than low vowels (Hombert 1975, Ohala 1987, Sapir 1989, Whalen and Levitt 1995)[3]. The data examined here are not controlled in terms of intrinsic pitch.

Once the declination line was calculated for a sentence, absolute F0 values were converted into values of excursion from the declination line. Then, one representative excursion value was chosen at each vowel according to the following criteria: (1) if the F0 contour of a vowel had a clear peak or valley: i.e., if the maximum excursion value is at least 10% higher than either end point excursion value, or if the minimum excursion value is at least 10% lower than either end point excursion value, the maximum excursion value or the minimum excursion value was chosen respectively; (2) if the F0 contour of a vowel did not have a peak or valley, the mid-point excursion value was chosen. Since it is not clear what aspects of acoustic measurements play a major role in the perception of pitch prominence in Kwak'wala (e.g. absolute F0 level or F0 movement), the representative excursion value should be taken as a tentative measurement.

Elicitation was done with various storyboards. The sentences analyzed here were elicited with the first drawing of each storyboard. This means that they are expected to be all-discourse-new sentences. After showing a drawing that depicts a scene, the researcher asked the native speaker to describe the scene in Kwak'wala. The researcher used English to ask questions. The use of English in elicitation potentially influenced the speaker's production in Kwak'wala.

Figure 9 shows the F0 contour and a phonological phrasing of an all-discourse-new sentence, /kʷéχidoχ páteχo ʒónəsas kʷéχayu/ 'Pat hit John with his bat'.

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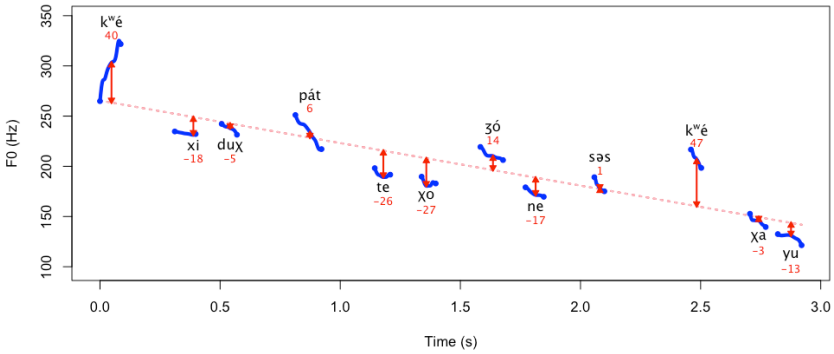
3 See Ohala 1987 and Sapir 1989 for a review of various acoustic explanations of intrinsic pitch of vowels.



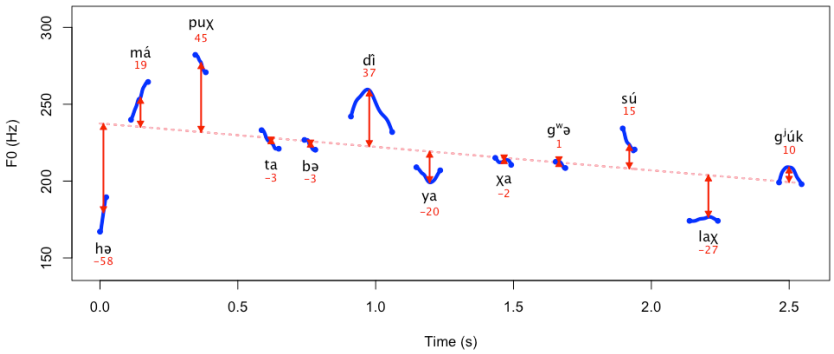
( )IP
( )( )( )( )PPh
( )( )( )( )PWd
kʷéχiduχ páteχo ʒónəsas kʷéχayu

kʷeχ-xʔid-uχ pat-χo ʒon-s-as kʷeχayu
hit-Rec.Past-Loc Pat-CaseJohn-Case-Poss bat
'Pat hit John with his bat'

Figure 9. F0 contour of /kʷéχiduχ páteχo ʒónəsas kʷéχayu/

The dotted line represents the declination line of the sentence. The number at each vowel is the representative excursion value (Hz) of the vowel. The first thing to note is that stressed syllables are aligned with an F0 prominence. This suggests that stressed syllables are associated with a high tone (H*). Stressed syllables, except for the first stressed syllable, have a falling contour, and an F0 drop from a stressed syllable to the following unstressed syllable is often noticeable. This suggests that the high tone is followed by a low tone (+L). The first stressed syllable has a noticeable rising contour. This suggests that there is a low tone at the beginning of the sentence or the left edge of the intonational phrase (%L).

Figure 10 shows the F0 contour and phonological phrasing of another all-discourse-new sentence, /həmápuχta bədíyaχa gʷəsú laχ gʲúk/ 'The cougar is eating a pig in a house'.



( ) IP
( )( )( )( ) PPh
( )( )( )( ) PWd
həmápuχta bədíyaχa gʷəsú laχ gʲúk

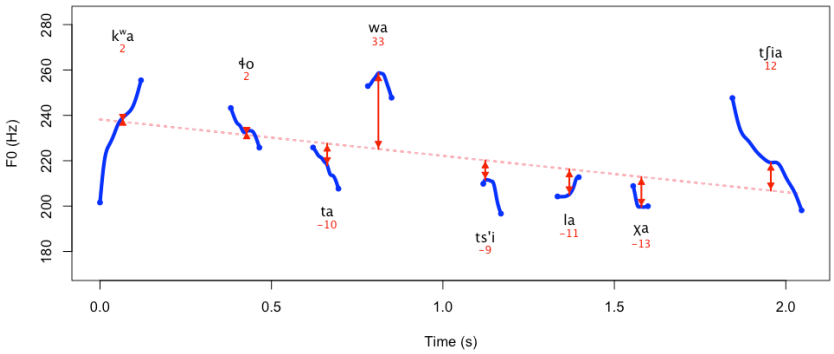
həm-ap-uχ-ta	bədí-ya-χa	gʷəsu	la-χ gʲuk
eat-Taste-Loc-Det	cougar-ʔ-Case	pig	PP-Case house

'The cougar is eating a pig in a house'

Figure 10. F0 contour of /həmápuχta bədíyaχa gʷəsú laχ gʲúk/

What is interesting here is that the stressed syllable in the verb is not aligned with an F0 prominence. One possible explanation for this misalignment is a peak delay due to the presence of a pre-tonic unstressed syllable. Note that the initial unstressed syllable has an extremely low F0, which is probably due to a boundary low tone (%L). It might be the case that this extremely low F0 onset causes a delay of F0 peak in the subsequent syllables. Also note that the second and the third phonological phrases have a pre-tonic unstressed syllable as well but do not show such a peak delay. This suggests that the idiosyncrasy is a positional effect. However, we need to look at more data before making any generalization.

Figure 11 shows the F0 contour and phonological phrasing of another all-discourse-new sentence, /kʷáɬuχta wáts'i laχa tʃiá/ 'The dog is sitting on a chair'. What is interesting here is that the verb has a relatively lower F0 prominence. A major difference between this example and the previous examples is that this example has an intransitive verb while the previous examples have transitive verbs. However, it is not yet clear how such a syntactic difference is reflected in intonational phonology in Kwak'wala. Also note that the final syllable has a noticeable falling contour. This is probably due to a boundary low tone (L%) at the right edge of the intonational phrase.



( ) IP
( )( )( ) PPh
( )( )( ) PWd
kʷáɬuχta wáts'i laχa tʃiá

kʷaɬ-uχ-ta wats'i la-χa tʃia
sit-Loc-Det dog PP-Case chair
'The dog is sitting on a chair'

Figure 11. F0 contour of /kʷáɬuχta wáts'i laχa tʃiá/

In sum, stressed syllables are associated with an F0 prominence and the transition from a stressed syllable to the following unstressed syllable is usually characterized by an F0 drop. These patterns may be analyzed in terms of a pitch accent, H*+L. This analysis, however, does not always apply to the sentence-initial verb domain. In Figure 10, we saw that stressed syllable is not aligned with an F0 prominence in the verb domain. In Figure 11, we saw that the verb domain has a relatively smaller F0 prominence. For the case presented in Figure 10, I suggested that the misalignment might be a consequence of a pitch peak delay due to the presence of pre-tonic unstressed syllable in the sentence-initial position. However, it should be pointed out that since phonological phrasing in the sentence- initial verb domain is not clear it is also possible that such a idiosyncrasy comes from a complexity involved the phonological phrasing. To answer to the question of whether the misalignment is a phonetic realization or a phonological derivation, we need to examine more data from different sentence types including non-canonical word orders such as SVO. Finally, the F0 contour of a sentence always begins with a rise and ends with a fall. These patterns may be analyzed in terms of boundary tones, %L and L%. Figure 8 shows a phonological analysis of the sentence presented in Figure 6. Note that there is a misalignment between a stressed syllable and an F0 prominence in the verb domain.

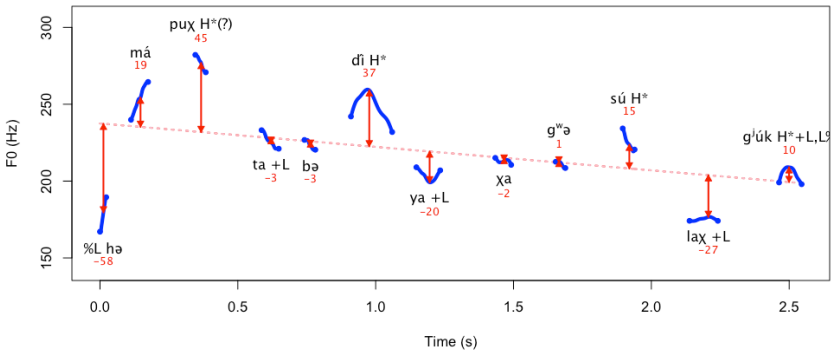


Figure 12. Tonal features of /həmápuχta bədíyaχa gʷəsú laχ gʲúk/

2.4 Summary

In Kwak'wala, word stress falls on the leftmost moraic syllable or the rightmost syllable if there is no moraic syllable in the word. 'Moraic syllable' refers to a syllable with a non-schwa nucleus or a plain sonorant coda. Stress is realized with a longer duration and a higher F0. Phonological phrasing in Kwak'wala is determined by a constraint that requires the left-edge alignment of a prosodic word and a lexical category word, Align(PWd, L; Lex, L), and a constraint that requires the left-edge alignment of a phonological phrase and a lexical XP, Align(PPh, L; XP^{Lex}, L). A stressed syllable is associated with a pitch accent (H*+L) in each phonological phrase. However, this analysis does not always apply to the sentence-initial verb domain. Remember that this study left open the issue of the phonological phrasing in that domain. More study is needed on both the syntax and the phonology of that domain. Finally, an intonational phrase is marked by boundary tones (%L and L%).

3 The semantics – phonology interface

3.1 Focus/information structure and intonation

Semantic input is an important component of intonational phonology. It is well known that focus and information structure affect intonation. In English, in-situ focus is marked by a pitch prominence (Jackendoff 1972, Selkirk 1995b, Ladd 1980). Cross-linguistically, however, connection between focus and pitch prominence is not universal. Zerbian (2006, Chapter 1) presents a comprehensive overview of different focus-marking strategies. According to her classification, there are three major domains of focus marking: prosody, morphology, and syntax. Even within the domain of prosody, pitch prominence is not the only way to mark focus. In some languages, focus is marked through phonological phrasing. A well-known case is the rephrasing and the subsequent

deaccentuation of post-focus material (Kanerva 1990 for Chichewa and Nagahara 1994 for Japanese). In languages like Italian, focus is marked by a pitch prominence, but the nuclear pitch accent has a fixed position and focused material is moved to the prominent position (Zubizarreta 1998).

Another important semantic input to intonational phonology is information structure, particularly the contrast between discourse-newness and discourse-givenness. In English, discourse-given material is deaccented (Chafe 1974, Halliday 1967, Ladd 1980, Vanderslice and Ladefoged 1972). However, it is known that languages like Spanish and Romanian strongly resist the deaccentuation of discourse-given material (Cruttenden 1993, Ladd 1990). Ladd (1980) also points out that the deaccentuation of discourse-given material is structurally conditioned. It is particularly prevalent in the post-focus domain.

Here, the notion of focus should be clarified. According to Jackendoff (1972), focus introduces information that yields a true proposition when it substitutes an appropriate variable in the semantic representation of presuppositional set (λx Presupps(x)). Rooth (1992) elaborates the Jackendoff's idea within the framework of Alternative Semantics. According to Rooth, a sentence with focused material (marked by F) has two semantic values: an ordinary semantic value and a focus semantic value. The focus semantic value of a sentence is "the set of alternatives from which the ordinary semantic value is drawn or a set of propositions which potentially contrast with the ordinary semantic value" (Rooth 1992:76).

(7) [Mary]F likes Sue
Ordinary semantic value: $[\![$[Mary]F likes Sue$]\!]o$ = {like(m,s)}
Focus semantic value: $[\![$[Mary]F likes Sue$]\!]f$ = {like(x, s)|x$\in$E}
where E is the domain of individuals.

One discourse context where focus is relevant is a Wh-question and answer pair. According to Hamblin (1973), the semantic value of a Wh-question is a set of propositions and each proposition is the denotation of a possible answer. In terms of Alternative semantics, the focus semantic value of an answer to a Wh-question is a proper superset of the ordinary semantic value of the question (Rooth 1992).

(8) $[\![$Who likes Bill$]\!]o$ = {like(x,b)|x$\in$E$\wedge$person(x)}
where E is the domain of individuals
$[\![$[John]F likes Bill$]\!]o$ = {like(x,b)|x=John}
$[\![$[John]F likes Bill$]\!]f$ = {like(x,b)|x$\in$E}
where E is the domain of individuals.

There are two major types of focus: presentational focus and contrastive focus. Presentational focus is used to introduce discourse-new information, and it is typically found in an answer to a Wh-question (Gussenhoven 2007) (see the above example). Contrastive focus, in contrast, is used to highlight the contrast between alternatives that are available in the

common ground of discourse, and it is typically found in a corrective statement like *Mary stole the cookies. No, [Peter]F stole the cookies*[4] (Krifka 2006). It is known that the distinction between presentational focus and contrastive focus is reflected in prosody in English (Selkirk 2002), and it plays a crucial role in a current model of the semantic-phonology interface (Féry and Ishihara 2009, Selkirk 2008). In this model, discourse-newness and presentational focus are treated as prosodically unmarked categories and contrastive focus and discourse-givenness are treated as prosodically marked categories. In other words, discourse-newness and presentational focus are realized with default intonation while contrastive focus and discourse-givenness are realized with a derived intonation; the pitch range of the phrase that contains contrastively focused material is expanded (Stress Focus) and the pitch range of the phrase that contains discourse-given material is compressed (Destress Given) (Figure 13).

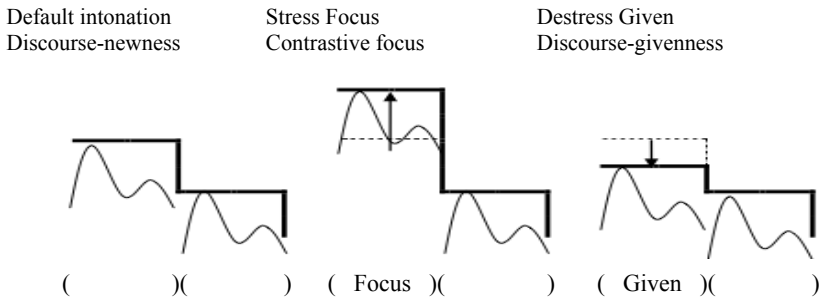


Figure 13. Stress Focus and Destress Given

When we look at a Wh-question and answer pair in the light of this model, it predicts that presentationally focused material in the answer is realized with default intonation and discourse-given material, or the presupposition

[4] A similar distinction was made by Kiss (1998) between information focus and identificational focus. Information focus 'conveys new non-presupposed information without expressing exhaustive identification performed on a set of contextually or situationally given entities' (Kiss 1998:246). Identificational focus, in contrast 'represents a subset of the set of contextually or situationally given elements for which the predicate phrase can potentially hold; it is identified as the exhaustive subset of this set for which the predicate phrase actually hold' (Kiss 1998:245). If we apply Kiss's proposal to the distinction between presentational focus and contrastive focus, it leads us to the question whether presentational focus and contrastive focus are analyzed in the same way in Alternative semantics. As Kiss's definitions suggest, while identificational focus requires alternatives from which particular entities are exhaustively identified, information focus does not necessarily require such alternatives; it merely conveys discourse-new non-presupposed information. If so, Wh-question and answer pairs discussed above do not necessarily invoke alternatives unless they are explicitly expressed as in a case like *Who likes Bill, John or Mary? –* [*John*]F *likes Bill*. Krika (2006:33) treats the difference between these two cases in terms of the difference between open alternatives (open focus) and closed alternatives (closed focus)

repeated in the answer, triggers Destress Given. This study examines whether Destress Given is observed in Kwak'wala. Since it has been known that the deaccentuation of discourse-given material is particularly prevalent in post-focus domain, this study examines post-focus Destress Given.

3.2 Predictions

In order to examine post-focus Destress Given in Kwak'wala, I compared two different focus constructions: subject focus and object focus. Subject focus was elicited as an answer to a subject Wh-question and object focus was elicited as an answer to an object Wh-question. Since the basic word order is VSO in Kwak'wala, in a subject focus construction, the discourse-given object noun that occurs after the focused subject noun would undergo deaccentuation.

(9) Subject focus construction

Q	ʔəngʷi həmapuχ gʷəsu 'Who is eating a pig?'	
A	(həmápuχ)([bədí]F yaχa)↓(gʷəsú)↓ 'A cougar is eating a pig'	post-focus Destress Given

In contrast, in an object focus construction, the discourse-given subject noun that occurs before the focused object noun would not undergo deaccentuation.

(10) Object focus construction

Q	m'atsaɬoχ həmaptsowas bədi[5] 'What is a cougar eating?	
A	(həmápoχ)(bədíyaχa)([gʷəsú]F) 'A cougar is eating a pig'	No post-focus Destress Given

3.3 Elicitation

Each session consisted of fifteen trials, four test trials and eleven filler trials. In each trial, a drawing that depicts a scene was shown to a native speaker, and the researcher asked a Wh-question, subject Wh-question or object Wh-question, in Kwak'wala. Target trials were grouped into pairs for a comparison (Table 4). In each pair, elicited answers shared the same verb, subject noun, and object noun, but differed in focus. A prepositional phrase was added after the VSO string in order to avoid the effect of final F0 lowering due to a boundary tone (L%). Four sessions were held with the same speaker. Note that the task crucially relies on discourse context and the task itself may alter the discourse context. In other words, materials introduced in a trial may be taken as

[5] This question is actually in the passive voice. In Kwak'wala, while subject nouns can be clefted without any morpho-syntactic operation, the clefting of non-subject nouns always requires the nouns to have moved up to the subject position via passivization (Levine 1980, Anderson 1984). This applies to the formation of object Wh-questions. Therefore, this question literally means 'What is eaten by a cougar in the house?'.

discourse-given if the trial is repeated shortly afterwards. Therefore, only one session was held per week. In total, four tokens of each target answer were recorded. However, some of the tokens were discarded because of their 'unnatural' characteristics such as an extremely long pause or laughter.

Pair	Focus	Context question and target sentence	Tokens
1	Subject	ʔəngʷi həmapuχ gʷəsu laχa guk 'Who is eating a pig in a house?' həmápuχ bədíyaχa gʷəsú laχa gúk 'A cougar is eating a pig in a house'	3
	Object	m'atsaɬuχ həmaptsowas bədi laχa guk 'What is a cougar eating in a house?' həmápuχ bədíyaχa gʷəsú laχa gúk 'A cougar is eating a pig in a house'	3
2	Subject	ʔəngʷi həmapuχ k'utɬa laχa atɬi 'Who is eating a fish in the forest?' həmápuχ bədíyaχa k'útɬa laχa átɬi 'A cougar is eating a fish in the forest'	3
	Object	m'atsaɬuχ həmaptsowas bədi laχa guk 'What is a cougar eating in a house?' həmápoχ bədíyaχa k'útɬa laχa gúk 'A cougar is eating a fish in a house'	2

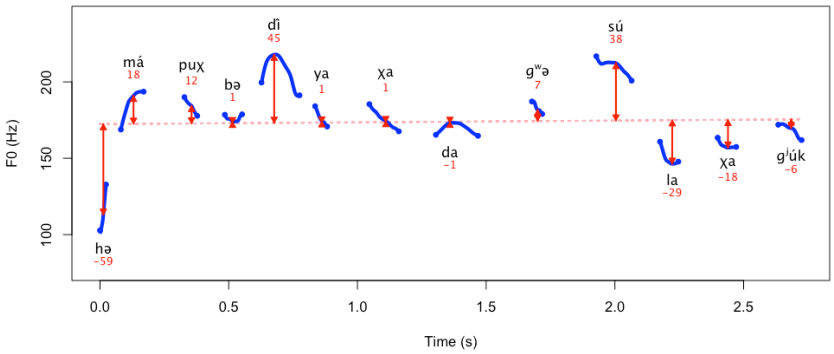
Table 4. Target answers and context questions

3.4 Measurements

F0 prominence was measured in the verb, subject noun, and object noun, using the same method described in the previous section. Having the same words in different focus constructions allowed for control of the effect of intrinsic pitch of vowels; the comparison was always made between the same vowels.

3.5 Results

Figure 14 shows the F0 contour of a sentence with object focus. Square bracket with F indicates a focused material. In this figure, a stressed syllable is aligned with an F0 prominence in each phonological phrase, except for the last one. Since the last phonological phrase contains discourse-given material and occurs in the post-focus domain, the reduced F0 suggests the occurrence of post-focus Destress Given. However, the F0 prominence of the sentence-final prepositional phrase shows a large amount of variation irrespective of focus construction. Moreover, the speaker's voice often gets very creaky towards the end of an utterance and it makes the measurement of F0 in that position difficult. Therefore, the current analysis focuses on the VSO string.



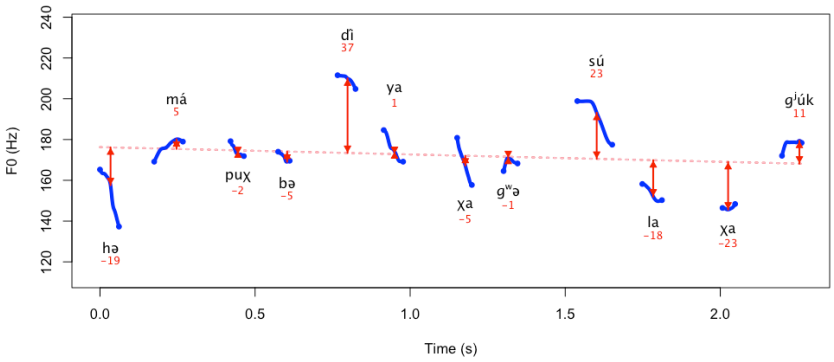
(həmápoχ)(bədíyaχada)([gʷəsú]F laχa)(gúk)

həm-áp-oχ	bədí-ya-χa-da	gʷəsú	la-χa	gúk
eat-?-Loc	cougar-?-Case-Det	pig	PP-Case	house

'A cougar is eating the pig in a house.'

Figure 14. Object focus

Figure 15 shows the F0 contour of the same sentence with subject focus. In this figure, a stressed syllable is aligned with an F0 prominence in each phonological phrase. However, the F0 prominence of the verb is much more reduced than that of Figure 14. In the post-focus domain, there is a downtrend in F0 contour from the focused subject noun to the post-focus discourse-given object noun. The same trend is observed between the pre-focus discourse-given subject noun and the focused object noun in Figure 14. However, the degree of downtrend is larger in Figure 15. This suggests the occurrence of post-focus Destress Given. Another point to note is the presence of the determiner /da/ before the focused object noun in Figure 14. Two tokens of object focus construction contain the determiner before the focused object noun. A recent study argues that the determiner /da/ functions as an ostention marker that might serve as a focus marker as well (Black 2011). In this study, even though the occurrence of /da/ is not consistent, when it occurs, it occurs with a focused object noun. Interestingly, it does not occur with focused subject nouns in the data examined here.



(həmápoχ)([bədí]F yaχa)(gʷəsúlaχa)(gúk)

həm-áp-oχ	bədí-ya-χa	gʷəsú	la-χa	gúk
eat-?-Loc	cougar-?-Case	pig	PP-Case	house

'A cougar is eating a pig in a house.'

Figure 15. Subject focus

Table 5 and Figure 16 show the summary of the quantitative analysis. Table 5 shows the mean of F0 excursion values (Hz) at three different positions, the verb, subject noun, and object noun, in two different focus constructions.

	Verb	Subject noun	Object noun
Object focus	2.53 (N=5, sd=15.47)	35.69 (N=5, sd=8.78)	41.83 (N=5, sd=8.98)
Subject focus	19.04 (N=6, sd=12.00)	38.75 (N=6, sd=7.98)	33.80 (N=6, sd=10.28)

Table 5. Mean F0 excursion values (Hz) in subject focus and object focus

The first thing to note is that the verb has a noticeably smaller F0 excursion in the object focus construction. Since the verb is always discourse-given in both focus constructions, Destress Given does not explain the difference. The subject noun has a similar F0 excursion in both focus constructions. The object noun has a smaller excursion in subject focus construction. These last two observations seem to follow the prediction that post-focus discourse-given material is deaccentuated. Two-sample t-tests were performed between the mean F0 excursion values in two different focus constructions. The results show that there is a weakly significant difference at verb position ($t = 1.9475$, $df = 7.507$, p-value = 0.0897), but no significant difference at subject noun position ($t = 0.5982$, $df = 8.269$, p-value = 0.5657) and object noun position ($t = -1.3826$, $df = 8.959$, p-value = 0.2003).

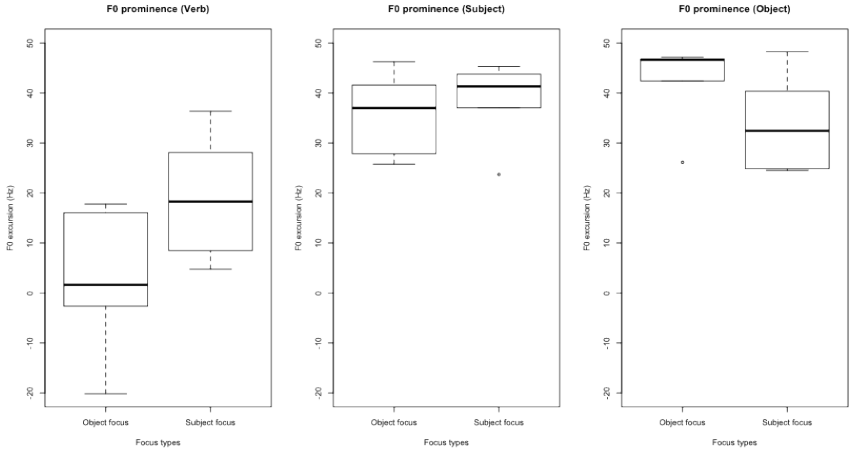


Figure 16. Differences in object focus and subject focus constructions

These results do not support the observation presented above. However, the data still shows an interesting pattern. If we focus on the global F0 contour, there is a clear difference between the two focus constructions. In the object focus construction, the global F0 contour shows a continuous rise from verb to object noun. In contrast, in the subject focus construction, the global F0 contour rises from verb to subject noun and then falls to object noun (Figure 17).

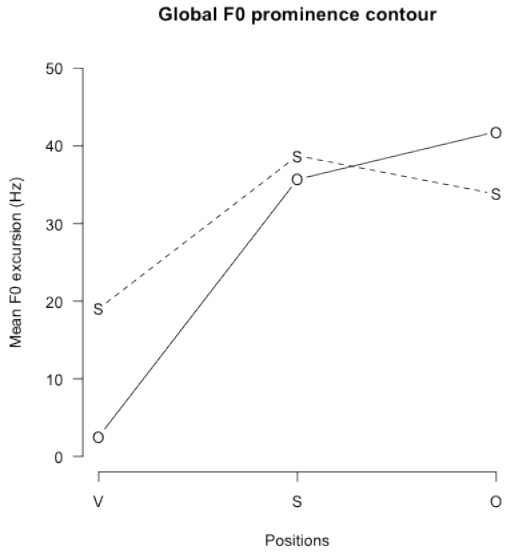


Figure 17. Global F0 prominence contour in subject focus (S) and object focus (O) constructions

Table 6 summarizes the differences in F0 excursion between subject noun and object noun in the two different focus constructions.

	Mean F0 excursion difference (Object-Subject) (Hz)	Tokens
Object focus	-4.95	5
Subject focus	6.14	6

Table 6. Differences in F0 prominence between subject noun and subject noun

A two-sample t-test was performed on the mean F0 excursion differences between the object focus and subject focus constructions, and the results showed that the difference is weakly significant ($t = 1.65$, $df = 8.68$, p-value = 0.1343).

3.6 Discussion

Despite their small number, the data examined here show some interesting patterns or tendencies. First, there is a difference in global F0 contour between object focus and subject focus constructions. In the object focus construction, the F0 contour rises from verb to object noun. In contrast, in the subject focus construction, the F0 contour rises from verb to subject noun, then falls to object noun. A possible analysis of these patterns is that the post-focus discourse-given object noun is deaccented while the pre-focus discourse-given subject noun is not. This follows the prediction made by post-focus Destress Given. Another interesting observation is that the F0 prominence of the verb is more reduced in the object focus construction than in the subject focus construction. Since the verb is always discourse-given in both conditions, Destress Given alone does not explain the difference. Moreover, the accentuation pattern of the verb is not entirely clear in this study. A possible analysis of these patterns is rephrasing in the pre-focus domain. In the object focus construction, phonological phrases in the pre-focus domain (verb and subject noun) are collapsed into a single phonological phrase, and a pitch accent is reassigned to the rightmost stressed syllable of the new phonological phrase. As a result, the verb loses its F0 prominence. In contrast, in the subject focus construction, since there is only one phonological phrase in the pre-focus domain (verb), such a rephrasing does not take place. Impressionistically, this analysis nicely accounts for the difference between Figures 10 and 11. It is worth examining the validity of such an analysis in future research.

4 General summary

In section 2, I discussed word stress, phonological phrasing, and default intonation in Kwak'wala. Word stress falls on the leftmost moraic syllable. 'Moraic syllable' refers to a syllable with a non-schwa nucleus or a plain sonorant coda. If there is no moraic syllable in a word, stress falls on the rightmost syllable. Word-final position seems to be a prosodically privileged position. Bimoraic syllables, or syllable with a non-schwa nucleus and a plain

sonorant coda, only occur in that position. Stress is realized with a longer duration and a higher F0.

Phonological phrasing in Kwak'wala seems to be determined by a constraint that requires the left-edge alignment of prosodic word and lexical category word, Align(PWd, L; Lex, L), and a constraint that requires the left-edge alignment of phonological phrase and lexical XP, Align(PPh, L; XP^{LEX}, L). This study, however, left open the question of phonological phrasing in the sentence-initial verb domain. Default intonation is derived by the assignment of a pitch accent (H*+L) to a stressed syllable in each phonological phrase and the assignment of edge tones (%L and L%) in the intonational phrase. The accentuation pattern, however, does not always apply to the verb. Along with the issue of phonological phrasing, accentuation in the verb domain needs more study.

In section 3, I examined post-focus Destress Given in Kwak'wala. I compared two different focus constructions, object focus and subject focus. The data examined in this study showed some interesting patterns. First there is a difference in the global F0 contour between object focus and subject focus constructions. In the object focus construction, the global F0 contour rises from verb to object noun. In contrast, in the subject focus construction, the global F0 contour rises from verb to subject noun, then falls to object noun. These patterns follow the prediction made by post-focus Destress Given. Second, there is a difference in the F0 prominence of the verb between the object focus and subject focus constructions. The F0 prominence of the verb is more reduced in the object focus construction than in the subject focus construction. A possible analysis of these patterns is rephrasing in pre-focus domain. However, we need to look at more data before making any generalizations.

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