7
Accent and tone in Arapaho, Plains Algonquian

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7.1 Introduction

This chapter focuses on word-level prominence in Arapaho (Hinóno'eitíít), a severely endangered Plains Algonquian language spoken by approximately 1000 people, most of them in Wyoming and Oklahoma (see Cowell and Moss 2011: 1–3). In this chapter I propose a novel analysis of the stress system of Arapaho. I argue that it is best analyzed as a *lexical accent* system, i.e. the position of accent within a morpheme is phonologically unpredictable and is part of the underlying phonological form of the morpheme. As in other lexical accent languages (Bogomolets 2020; Revithiadou 1999; van der Hulst 2010), while the underlying position of an accent within a morpheme is generally unpredictable, a small number of regular rules governs the distribution of stresses within a word. The defining role in the system belongs to (i) the underlying specification of some syllables within some morphemes as carrying accent, to (ii) an accent competition resolution whereby the rightmost of competing accents wins, and to (iii) a trisyllabic stress 'window' aligned to the right edge of a morphological word. Stress must be present within the final three syllables of every morphological word, while a default penultimate accent is the result of an iambic foot followed by an extrametrical syllable.[1]

Data from a number of Algonquian languages have informed theoretical literature on stress/accent/prominence: Halle and Vergnaud (1987); Hayes (1995); Kaye (1973); Stowell (1979); Valentine (1994). Most of the Algonquian languages, which have received attention in theoretical accounts, have been analyzed as having iambic stress systems (see Rice 2010 and this volume for an overview). Plains Algonquian languages, however, appear to be exceptional in the family with respect to the features of prominence.[2] Arapaho presents a number of typologically unusual stress properties. Firstly, multiple 'primary' stresses are allowed within a

[1] In §7.2.2 I formalize this using the terminology of van der Hulst (2012).

[2] It is important to remember that Plains Algonquian is usually not considered a genetic subgroup but rather an areal or geographic grouping (Goddard 1979; Mithun 1999; for an alternative view see Proulx 2003). Among the Plains Algonquian languages, Blackfoot has been shown to be the most divergent phonologically and lexically (Goddard 1996), while Arapaho exhibits a wide range

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morphological word. Secondly, despite the fact that accent in the language is *lexical,* i.e. it is not predictable from phonological properties of morphemes or words and has to be lexically specified, the system of accent assignment in Arapaho does not make any meaningful reference to the morphological structure. This is evident in a number of properties of the system. Firstly, underlyingly accented morphemes of all kinds (prefixes, suffixes, roots, and clitics) are treated in the same way, and underlyingly unaccented morphemes of all kinds are treated in the same way as well. Secondly, there is no evidence that morpho-syntactic structure affects stress assignment: for instance, the most embedded morphemes and the least embedded morphemes within complex morphological words show identical stress patterns; morphemes which could be analyzed as inflectional show the same stress patterns as morphemes which could be analyzed as derivational; and there are no differences in the stress behavior between words belonging to different morphological classes. Morphological structure does not play any role in the resolution of accent competition in the language either. Specifically, I show that in the situation of accent competition, the rightmost of the competing accents is realized as primary stress across the board regardless of its affiliation with any particular kind of morphemes. The Arapaho stress system thus brings forward the point that *lexical accent* does not equal to *morphologically-conditioned accent.*[3] Finally, Arapaho is typologically unusual in that it uses the acoustic cues of stress (fundamental frequency modulations and duration) in both segmental and prosodic contrasts. In what follows, I discuss these properties in detail.

This chapter is organized as follows. I first briefly introduce the basics of the morphological and phonological system of Arapaho (§7.1.1–7.1.2). I then present the acoustic side of the Arapaho prominence in §7.2.1, where I propose a relativized version of the *Functional Load Hypothesis* (Berinstein 1979). I argue that a weaker version of the *Functional Load Hypothesis* is motivated by the fact that Arapaho seems to be utilizing the same acoustic cues (vowel duration and modulations of F0) in both cuing stress and in cuing other contrasts in the language (phonemic vowel length and marking lexical tone respectively). The central empirical generalizations regarding the distribution of stress in Arapaho are presented in §7.2.2. An examination of these generalizations leads to the conclusion that although the position of stress in a given morpheme is unpredictable (i.e. Arapaho is a *lexical accent* language), the distribution of stresses within a morphological word can be explained with a highly constrained account. §7.2.3 discusses the issue of stress Culminativity in the language. In §7.3, I provide a brief overview of the

of morpho-syntactic innovations (Bogomolets et al. 2018; Cowell and Moss 2011). These languages nevertheless share multiple linguistic features (Goddard 1994; 2001).

[3] I refer the reader to Bogomolets (2020: Chapter 1) for a discussion of the distinction between lexical accent languages which require morphological information in their stress assignment and lexical accent languages which, like Arapaho, do not make any non-trivial reference to the morphological structure.

tone system in Arapaho which is independent from stress in the language. Finally, §7.4 provides some conclusions.

Before moving on to the presentation of the Arapaho prominence, a note on terminological conventions is in order. It is well-known that the terms 'stress' and 'accent' are somewhat problematic. In this chapter I follow the distinction between the two elaborated in detail in van der Hulst (1996, 2010, 2011 and other works). In this view, the term *accent* is used to mean an abstract property of a unit, a lexical mark, which does not provide any information about the phonetic cues, while *stress* is used to mean the phonetic or phonological manifestation of *accent* (see also Hyman 2006, 2009 for a discussion of the two terms). Consequently, the terms *primary stress* and *secondary stress* refer to the degrees of phonetic strength. I use the term *lexical accent* to refer to an abstract autosegmental feature, which is supplied for some syllable(s) within some morphemes in the lexicon of *lexical accent languages* (see for instance Alderete 2013, 2001; Bogomolets 2020; Revithiadou 1999). Lexical accent languages are contrasted with languages which have *phonologically predictable accent* where accent placement can be predicted from syllable weight and/or distance from the word edges (see Bogomolets and van der Hulst this volume). Finally, I adopt a general and most simplistic definition of *rhythm* for now taking *rhythm* to refer to an alternation of phonetically and/or phonologically strong and weak syllables organized in a principled way (see also Bogomolets 2020: 219–261).

Data in this chapter come from a number of sources: from fieldwork conducted and generously shared with me by Ives Goddard and Andrew Cowell, from the author's fieldwork conducted under the supervision of Andrew Cowell in 2013–2014, as well as from the descriptive grammar of the language (Cowell and Moss 2011) and from descriptions available in the literature (Cowell n.d.; Goddard 1974, 2015).

7.1.1 Morpho-syntactic background

Algonquian languages have a characteristically complex morphological system and have been described as polysynthetic, non-configurational, and head-marking.[4] Overt nominals are optional and syntactic arguments are frequently expressed via agreement on the verb. Verb forms can get quite long and morphologically complex, and it is usual for them to stand on their own as separate clauses. As an illustration of the possible morphological complexity of both nominal and verbal words in Arapaho consider the following (simplified) templates.

[4] In this chapter, I use theory-neutral terms 'highly synthetic languages' or 'languages with complex morphology' to refer to the set of languages that are traditionally called polysynthetic; see for example Fortescue et al. (2017) and the introduction to this volume for an overview of the terminological issues in this area.

Figure 7.1 presents the template of a morphologically complex nominal (based on Cowell and Moss 2011: 51–72, 99–119). A noun can have overt marking for features such as case, number, and obviation (slot +4), and possessor features in both prefixes (slot −2) and suffixes (slots +3 and +5). It can also include one or more incorporated bound or free root-like morphemes (slots −1, +1).

−2	−1	0	+1	+2	+3	+4	+5
Person (possessor)	Incorporated Root (modifier)*	Root	Incorporated Root*	Diminutive	Possession Theme	Inflection (PL/LOC/VOC/OBV)	Possessor PL
*Iterable							

Figure 7.1 Nominal template (head root in gray, slot 0).

Consider an example of a morphologically complex noun in (1) below[5]:

(1) no-wox-'uheh-'ib-eʔ
1-bear-DIM-POSS-LOC
'on my little bear' (Cowell and Moss 2011: 108)

Verbal morphological complexity is even more striking in Arapaho, as it is in all Algonquian languages. Figure 7.2 presents the template of a morphologically complex verb (based on Cowell and Moss 2011: 73–98, 121–188, 205–239). The pre-root part of a verb can include a large number of inflectional and derivational morphemes marking tense, aspect, mood (slots −2, −4, −5, −7), negation (slot −3), and person agreement (slot −6). The root in a verbal form can also be preceded by one or more incorporated roots (slot −1); these morphemes express a variety of adverbial, quantificational, and aspectual meanings. The post-root part of a verbal word may include incorporated lexical material as well (slot +1), inflection marking agreement with one or more arguments (slots +2, +3), and mood marking (slot +4).

[5] Traditional orthography is used in this chapter except for two sound-letter correspondences: 1. the traditional orthographic sign for the glottal stop (') – apostrophe has been substituted with the IPA glottal stop symbol to avoid the confusion with the IPA stress diacritic used throughout this chapter; 2. the traditional orthographic symbol for the dental non-sibilant fricative (*3*) has been substituted with the IPA symbol (θ) for ease of reading. Additionally, stresses are marked with acute accents in the dictionaries, grammars, and sketches of Arapaho (e.g. Cowell and Moss 2011; Goddard 1979, 2015; Salzmann 1983). I use the IPA stress diacritics throughout this chapter for marking stress. See Tables 7.1 and 7.2 for the rest of the IPA-orthography correspondences.

−7	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4
Clause Type/Mood	Person	Tense	Aspect II	Negation	Aspect I	Incorporated Root (adverbials)*	Root	Incorporated Root*	Agreement Inflection I	Agreement Inflection II	Mood
*Iterable											

Figure 7.2 Verbal template (head root in gray, slot 0).

Consider an example of a morphologically complex verb in (2):

(2) hoo'wu-niʔ-cih-'noho'ʔuhce'hi-noʔ
NEG-able-to.here-jump.up-3PL
'They couldn't run/jump up here.' (Cowell and Moss 2011: 226)

If overt nominals do occur, their order is largely governed by pragmatic and discourse factors (for recent formal accounts of Algonquian morphosyntax see Bliss 2013; Bogomolets et al. 2018; Déchaine 1999; Déchaine and Wiltschko 2010; LeSourd 2006; Oxford 2014 among many others).

7.1.2 Phonemic inventory and syllable structure

Arapaho has twelve consonants, three vowels with contrastive length, and three diphthongs. The inventory of consonants with the standard orthographic form in parentheses is given in Table 7.1 (adapted from Cowell and Moss 2011: 14):

Table 7.1 Phonemic inventory of Arapaho consonants

	Labial	**Dental**	**Alveolar**	**Palatal**	**Velar**	**Glottal**
Plosive	b (b)		t (t)		k (k)	ʔ (')
Fricative		θ (3)	s (s)		x (x)	h (h)
Affricate				t͡ʃ (c)		
Nasal			n (n)			
Glide	w (w)			j (y)		

Arapaho has only three phonemic vowels listed in Table 7.2 below (standard orthographic form in parentheses).

The high front vowel /i/ has a high back allophone which is orthographically represented as *u* in Arapaho. Synchronically, all occurrences of this allophone, with just a few exceptions of unknown origin, can be explained as an outcome of

Table 7.2 Phonemic inventory of Arapaho vowels

	Front	**Back**
High	i (i)	
Low	ɛ (e)	ɔ (o)

the backness vowel harmony process (Cowell and Moss 2011: 15–16). The phonetic quality of the high back vowel has been defined in Goddard (1974: 1119) as 'lower-high back unrounded' [ɯ], which is consistent with my auditory impression and with the results of an instrumental analysis conducted in Bogomolets (2014). There are no minimal pairs based on the [i]-[ɯ] contrast in the language. Moreover, the distribution of [ɯ] is restricted with respect to the consonantal environment: /b/,/t͡ʃ/, /n/, /s/, /t/, /θ/, and /j/ never occur before [ɯ].[6] Goddard (1974) posits a three-vowel system for Proto-Arapahoan consisting of /i/, /e/, /o/, and I analyze the modern Arapaho system as containing these three-vowel phonemes as well (see also Picard 1994 for a diachronic account of the development of the Arapaho vowel system). The non-phonemic status of [ɯ] is somewhat obscured by the orthographic tradition where it has an independent status (being written as *u*). Although three-vowel systems are not uncommon cross-linguistically, the distribution of vowel qualities in the vowel space found in Arapaho is typologically highly unusual if not unique (cf. Maddieson and Precoda 1989; Ladefoged and Maddieson 1990; Schwartz et al. 1997). The UCLA Phonological Segment Inventory Database (UPSID, Maddieson 1984) includes 23 languages with three-vowel systems (about 5% of all languages in UPSID), but none of them has an Arapaho-like vowel distribution.[7]

All vowels in the language can occur in two contrastive lengths, short and long; vowel length is conventionally shown with vowel doubling in the orthography; consider examples in (3) below:

(3a) 'hisiʔ 'tick' vs. 'hiisiʔ 'day'
(3b) 'hocoo 'steak' vs. 'hoocoo 'devil'
(3c) heces- 'small' vs. heeces- 'before' (Cowell and Moss 2011: 14–15)

[6] This can be explained by the fact that virtually all instances of the high back allophone of /i/ are a result of the backness vowel harmony process with the [−back] consonants blocking the backness harmony. In Arapaho, backness vowel harmony which can be seen as the acquisition of [+back] feature, is blocked by all elements with the conflicting [−back] feature (see Bogomolets 2022).

[7] The other two Plains Algonquian languages have small vowel inventories as well. Different dialects of Blackfoot have been reported to have the systems /i o a/ (Elfner 2006: 141) and /i u a/ (Kaneko 2000: 12–16) with contrastive lengths. Cheyenne has the vowel system /e o a/ (Leman 1981). There are other examples of identical systems in UPSID: Alabama (Muskogean) and Amuesha (Arawakan) have been reported to have /e o a/, and Pirahã has been reported to have the /i o a/ system (based on UPSID, Maddieson 1984). Such vowel inventories are also very unusual. /i u a/, on the other hand, is typologically unmarked.

In the traditional spelling of Arapaho, we find sequences of up to three vowels of the same or of different quality as exemplified in (4) below:

(4a) 'booo 'road'
(4b) 'hiii 'snow'
(4c) 'hooo 'bed'
(4d) hi'heio 'his aunt' (Cowell and Moss 2011: 43, 44, 46, 346)

Even though the three-vowel sequences are represented orthographically as an unparsed string of vowels, the orthographic tradition exemplified in (4) is not reflecting the phonetic reality as there is a clear phonetic marking of the syllable boundaries in sequences of three vowels: speakers epenthesize an audible consonantal element at the syllable break. Impressionistically, the quality of the epenthetic consonant varies between a voiced glottal fricative, a voiceless glottal fricative, a voiced velar fricative, and a glottal stop. The observation of the maximally bimoraic nucleus has been included in some of the existing sources on the phonology of Arapaho (Cowell and Moss 2011; Goddard 1979), while Cowell and Moss (2011: 41–42) also note in passing that an epenthetic glottal stop tends to be inserted at the syllable boundaries in the three-vowel sequences (see also Bogomolets 2020: 46–48). Due to the potential difficulty with reliably locating stress in such sequences, in this chapter, I focus on stress patterns in short and long vowels which are not part of the (orthographic) tri-vocalic sequences.

In addition to short and long vowels, Arapaho has three diphthongs - /ei/, /ou/, /oe/, bold-faced in (5) below:

(5a) 'hi.s**ei** 'woman'
(5b) wo.'s**ou**h.ʔun 'sock'
(5c) woθo'noho'ʔ**oe** 'pen, pencil'
(Cowell n.d.: 6; Cowell and Moss 2011: 18, 35)

Long diphthongs are disallowed in the language since tautosyllabic tri-moraic sequences are not permitted. Cowell (n.d.) notes, amending Cowell and Moss (2011), that orthographic tri-vocalic sequences which potentially could be analyzed as 'long diphthongs' historically all in fact originate from the loss of intervocalic *k in bi-syllabic sequences, and they retain their bi-syllabicity in the modern language:

(6) Proto-Algonquian origins of the Arapaho diphthongs
(6a) *saaki- > no.uu[8]- 'out(side)'
(6b) *akoocin-wa > ho.uuθine[9]- 'to hang' (Cowell n.d.: 12)

[8] Word-initially, Proto-Algonquian *s becomes /n/ in Arapaho as a regular (albeit surprising) historical correspondence (rule 10a in Goddard 1974: 107).

[9] The asterisk sign (*) is used in the Proto-Algonquian examples with the meaning 'reconstructed' rather than 'ungrammatical'.

Just like with the tri-moraic sequences above in (4), the bi-syllabic status of the tri-moraic sequences involving a diphthong is phonetically evidenced by epenthetic consonants.

The permissible syllable shape is schematized in (7) below. In (7), parentheses indicate optionality. The vocalic nucleus – V – can be short, long, or a diphthong; the coda (C_{coda}) may be either a single consonant or /hC/. Onsetless syllables are not permitted, and consonant clusters are prohibited in the onsets (see Picard 1994: 113–137 for the historical development of the Arapaho clusters and cf. Denzer-King 2012 for an analysis of consonant clusters in Blackfoot).[10]

(7) $C_{ons}V((h)C_{coda})$

In the absolute beginning of the word, all morphemes, which underlyingly begin with a vowel, get epenthesized with a voiceless glottal fricative, orthographically 'h'. Contrast the form of the future tense prefix /et-/ in examples in (8a) and (8b) below. While in (8a) the future prefix /et-/ has its underlying vowel-initial form, in (8b), where the prefix is word-initial, it has the epenthesized form due to the constraint on the onsetless syllables:

(8a)	'ne**et**.cii.bi.θi.'hi.noʔ	FUT prefix word-internally
	ne-**et**-cii-biθihi-noʔ	
	1-FUT-NEG-eat-12	
	'We're not going to eat.'	
(8b)	'**heet**.bii.θi.'hi.noo	FUT prefix word-initially
	h<e>et-biiθihi-noo	
	<IC>FUT-eat-1SG	
	'I will eat.'	(Cowell and Moss 2011: 93, 259)

Word-internally a number of resolutions are available for onsetless syllables, including resyllabification, consonant epenthesis, and vowel deletion.

7.2 Stress in Arapaho

This section presents the core data and analysis of the stress system of Arapaho. I first briefly discuss the acoustic correlates of prominence in the language, and after that I present the phonological patterns of accent distribution and accent competition in the language. It will be shown that the distribution of stress in Arapaho is best accounted for with a *lexical accent* analysis whereby both roots and affixes

[10] I thank an anonymous reviewer for pointing out to me that all syllable structures in the language can be captured with a single schema (7).

may be underlyingly accented. It will also be shown that the Arapaho accent does not make any reference to the complex morphological system of the language.

7.2.1 Acoustic correlates of stress

Arapaho makes use of all four groups of acoustic cues involved cross-linguistically in signaling stress (see Gordon and Roettger 2017 for a cross-linguistic overview): duration, fundamental frequency, spectral qualities, and amplitude (Bogomolets 2014). It, however, appears to be quite unique in using different cues for phonemically long vs. phonemically short vowels. Stress on phonemically long vowels in Arapaho produces extra length, while stress on phonemically short vowels is manifested through significantly higher mean F0 throughout the stressed vowel. Higher pitch on stressed short vowels is also correlated with significantly higher mean amplitude throughout the stressed vowel and significantly higher mean amplitude peak (see Bogomolets 2014 for details; see Lehiste 1970; Titze 1989 for a discussion of the correlation between pitch and intensity). Additionally, a comparison of spectral qualities of stressed vs. unstressed vowels has revealed that values of the first two formants differ for low vowels (both phonemically long and phonemically short) - /ɛ/ and /ɔ/. When unstressed, /ɔ/ is shifted toward [ə], /e/ gets fronted and raised toward [ɪ]. Unstressed /i/ and [ɯ] do not show any significant changes in quality when compared with their stressed counterparts, which seems to be cross-linguistically a common quality-reduction pattern (see, for example, Crosswhite 2001 for a detailed discussion of comparable patterns in Russian). Interestingly, phonemically short high vowels when unstressed 'compensate' for the lack of quality reduction with extensive quantity reduction. Cowell and Moss (2011: 47) observe that in their database short unstressed /i/ and [ɯ] are syncopated two-thirds of the time, while short unstressed low vowels are only syncopated in less than 5% of the cases. Quality and quantity vowel reduction can thus be considered an additional cue of stress in Arapaho.

The resulting system of acoustic contrasts in Arapaho presents an interesting picture from the point of view of the *Functional Load Hypothesis (FLH)* which postulates that acoustic parameters involved in segmental contrasts in a language will be dispreferred as cues of stress in that language (Berinstein 1979). For instance, a language with phonemic vowel length is predicted to avoid cueing stress with vowel duration. Arapaho, however, contrastively uses duration (as vowel length) and pitch modulations (as restricted lexical tone; see §7.3 for details). Thus, an interesting question is in what way stress can exist and be phonetically manifested in a language which uses the primary acoustic correlates of stress (pitch and duration) for other purposes. The Functional Load Hypothesis has been a source of debate ever since its first formulation with some studies finding strong supporting data for it (e.g. Creek, Martin 2011; Fijian, Dixon 1988; Hungarian,

Vogel et al. 2016), and others pointing out languages which seem to go against the predicted patterns (Aleut, Rozelle 1997; Taff et al. 2001; Chickasaw, Gordon 2004; see also Lunden et al. 2017 for an overview of the reported correlates of stress for 140 languages in the relation to the use of contrastive duration). In a recent overview, van Heuven (2019) proposes that FLH might only be valid within the domain of prosodic contrasts and not in the interactions between segmental distinctions and prosodic properties.

The Arapaho stress however appears to be sensitive to both – segmental and prosodic contrasts. Phonemically short vowels are not lengthened when stressed since it could potentially obscure the phonemic vowel length contrast; the lengthening of phonemically long vowels, however, does not introduce such an ambiguity. Thus, phonemically long vowels are lengthened when stressed. On the other hand, lexical tone in Arapaho is only ever found on phonemically long vowels (see §7.3 for details) and using pitch modulation to cue stress on phonemically long vowels could be ambiguous. However, lexical tone can never surface on phonemically short vowels which makes higher F0 an available (and unambiguous) stress cue for phonemically short vowels. To my knowledge, a system of this kind has not been reported before. To account for this pattern, I propose the following formulation of FLH:

(9) Relativized Functional Load Hypothesis (RFLH)
A language with a phonological contrast *C* will not use cues associated with *C* in signaling stress in as much as using them has a potential for creating an ambiguity.
(where *C* is either segmental or prosodic)

The Relativized FLH (9) is a weaker form of the original FLH: it states that acoustic properties involved in segmental contrasts, prosodic contrasts (outside of stress), or both will be avoided as correlates of stress but only to the extent necessary to avoid a systematic ambiguity. In other words, a language might use vowel length as a segmental contrast *and* as an acoustic cue of stress *iff* an ambiguity does not arise. The weak version of the FLH proposed here aims to capture the following observations: (a) *contrary to* the original FLH, we do find languages using duration for both stress and vowel length contrast, but (b) *in accordance with* the original FLH, we find that ambiguity is always avoided.

Arapaho shows one possible strategy of avoiding the stress correlates ambiguity. Aleut is another language often cited as a counterexample to Berinstein's FLH (Rozelle 1997; Taff et al. 2001). Aleut uses vowel length contrastively, and thus, by the original version of FHL, it is predicted to avoid vowel duration as a cue of stress. Taff et al. (2001), however, show that stressed vowels, both phonemically short and phonemically long, are significantly longer than their unstressed counterparts. Unstressed short vowels are on average 64 ms long while unstressed long vowels are 130 ms long. Short vowels bearing stress are 78 ms long on average,

while long vowels when stressed average 151 ms. Through a series of statistical tests, the authors show that, firstly, vowel duration is a correlate of stress in Aleut, and, secondly, that the average durations of a short *stressed* vowel (78 ms), and a long *unstressed* vowel (130 ms) are significantly different. Thus, crucially, although stress affects duration in both long and short vowels, the contrast between phonemically short and phonemically long vowels is preserved, and the ambiguity of the phonemic vowel length vs. stress-induced vowel lengthening is not likely to arise. Importantly, the Aleut case is compatible with RFLH.[11] There are thus various strategies to ensure that both prosodic and segmental contrasts are preserved and it appears to not be possible to *a priori* rule out the availability of a particular acoustic stress cue for a particular language on the basis of the structural properties of its phonological system.

7.2.2 Phonology of stress in nominals and verbs

The remaining part of this section deals with the phonological properties of stress in Arapaho. The stress patterns found in nominals and verbs in Arapaho are identical. Stress in the language is marginally contrastive: *minimal pairs*, although infrequent, do occur with both verbs and nouns, although simplex minimal pairs are quite rare in the language. Consider examples below (stressed syllables are bold-faced):

(10a)	te'**ce**noo door 'door'	vs.	(10b)	'**te**cenoo roll 'Roll it out!'
(11a)	'**h<o**n>oo'**soo-ʔ** <IC>fancy-SG 'It is fancy.'	vs.	(11b)	**h<o**n>oo'**soo-ʔ** <IC>rain-SG 'It is raining.'

(Cowell and Moss 2011: 23, 36)

The particular position of stress cannot be predicted from phonological properties of the syllables, i.e. stress in the language is *quantity-insensitive*: light syllables and heavy syllables can be stressed, and, importantly, heavy syllables are not required to be stressed, cf. the stress patterns possible in disyllables in (12) and in longer

[11] Another relevant example has been brought to my attention by Anja Arnhold: vowels in Yup'ik contrast in length, while vowel duration is a correlate of stress in the language as well. However, as predicted by the RFLH, the stress correlates ambiguity is avoided in Yup'ik. The strategy seen in Yup'ik differs from both Arapaho and Aleut. The stress contrast is neutralized for long vowels, which are always stressed, whereas short vowels contrast between stressed and unstressed. Within stressed vowels, the length contrast is preserved durationally, which creates a three-way durational contrast (see Alden 2020 for a detailed analysis of the Central Alaskan Yup'ik stress system).

nouns in (13). We can thus conclude that accent is part of the underlying form of the morphemes, i.e. Arapaho is a *lexical accent* language (Bogomolets 2020):

(12) Quantity-insensitive stress in disyllables

(12a)	ho.'tii	'wheel, car'	
(12b)	'ko.soo	'scrotum'	
(12c)	wo.'teʔ	'hat'	
(12d)	'ho.kok	'soup'	
(12e)	bii.'ciis	'leaf'	
(12f)	'hii.teen	'village'	(Cowell n.d.)

(13) Quantity-insensitive stress in multi-syllabic words

(13a)	bii.'ne.ʔeek	'gravy, sauce'	
(13b)	hoh.ʔo.'yoox	'cactus'	
(13d)	'hi.co.ʔok	'waist'	
(13e)	ni.'si.ko.coo	'cake'	(Cowell n.d.)

7.2.2.1 Right edge three-syllable window

Stress in Arapaho (in both nominal and verbal forms) must surface in the *three-syllable window* at the right edge of a morphological word.[12] In other words, there are no words in the language which would not have at least one stress in the last three syllables, while it is quite common to find a sequence of three or more unstressed syllables elsewhere within a morphological word, including at the left edge of a word, cf. below (lapses are bold-faced)[13]:

(14a) **wo.θo.no.**'hoe
book
'book'

(14b) **no.-wo.θo.no.**'hoe
1-book
'my book' (Cowell and Moss 2011: 55, 61)

I formalize the three-syllable stress window pattern with a ternary constituent. More specifically, I adapt the formal representation proposed in van der Hulst

[12] Window stress systems have obligatory stress within a disyllabic or trisyllabic sequence of syllables at the edge of the domain (van der Hulst 2012, 2014). Stress within the window can either be unpredictable/lexically specified, or it can be predictable based on the phonological properties of the syllables in question (Kager 2012; Bogomolets and van der Hulst this volume). The latter has been reported, for instance, for Pirahã, where stress is assigned to the heaviest syllable within the last three syllables of the word (Everett 1988). Some of the recent accounts of the Blackfoot prosody have also claimed that the language has a weight-sensitive accent in the three-syllable window at the left edge of the word (Weber 2016).

[13] As noted in Rice (2014), both right-edge oriented and left-edge oriented stress systems are found among Algonquian languages. Some examples of the former are Western Abenaki, Montagnais, Menominee, and Plains Cree; some examples of the latter are Blackfoot, Ojibwa, Delaware, Maleseet-Passamaquoddy.

(2012) where a three-syllable window at the right edge of a word is a result of the appropriate settings of two domain-related parameters. The Arapaho-specific settings are bold-faced and are further explained below:

(15a) BOUNDED
form a *disyllabic domain (DD)* at the edge of a word L/**R**

(15b) SATELLITE
adjoin a syllable at the edge of the *DD*
to form *Obligatory Stress Domain* (OSD) L/**R**

A bounded *disyllabic domain* in this approach is similar to a non-iterative foot in the Metrical Theory (Halle and Vergnaud 1987; Hayes 1980, 1995; Liberman and Prince 1977). However, it is not associated with rhythm or with headedness in the way the term *foot* normally is. This makes it a preferable term for capturing the Arapaho stress facts. As is apparent from lapses such as in the examples in (14) above, Arapaho lacks rhythm which in turn suggests that there is no evidence for foot structure.[14] Additional evidence for this will be presented throughout this chapter (for a metrical account of three-syllable stress windows in terms of feet see for example Blevins and Harrison 1999). The notion of *satellite* in van der Hulst (2012) captures the notion of Extrametricality in the Metrical Theory. The SATELLITE parameter involves an extension of the accentual domain at the word periphery (such satellite is called *external*), but it also includes an extension of the accent domain with an internal syllable. The advantage of the notion of *satellite* for the present analysis of Arapaho is that a satellite, unlike an extrametrical syllable, can be accented either regularly or in a limited set of language-specific circumstances (see van der Hulst 2012: 1502–1504 for some examples). The representation in (16) below crucially groups the three syllables at the right edge of a word into a constituent where the binary stress domain is within the parentheses and the binary stress domain with the adjunct of an external satellite is in curly brackets; the square bracket represents the word boundary:

(16) Stress domain in Arapaho
BOUNDED(R) SATELLITE(R)
$\ldots\sigma\ \{(\sigma\ \sigma\ _{DD})+\ \sigma\ _{OSD}\}]$

I will be referring to the ternary constituent in curly brackets in (16) as the *Obligatory Stress Domain (OSD)* throughout this chapter (see Bogomolets 2020: 58–60 for a discussion of this type of constituent).

[14] A potential counterargument is that Arapaho apparently enforces the word minimality constraint: every content word must contain at least a light-light sequence of syllables or it may consist of just a heavy syllable with CVC counting as heavy (Goddard 2015). The word minimality conditions have traditionally been viewed as a result of the application of the Foot Binarity constraint (McCarthy and Prince 1999). I, however, follow the line of work which views word minimality as autonomous from foot structure (Garrett 1999; Gordon 2007; Piggott 2008).

7.2.2.2 Penultimate default

Both roots and affixes (prefixes and suffixes) can be underlyingly accented or unaccented in Arapaho; affixes can also be pre-accenting. In the absence of lexical marking within the *Obligatory Stress Domain*, a default stress surfaces on the penultimate syllable in both nominals and verbs. Consider, for instance, the noun *'bee.θei* 'owl'. This noun is underlyingly accented on the penultimate syllable of the root:

(17) 'bee.θei
owl
'owl' (Cowell and Moss 2011: 62)

The root retains its stress when it is affixed with an underlyingly unaccented agreement suffix (18) since the root's stress remains within the three-syllable OSD:

(18) he.'bee.θei.bin
he-'beeθei-b-in
2-owl-POSS-AGR
'our (incl.) owl' (adapted from Cowell and Moss 2011: 62)

However, with the addition of another unaccented suffix to the form in (18) above, the root's stress falls outside of the three-syllable OSD. In this case, the penultimate default stress is assigned, as shown in (19) below:

(19a) he.'bee.θei.'**bi.**noo
he-'beeθei-b-in-oo
2-owl-POSS-AGR-PL
'your (Pl.) owl'

(19b) *he'bee.**θei.bi.noo** 'int.: your owl(s)'

(Cowell and Moss 2011: 62, p.c.)

Note that the root stress in (19a) does not get deleted but is preserved as a stress of equal prominence, thus both of the stresses are marked as primary in (19a) (see §7.2.3 for a discussion of Culminativity of stress in Arapaho). The default pattern found in Arapaho can be formally represented via the setting of the DEFAULT accent parameter (van der Hulst 2012) in (20) below; the Arapaho-specific setting is bold-faced:

(20) DEFAULT L/**R**
assign accent to the leftmost or the rightmost syllable in *disyllabic domain* if no accent mark is present in OSD

The setting of the DEFAULT parameter in (20) produces a default stress on the penultimate syllable of a morphological word if there is no lexical accent within the OSD. It should be noted that the penultimate stress is the prevalent stress pattern in both nouns and verbs, and that (fixed) penultimate stress has been reconstructed for Proto-Algonquian as well (see Goddard 2015).

7.2.2.3 Stress in root+suffixes

The application of the penultimate default and its interaction with the lexically specified accent can be illustrated further with the stress patterns in singular vs. plural noun forms. Plural of all non-mass nouns in Arapaho is formed via suffixation, and nouns fall within one of two types (synchronically unpredictable): 1. Suffix *-o* for inanimate nouns and *-oʔ* for animate nouns; 2. Suffix *-ii* (or the vowel harmony-conditioned alternant *-uu*) for both animate and inanimate nouns (see Cowell and Moss 2011: 54–56 for examples and discussion). It has been noted that in some cases adjunction of the plural suffix (of either of the two types) produces a 'shift' of stress in nouns, compare (21a) and (21b) below (Cowell and Moss 2011: 37–40):

(21a)	'nee.cee	(21b)	nee.'cee.n-oʔ
	chie		chief-PL
	'chief'		'chiefs'
(21c)	*'nee.cee.n-oʔ		
	Intd. 'chiefs'		(Cowell p.c.; Cowell and Moss 2011: 38)

In (21a), the noun *'neecee* 'chief' has a stress on the penultimate syllable of the root in singular, but the same noun 'shifts' its stress to the final syllable of the root when affixed with the plural suffix (21b). In other nouns, however, the 'shift' fails to occur:

(22a)	he.'nee.cee	(22b)	he.'nee.cee.n-oʔ
	buffalo.bull		buffalo.bull-PL
	'buffalo bull'		'buffalo bulls'
(22c)	*he.nee.'cee.n-oʔ		
	Intd. 'buffalo bulls'		(Cowell p.c.; Cowell and Moss 2011: 38)

In (22a), the noun *he'neecee* 'buffalo bull' has a stress on the penultimate syllable of the root in singular, just like the noun in (21a). In contrast to the example in (21), however, *he'neecee* 'buffalo bull' retains the stress position when affixed with the plural suffix (22b). The behavior of these two kinds of nouns can be explained if we assume that only roots of the 'buffalo bull' type are underlyingly specified for accent, while roots of the 'chief' type are not. Thus, nouns like 'chief' in the absence of an underlying accent on the root receive the default penultimate stress in singular. When the plural suffix is added, the penultimate default rule applies to the whole wordform due to plural being underlyingly unaccented. This produces a stress on the penultimate syllable in the plural form in *nee.'cee.noʔ* 'chiefs'. In nouns of the 'buffalo bull' type, however, the lexically specified underlying accent on the penultimate syllable of the root surfaces in both singular and plural forms, which produces the antepenultimate stress in the plural forms: *he.'nee.cee.noʔ* 'buffalo bulls'. The crucial point is that the surface penultimate stress on the root of nouns in singular can be of two kinds – lexically specified or default, which produces

different patterns when a noun is affixed with the underlyingly unaccented plural suffix.

In cases where the singular form of the noun has stress on the final or on the antepenultimate syllable, stress must result from lexically specified accent, since there can only be a single default position for stress, which is penultimate in Arapaho. In these cases, the lexical stress on the root is always preserved. Consider the examples of plural adjoining to nouns with stem-final stress:

(23a)	bee.xoo.'kuθ	(23b)	bee.xoo.'ku.t-o
	molar		molar-PL
	'molar'		'molars'
(24a)	ho.'tii	(24b)	ho.'tii.w-oʔ
	wheel		wheel-PL
	'wheel, car'		'wheels, cars'

(Cowell n.d.: 7; Cowell and Moss 2011: 63)

In (23)–(24), we observe the underlyingly specified accent on the final syllable of the singular forms. There is no definitive way of establishing whether the penultimate stress in plural number forms is the projection of the underlying accent of the root or whether the default penultimate stress surfaces when the plural morpheme is suffixed. However, there are noun stems in Arapaho with underlying accent on the final syllable of the stem in singular which suggest the former. In a number of nouns in the language, the last syllable of the stem undergoes syncope in singular. In plural, however, the dropped syllable has to surface. In these cases, the lexical stress on the root surfaces producing antepenultimate stress in the plural forms which means that the default penultimate stress does not surface:

(25a)	nii.'cii	(25b)	nii.'cii.ho.h-o
	river		river-PL
	'river'		'rivers'
(26a)	hoo.'xeb	(26b)	hoo.'xe.bi.n-o
	spring		spring-PL
	'spring'		'springs'

(Cowell and Moss 2011: 70)

In nouns with antepenultimate stress in singular, when plural is formed, the penultimate default must surface due to the requirement of there being a stress in the three-syllable window at the right edge of any given wordform in the language. Lexical stress on the root, however, does not have to be deleted (see §7.2.3 for a discussion of stress Culminativity):

(27a)	be.'ce.ʔi.ʔoo	(27b)	be.'ce.ʔi.'ʔoo.n-o
	cheek		cheek-PL
	'cheek'		'cheeks'

(28a)	ni.'si.ko.coo	(28b)	ni.'si.ko.'coo.n-o
	cake		cake-PL
	'cakes'		'cakes'

(Cowell n.d.: 8; Cowell and Moss 2011: 478)

7.2.2.4 Rightmost accent wins

It can be observed from the examples presented so far that multiple stresses within a word are permitted in Arapaho (cf., for instance, (19a), (27b), (28b)). However, clashes are banned within morphological words in the language. When two adjacent syllables carry an accent, the right-hand accent wins. To formally capture this generalization, I adopt the SELECT parameter proposed in van der Hulst (2012); the Arapaho-specific setting of this parameter is bold-faced:

(29) SELECT L/**R**
preserve the leftmost or the rightmost of the competing accents

By (29), the right-hand stress in a clash situation is selected, and the left-hand one gets deleted; this is schematically represented in (30) below where the 'x' grid marks stand for underlying accents:

(30) x x → x
[σ σ] → [σ σ]

I illustrate the application of (30) with the so-called 'locative shift' in nouns. Cowell and Moss (2011: 32) observe that the addition of the locative suffix (*-eʔ* or *-iʔ* depending on the noun class) to a noun root produces the same effects on the stress placement as the addition of the plural number suffix: it tends to produce a stress on the penultimate syllable of the resulting wordform. Consider examples in (31) below; stressed syllables are bold-faced:

(31a)	'**no.**-ʔooθ	(31b)	no.-'**ʔoo.**t-o	(31c)	no.-'**ʔoo.**t-eʔ
	1-leg		1-leg-PL		1-leg-LOC
	'my leg'		'my legs'		'on my leg'

The noun in (31) is of the *'neecee* 'chief' type (21): according to the analysis proposed above, it does not have an underlying accent on the root and gets the penultimate stress in singular (31a) by DEFAULT (20). When plural is added, the default stress must surface on the penultimate syllable of the newly formed word (31b). We observe in (31c) that when the locative suffix is added, the stress pattern is identical to the plural form in (31b). However, the parallel between the effects of plural and locative does not extend beyond examples of the 'chief' type (21), (31). Recall the nouns of the *he'neecee* 'buffalo bull' type (22): these, according to my analysis, have an underlying accent on the penult in singular which is preserved when the plural suffix is adjoined thus producing the antepenultimate stress pattern in plural. However, nouns of this type undergo the 'locative shift' just like the noun in (31). Consider examples in (32) below; stressed syllables are bold-faced:

(32a)	ˈ**ni.**ʔec	(32b)	ˈ**ni.**ʔe.c-ii	(32c)	ni.ˈ**ʔe.**c-iʔ
	lake		lake-PL		lake-LOC
	‘lake’		‘lakes’		‘at the lake’

The same asymmetry between the stress realization of plural and locative is observed in the nouns with the stress on the surface final syllable of the root in singular in which the underlying final syllable is syncopated in singular; recall examples in (25)–(26) and compare to the following:

(33a)	nii.ˈ**cii**	(34a)	hoo.ˈ**xeb**
	river		spring
	‘river’		‘spring’
(33b)	nii.ˈ**cii.**ho.h-o	(34b)	hoo.ˈ**xe.**bi.n-o
	river-PL		spring-PL
	‘rivers’		‘springs’
(33c)	nii.cii.ˈ**he.**h-eʔ	(34c)	hoo.xe.ˈ**bi.**n-eʔ
	river-LOC		spring-LOC
	‘at the river’		‘in the spring’ (Cowell and Moss 2011: 32)

The difference between the plural and the locative pattern can easily be explained if we assume that unlike plural suffixes, which do not carry an underlying accent specification, the locative suffixes do. Specifically, locative suffixes are pre-accenting, i.e. they place an accent on the immediately preceding syllable. In the framework adopted in this chapter, pre-accenting is formalized as a type of underlying (*lexical*) grid marking, and as such it formally has a status equal to the other possible types of underlying grid marking – accenting and post-accenting. To formally capture this, I adopt the representation from Revithiadou et al. (2006):

(35) Pre-accenting grid marking

x
x x
σ

Under this assumption, in forms such as (33)–(34) above, the adjunction of the locative suffix produces a stress clash with the underlying accent of the root; the clash is bold-faced:

(36) *hoo.ˈ**xe.**ˈ**bi.n**-eʔ int. ‘in the spring’

The rightmost of the two lexical accents wins and the root accent gets deleted producing the penultimate stress in the surface form by SELECT (R), (29)–(30).

SELECT (R), (29)–(30) applies across the board in verbs as well and accounts for the accentual patterns which have previously appeared to be ‘exceptional’ and appeared to require some special idiosyncratic rules (cf. Cowell n.d.). I present

one verbal paradigm to illustrate this: the 'stress shift' in verbal stems in reflexive/reciprocal forms. Consider the forms of two verb stems *'noohow-* 'to see someone' and *'niʔeeneb-* 'to like someone'[15]:

(37a)	no.'**noo**.ho.'**be.**θen n<o'n>ooho'b-eθen <IC>see-1>2 'I see you.'	(37b)	no.'**noo**.ho.'**bei**.noo n<o'n>ooho'b-einoo <IC>see-3>1 'S/he sees me.'
(38a)	'**nii.**ʔee.ne.'**be.**θen 'n<i>iʔeene'b-eθen <IC>like-1>2 'I like you.'	(38b)	'**nii**.ʔee.ne.'**bei**.noo 'n<i>iʔeene'b-einoo <IC>like-3>1 'S/he likes me.'

For the sake of space, I only provide a couple of forms in (37)–(38), but note that lexical accent falls on the penultimate syllable of the stem in *'noohow-* 'to see someone' and on the antepenultimate syllable in *'niʔeeneb-* 'to like someone' throughout the paradigms. Suffixes, additionally, also bear stress either assigned lexically or by default; in the cases of penultimate stress, it is not possible to determine whether that stress is lexical or assigned by default based solely on these data, but it is not important at this point. Cowell (n.d.) observes that verb stems with stress on the penultimate syllable (such as *'noohow-* 'to see someone') 'shift' their stress one syllable to the right when suffixed with the reflexive/reciprocal morpheme *-eti,*[16] compare the forms below to (37) above; stressed syllables are bold-faced:

(39a)	no.noo.'**ho.**be.'**ti.**θiʔ n<on>oo'hob-e'ti-θiʔ <IC>see-REFL-3PL 'They see themselves.'	
(39b)	no.noo.'**ho.**be.'**ti.**noo n<on>oo'hob-e'ti-noo <IC>see-REFL-1SG 'I see myself.'	(adapted from Cowell n.d.)

The alternation in the position of the stress in the verb stem observed between (37) and (39) can be explained if we assume that the reflexive/reciprocal morpheme *-eti* is pre-accenting. Under this analysis, whenever this morpheme is suffixed to a stem stressed on the penultimate syllable, a clash results:

(40) * no'**noo**'**hob**-eti-θiʔ Int.: 'They see themselves.'

[15] The comparison of the accentual behavior of these two verb stems was first presented in Cowell (n.d.).

[16] There are no appropriate data to determine whether the stress on the second syllable of *-eti* is underlying or assigned by the default.

The clash is resolved via the application of (29): the right-hand accent wins, i.e. the lexical accent on the penultimate syllable of the stem gets deleted. This account is further supported by the pattern found in verb stems with lexical accent on the antepenultimate syllable, such as *'niʔeeneb-* 'to like someone'. This analysis predicts that suffixation of *-eti* to such verb roots would not affect the lexical accent of the root but would produce an additional stress on the final syllable of the root since a clash would not arise and multiple non-clashing stresses are tolerated in the language (see §7.2.3). This prediction is borne out, compare the forms below to the ones in (38) above; stressed syllables are bold-faced:

(41a) '**nii**.ʔee.'**ne.**be'**ti.**θiʔ
'n<i>iʔee'neb-e'ti-θiʔ
<IC>like-REFL-3PL
'They like themselves.'

(41b) '**nii**.ʔee.'**ne.**be'**ti.**noo
'n<i>iʔee'neb-e'ti-noo
<IC>like-REFL-1SG
'I like myself.' (adapted from Cowell n.d.)

Thus, the patterns of the 'stress shift' in reflexive/reciprocal forms are in fact patterns produced by pre-accenting and a regular stress clash resolution, and no additional stipulations or idiosyncratic 'stress shift' rules are necessary.

7.2.2.5 Stress in the pre-stem part of words

So far, the analysis of the Arapaho stress patterns proposed in this chapter has been focused on the patterns found in the root+suffixes. Arapaho also has a large number of pre-stem morphemes (cf. Figures 7.1–7.2), and below I will demonstrate that they follow the same stress patterns.

The only prefix found with nouns is the possessor marker. Most noun roots can be preceded by a possessive morpheme. The language also has a class of the so-called inalienable or obligatorily possessed nouns, which must be prefixed with a possessive marker. The two sets of possessive prefixes (the obligatory possessive prefixes, and the possessive prefixes used with non-obligatorily possessed nouns) behave differently with respect to stress. Stress with alienable (non-obligatory) possessive prefixes is regular; these prefixes are underlyingly unaccented, consider examples below:

(42a) wo.θo.no.'hoe
book
'book'

(42b) no.-wo.θo.no.'hoe
1-book
'my book'

(42c) ho-woθono'hoe
2-book
'your (Sg.) book'

(42d) hi-woθono'hoe
3-book
'his/her book'

Inalienable possessive prefixes, obligatory with the so-called 'dependent' nouns, have idiosyncratic lexical accent, i.e. their stress varies from stem to stem, suggesting a close morpho-phonological relation between the root and the prefix in these constructions (on the morpho-phonological differences between the alienable and inalienable possessive prefixes in Algonquian, see for example Bogomolets to appear, b). Compare (43) and (44) below; note that the stress tends to be regular within the paradigm for a particular stem, cf. (44):[17]

(43) ne-bii'ʔoʔoo
1-sweetheart
'my sweetheart'

(44a) 'no-to'nihiʔ
1-horse
'my horse'

(44b) 'ho-to'nihiʔ
2-horse
'your horse'

(44c) 'hi-to'nihʔ-o
3-horse-OBV
'his horse'

Verbal morphology in Arapaho includes a wide array of pre-stem morphemes. These include a polar question morpheme and *wh*-morphemes, Tense/Aspect/Mood prefixes, negation, and morphemes with various adverbial, quantificational and aspectual meanings (traditionally known as 'preverbs' in the Algonquianist literature, see Figure 7.2 above and Cowell and Moss 2011: 205–234). Most of the inflectional prefixes are underlyingly unaccented. In what follows, I will consider the stress behavior of the future tense prefix and person prefixes which are monosyllabic and underlyingly accented and thus allow us to observe stress interactions with the following root when the root carries an underlying accent on the initial syllable. It will be shown that SELECT (R) (29) is active in resolving accent clashes in the prefix-root part of the verbal words as well.

Firstly, consider examples in (45)–(46) showing that the future tense prefix *'et-* carries an underlying accent:[18]

(45) koo.'**het.**ce.'nis
koo-'het-ce'nis
Q-FUT-fall
'Will it fall?'

[17] The /e/-/o/ alternation in the prefixes is due to a regular process of vowel harmony (see Cowell and Moss 2011: 20–22; Bogomolets 2022).

[18] The future tense prefix has a few allomorphs: the *'et-* prefix is epenthesized with an /h/ when word-initial and following the 'clause type' morphemes (slot -6 in Figure 7.2). I refer the reader to Bogomolets, Fenger, and Stegovec (2018a,b) for a brief discussion of the /h/-inducing prosodic boundary following the 'clause type' morphemes in Arapaho. Note also that when preceding a vowel-initial morpheme, the future tense prefix has the form *'(h)etn-*. Finally, this prefix can also be realized as *'(h)ot-*/*'(h)otn-*. These variants are used by older speakers, i.e. the variation appears to be generational, see Goddard (2015: 377).

(46) '**hoot.**bii.'nein
'h<o>ot-bii'n-ein
<IC>FUT-give-3SG>2SG
'He will give it to you.' (adapted from Goddard 2015: 376)

Examples in (45)–(46) above show the future tense prefix realizing its accent as stress on the antepenultimate syllable. The stress on the antepenultimate syllable in both (45) and (46) is due to the underlying accentual marking of the future tense prefix since it cannot be explained by default (i.e. it is not penultimate). Importantly, the future tense prefix is part of the stress domain of the stem which can be concluded from the data showing that stress on the future tense prefix counts toward satisfying the three-syllable window requirement:

(47) '**heet.**coo.noo
'h<e>et-coo-noo
<IC>FUT-come-1SG
'I will come.'

In (47), the underlyingly accented future tense prefix is followed by two underlyingly unaccented morphemes. We can observe that penultimate default stress is not assigned, which indicates that the stress on the antepenultimate syllable in the future tense prefix satisfies the requirement of the OSD. When the future tense prefix is followed by a morpheme stressed on the first syllable, the clash is resolved via the same setting of the SELECT parameter as in all the clash cases seen so far (cf. (29)): the right-hand accent wins, and the future tense prefix loses its accent. Consider the position of stress in the verb *'iisisee-* 'to walk' in (48)–(49), which has an underlying accent on the initial syllable:

(48) ni.'**hii.**si.seet
ni'h-iisisee-t
PST-walk-3SG
'He went.'

(49) heet.'**nii.**si.seet
h<e>et'n-iisisee-t
<IC>FUT-walk-3SG
'He is going to go.'

Example (48) illustrates that the verb root has a lexical accent on the first syllable. The past tense prefix is underlyingly unaccented, and in (48) the root realizes its underlying accent as stress. In (49), however, the underlying accent of the future tense prefix clashes with the underlying accent on the initial syllable of the root producing an illicit form *'***heet**'***nii***siseet*.* We observe that accent on the future tense prefix gets deleted, and the rightmost of the two accents is realized as stress. These examples demonstrate that the accentual behavior of the tense prefixes is parallel

to the accentual behavior of the morphemes at the right edge of morphological words: they can be underlyingly accented or unaccented, they count as part of the OSD, and accent clashes between the prefixes and the following morphemes are not tolerated and are resolved via SELECT (R).

The first and second person prefixes – *ne-* and *he-* show the same pattern. They are underlyingly accented and are part of the same stress domain as the following stem which is evidenced by the fact that they undergo the same stress clash resolution when followed by a lexical stress on the verb root. Consider examples in (50)–(51) below; the person prefix is bold-faced in both:

(50) '**he-i**hoow-'koon-oo'ku-n
2-NEG-open-eye-12
'We are not opening our eyes.'

(51) koo-**ho-**'koon-ook
Q-2-open-eye
'Are you opening your eye?'

In (50), the second person morpheme realizes its stress before the negation morpheme which is underlyingly unaccented. In (51), the stress on the second person prefix is deleted by the application of SELECT as it is followed by a stressed verb root.

The discussion above demonstrates that prefixes in Arapaho, just like roots and suffixes, can be underlyingly unaccented or underlyingly accented, and that even the outermost left edge prefixes take part in the regular stress assignment. Thus, all stress patterns in both nominal and verbal forms can be accounted for with the following settings of only four accent parameters:

(52) Arapaho stress parameter settings

Accent Domain	BOUNDED (R)
	SATELLITE (R)
Accent Placement	SELECT (R)
	DEFAULT (R)

The accent domain parameters ensure that a trisyllabic domain which I call the *Obligatory Stress Domain* is formed at the right edge of the word in Arapaho, while the accent placement parameters govern stress placement in the cases of stress competition (SELECT (R)) or in the cases where lexical marking is absent (DEFAULT (R)). The settings of the parameters in (52) hold across the board which yields a rather simple stress system. In §7.2.3, I discuss the co-occurrence of multiple stresses within a morphological word in the language in more detail.

7.2.3 Culminativity of stress in Arapaho

As noted earlier, multiple stresses within a morphological word are allowed in Arapaho. The question of whether there is a phonological and/or phonetic hierarchy of prominence within a word in Arapaho is not a trivial one.

A number of factors complicate an otherwise preferred (typologically unmarked) analysis of multiple prominences within a wordform in Arapaho as secondary stresses. One might be tempted to argue that the rightmost stress within a wordform should be seen as primary and the remaining stresses should be analyzed as secondary. Indeed, we see that the stress system in the language is right-oriented: (i) the OSD is situated at the right edge of the words, and (ii) in the accent clash resolution, the right-hand accent always wins. However, it is not unusual for the OSD to contain two accents, both of which are realized as stresses, as is the case in some examples throughout this chapter (eg. (45), (46), (50)). An accent competition in fact only seems to ever arise in the situations of clashing accents.

The secondary stress analysis for the stresses other than the rightmost one is also questioned by the reported minimal pairs based on the position of these, potentially secondary, stresses, for instance:

(53a)	'h<on>oo'soo-ʔ	vs.	(53b)	h<on>oo'soo-ʔ
	<IC>fancy-SG			<IC>rain-SG
	'It is fancy.'			'It is raining.'

(adapted from Cowell and Moss 2011: 23)

If the initial stress in *'honoo'sooʔ* 'it is fancy' were to be analyzed as a secondary stress, the minimal pair in (53) would be distinguished solely by the presence of a secondary stress, which might be unexpected.

Based on the factors stated above, as well as on the fact that no consistent phonetic difference between multiple stresses within a morphological word has been reported for Arapaho, I argue that Arapaho allows for multiple equal stresses within the domain of morphological word.[19] This puts Arapaho in line with a number of other highly synthetic languages where no clear phonetic differences between multiple stresses within synthetic words have been reported, for instance Mapudungun (Molineaux 2018, this volume) and Blackfoot (Stacy 2013). However, despite the frequent co-occurrence of multiple stresses in Arapaho words, Bogomolets (2020: Chapter 5) argued that stress in Arapaho should be analyzed as culminative because accent clashes are disallowed in the language. The ban on accent clashes is analyzed as a possible instantiation of the CULMINATIVITY

[19] Note also that in all the existing sources on the Arapaho language all prominent peaks are marked with an acute accent.

parameter which I briefly discuss below (refer to Bogomolets 2020: Chapter 5 for a detailed discussion).

It has long been noted that languages vary in the domain of application of Culminativity. In fact, Hayes (1995: 25) in a brief note on languages which have been reported to violate Culminativity (which also includes Obligatoriness in his terminology) states that 'culminativity may be a universal of stress systems, which is subject to parametric variation for the level at which it holds'. Bogomolets (2020: Chapter 5) proposes to view Culminativity of a phonological feature *x* (PF_x) as a macroparameter encompassing a number of relevant microparameters:

(54) Culminativity microparameters

a. Is PF_x culminative in *some* domain in the language?	Y/N, if Y:
i. Is PF_x culminative in roots?	Y/N
ii. Is PF_x culminative in stems?	Y/N
iii. Is PF_x culminative in MWord?	Y/N
iv. …	
b. Are two adjacent units bearing PF_x banned in *some* domain?	Y/N

Culminativity of a phonological feature *x* (PF_x) can thus be instantiated through a ban on more than a single occurrence of that feature within the relevant domain (54a), or through a ban on adjacent units bearing the feature (54b), or both. The definition of Culminativity in (54) is stated in general terms and does not imply that these microparameters must be unique to stress. On the contrary, for any phonological property, which exhibits Culminativity, we might expect to encounter systems which vary along these microparametric values. Such general definition of Culminativity is motivated by the fact that phonological features other than stress may exhibit Culminativity.[20] The microparameters in (54) may be restated specifically for Culminativity of stress in the following way:

(55) Stress Culminativity microparameters

a. Is stress culminative in *some* domain in the language?	Y/N, if Y:
i. Is stress culminative in roots?	Y/N
ii. Is stress culminative in stems?	Y/N
iii. Is stress culminative in MWord?	Y/N
b. Is stress clash banned in some domain?	Y/N

[20] This is crucially different from Culminativity as defined in the Metrical Theory which derives Culminativity from the structural nature of stress: stress is culminative within a domain because prominence relations are imposed at all levels of the grid. Thus, there is always a topmost level with a single grid mark. Hayes (1995: 30) explicitly states that 'genuine phonological features such as [round] or [nasal] are not distributed culminatively because they do not form hierarchical domains across the phonological string'. This is contrary to the empirical facts: such phonological features as aspiration, glottalization, and nasality have been reported to exhibit Culminativity cross-linguistically (see Hyman 2006, 2009; Bogomolets 2020: 196).

According to the traditional definitions of Culminativity, we should not be able to find a stress language with more than one syllable of the highest degree of prominence within a (morphological or phonological) word. According to the macroparametric definition of Culminativity (55), we should not be able to find a stress language with the negative settings for both microparameters (55a) and (55b).[21]

Arapaho allows for multiple stresses across different domains within a morphological word having the **'N'** setting for the parameter (55a). However, Arapaho does not allow for clashing stresses within the morphological word domain, which suggests a positive setting for the microparameter (55b). In all cases, stress clashes are resolved through the application of SELECT (R). The Culminativity microparameters in Arapaho are thus set in the following way:

(56) Stress Culminativity microparameters in Arapaho
  a. Is stress culminative in *some* domain in the language? Y/**N**
  b. Is stress clash banned in MWord? **Y**/N

It is worth noting that the domain of Culminativity in Arapaho coincides with the edges of the morphological word: stress clashes are banned in morphological words however long and morphologically complex they might be, but clashes are tolerated *between* morphological words. Consider an example in (57) below; the clash is bold-faced:

(57) nih-'noohow-oʔ hi'**nen** '**h<e>et**-no'hʔ-ot
  PST-see-1>3 man <IC>FUT-kill-2SG
  'I saw the man that you were going to kill.' (Goddard, n.d.)

In allowing for stress clashes between morphological words while banning them word-internally, Arapaho follows a cross-linguistically robust pattern: stresses are in competition maximally within the boundaries of a morphological word. In other words, we generally do not find languages in which accents would be competing for being realized as primary stress across word boundaries (see Kaisse 2017 for a typological overview and some seeming exceptions).[22] The right edge of the morphological word is also demarcated in Arapaho by the Obligatory Stress Domain: an accent must be assigned in a three-syllable window at the right edge of a morphological word in the language.

The final section of this chapter presents a brief overview of the lexical falling tone in Arapaho. Although important for the overall characteristic of the prosodic system of Arapaho, the tonal system is not directly involved in phonology of stress.

[21] Bogomolets (2020: Chapter 5) discusses the possible combinations of the settings of parameters (55a)–(55b) and examples of stress systems differing in the settings of these parameters.

[22] See, however, Gordon and Applebaum (2010, this volume) for an interesting case of an interaction between stress and minimal word constraints in a highly synthetic Northwest Caucasian language Kabardian.

7.3. Lexical tone in Arapaho

This chapter is mainly focused on the properties of stress. However, a brief note on lexical tone in the language is in order. Arapaho has historically developed a falling tone through a process of glottalization – the loss of glottal stop before a consonant and compensatory lengthening of the preceding vowel. Upon deletion of the glottal stop, HL tone surfaced on the newly formed long vowel. In Arapaho, falling tone is synchronically unpredictable (Goddard 1974, 2015). Consider the following example (58); the syllable carrying the falling tone is bold-faced:

(58) Arapaho ***θô:****xoˈhohoʔ* 'mitten'< Proto-Algonquian **θaʔθehsa* 'mitten, glove'
(Goddard 2015: 356)

The form in (58) shows a pitch fall over the long vowel in the first syllable in place of the Proto-Algonquian short vowel followed by the *ʔθ* cluster. The falling tone formation in this environment is not an Arapaho-specific phenomenon. Goddard (1974: 110) notes that the closely related language Gros Ventre shows a falling tone in this environment as well. Blackfoot has a synchronically predictable falling tone conditioned by the same environment (see Stacy 2004; Frantz 2009). The falling tone in Blackfoot arises through a process which is virtually identical to the glottalization process in Arapaho. The only difference between the HL tone in Blackfoot and the HL tone in Arapaho is in the historical timing: in Blackfoot the glottalization process is ongoing and thus is predictable from the synchronic phonological form of the morphemes in a word, while in Arapaho falling tone is synchronically unpredictable as it has developed through a diachronic loss of glottal stops at the earlier stages of the language history (Goddard 1974, 2015). Consider the following Blackfoot example (59), where the fall in the pitch contour occurs in the place of the glottal stop deletion in the penultimate syllable. The first line in (59) presents the surface form while the second line presents the underlying form; the syllable carrying the surface falling tone is bold-faced.

(59) 'a:xkio**ksâ:ts**i̯s
aah.kio.**ksaʔ.ts**is
'boat' (Stacy 2004: 119)

Falling tone in Arapaho is part of the underlying shape of a morpheme and as such can surface anywhere in a wordform, i.e. there are no restrictions on its distribution, except that it only occurs on long vowels and diphthongs. Tonal minimal pairs are infrequent but possible:

(60a) Proto-Arapaho-Atsina *oiθine- > Arapaho houˈθine- 'to hang' vs.
(60b) Proto-Arapaho-Atsina *oiʔθine- > Arapaho hôuˈθine- 'to float'
(Goddard 1974: 110–111)

Stress and tone on the adjacent syllables are allowed (61a–b):

(61a) hê:'tec 'ocean'
(61b) sî:'si:c 'duck' (Goddard 2015: 356)

Examples such as (61) above also illustrate that a single morpheme can carry both accent and tone, while it is not possible for a single morpheme to have multiple underlying accents. Moreover, a syllable carrying falling tone can bear stress. The example in (62) below has falling tone on both the penultimate and the final syllable. The penultimate syllable additionally bears stress – the vowel in the penultimate syllable is lengthened (which is the main acoustic cue of stress for phonemically long vowels in Arapaho, see discussion in §7.2.1):

(62) ne'**bî:**xû:t 'my shirt, my dress'

Falling tone has no involvement in the morphological system of the language. The tonal system of Arapaho is best described as (i) metrically-independent: tone is not conditioned by stress; (ii) restricted: there is a single toneme; and (iii) it is a low-density tone system, i.e. one in which many syllables do not bear tone (the term is borrowed from Michael 2011).

7.4. Summary

In this chapter, I have proposed a novel analysis of the Arapaho stress system. I have argued that this system is best analyzed as a *lexical accent* system where accent is part of the underlying phonological form of some morphemes. I have also argued that even though the language has a characteristically complex morphological system, the stress placement mechanism does not reference it, i.e. there is no evidence that morpho-syntactic structure affects stress assignment. The following generalizations regarding the phonological behavior of the Arapaho accent have been made in this chapter:

(63) Arapaho accent generalizations
   a. Stress must be present in the three-syllable window at the right edge of a morphological word (OSD).
   b. In words with no underlying accents in the OSD, default assigns accent to the penultimate syllable, i.e. stress is Obligatory.
   c. Multiple underlying accents can be realized as stress in a morphological word, but not in adjacent syllables.
   d. When two underlying accents are adjacent, the right-hand one is realized as stress and the left-hand one is deleted.

Following the accent formalism proposed in van der Hulst (2012), I formally capture the generalizations in (63) through the appropriate settings of the four parameters in (64) below:

(64) Arapaho stress parameter settings

Accent Domain	BOUNDED (R)
	SATELLITE (R)
Accent Placement	SELECT (R)
	DEFAULT (R)

Additionally, Arapaho presents an interesting case for the study of acoustic correlates of stress suggesting that (i) phonemically long and phonemically short vowels within a single language can have different acoustic cues for stress, and (ii) that it is not possible to *a priori* rule out the availability of a particular acoustic cue of stress in a particular language on the basis of the structural properties of its phonological system. Further research, however, is needed in order to investigate the acoustic side of the stress patterns in the language in more detail and on a larger data sample than that which was used in Bogomolets (2014). The issues of the interactions between word-level stress and prosodic phenomena at higher levels are also left for future research.

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