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Grammar Matters: Evidence from Phonological and Morphological Development in Northern East Cree

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1. Introduction

Linguistic theories, all of which aim at explaining the nature and functioning of language, are generally elaborated through the systematic observation of adult languages. It is, however, the case that the empirical base of these theories is limited to a relatively small set of typological observations, often coming from a handful of languages. This problem, unavoidable given the as yet relatively limited state of empirical documentation of linguistic systems, is compounded by the sheer complexity of language typology; entire theories must be developed to account for particular linguistic sub-systems (e.g., phonological or morphological), often without much regard for other sub-systems. All current linguistic theories are thus more than likely to be incomplete and, as such, to be compromised if considered in light of new evidence. This situation, in which different types of empirical evidence may be taken into consideration or, in other cases, ignored, also gives rise to a number of competing linguistic theories, many of which offer radically different outlooks on the nature of human language. In turn, these theories have implications in the context of language development and related applications, as each theory more or less explicitly sets paths for how language should be acquired by first and/or second language learners.

This situation has consequences beyond empirical adequacy. For example, two different theories of language acquisition — one that makes predictions based on input frequency, the other on the basis of structural complexity — may make equivalent empirical predictions in cases where structural simplicity is pervasive in frequently-occurring contexts. Both theories would correctly predict fast acquisition of the ‘simple’/‘frequent’ units, however for fundamentally different reasons. This also has implications outside of the theoretical realm; for example, in the development of associated educational or clinical methods, the frequency-driven theory favours the repetitive usage of the problematic units, while the structural approach favours the systematic contrasting of these problematic units against other units in the system. It is thus important that we confront different theories out of their comfort zones, in order to determine which one fares best in light of the widest range of empirical evidence possible.

In this paper, we compare two of the most predominant theories debated in the current literature: the grammatical approach, which is central to the generative framework, and the exemplarist approach, favoured by usage-based frameworks that reject the notion of grammatical constituency or rules. We compare predictions made by these two general approaches in light of evidence from the acquisition of Cree, a language which is both relatively underdescribed in and of itself, and underrepresented in the acquisition literature in terms of its typology (tending toward the polysynthetic end of the typology scale). Cree is one of three major sub-groupings comprising the Cree-Montagnais-Naskapi (CMN) dialect complex, a Central Algonquian language spoken across much of Canada. Six principal sub-dialects of Cree are recognized: (from west to east) Plains Cree, Woods Cree, Swampy Cree, Moose Cree, East Cree, and Atikamekw Cree. Our acquisition data were gathered from learners of Northern

* A preliminary version of this paper was presented at the *2010 Annual Congress of the Canadian Linguistic Association*. We owe special thanks to Patricia Balcom and Kevin Russell for their valuable feedback. We are also grateful to members of the audience at the *GALANA 4* conference, in particular Elan Dresher, Heather Goad, Jeffrey Lidz, Kamil Ud Deen, and Lydia White for their useful questions and comments.

East (NE) Cree, which is spoken in Northern Québec. More specifically, we discuss a case study of the development of NE Cree from two perspectives. From a phonological perspective, we consider the development of the stress system. From a morphological perspective, we study the emergence of (intransitive) verbal forms. In both cases, the theories we pit against one another make crucially different distinctions. In both cases, we show that the child under investigation begins with what can arguably be considered to be grammatical defaults in the language, in spite of statistical tendencies in the ambient language pointing in other directions.

The paper is organized as follows. We begin with a brief description of the two theories under scrutiny. We then provide, in section 3, a brief description of the case study we are currently investigating, which draws on productions recorded from a first-language learner of NE Cree (code-named Ani). In section 4, we discuss Ani's linguistic development with respect to stress and verbal morphology. In each case, we begin our discussion with a description of the relevant linguistic properties of NE Cree, and their implications for developmental paths under both the grammatical and exemplar-based approaches. As we will see, Ani's linguistic development can be best related to grammatical, as opposed to statistical, properties of the input. While we do not reject input statistics as a potential factor of influence in language development, we argue that only linguistic theories based on grammatical constituency can account for the developmental patterns observed. More generally, we reject theories based solely on statistics of the input as being over-simplistic; while these theories can be empirically adequate at times, they lack the sophistication to account for fundamental aspects of linguistic systems and their acquisition.

2. The theories and their predictions

In this section, we provide a brief description of the theories at stake. While we are aware that each theoretical stance can offer more than one specific approach, we take as a starting point two fairly well defined approaches from the literature on lexical (and related phonological) development. Under both approaches, development is depicted as the building of lexical representations, however based on two radically different mechanisms. While each theory makes particular claims about the nature of other aspects of the grammar such as syntax and syntactic development, in the comparison that follows, we limit ourselves to the nature of lexical representations and the implications for acquisition.

2.1. The grammatical/generative approach

Within the generative framework, the learner is seen as building a series of lexical representations following universal principles which govern the nature of linguistic constituency. Associated to a word meaning, lexical representations contain a set of hierarchically-organized constituents such as feet, syllables, segments and features. Some of the most explicit proposals in the recent literature on acquisition include works such as Fikkert (1994), Levelt (1994), Freitas (1997), Goad and Rose (2004) as well as Fikkert and Freitas (2006): in each of these works, phonological development is seen as the gradual incorporation of more structure into lexical representations.

Under this approach, across-the-board generalizations can occur at each formal level of lexical representation. For example, an emergent stress pattern or phonological feature may be generalized and, at times, over-generalized, over a series of lexical entries. Because these generalizations are grammatical in nature, they may not necessarily arise from statistical pressure; rather, they are conceived of by the learner as the outcome of analyses of aspects of the ambient language.

2.2. The exemplar-based approach

The exemplarist approach, on the other hand, can be generally described as a more concrete, or *wysiwyg* (what-you-see-is-what-you-get) model. The word, as opposed to its sub-parts, is considered the fundamental unit of analysis; sub-lexical units such as morphemes are considered as epiphenomenal. As recently claimed by Bybee (2001) and Vihman and Croft (2007), phonological representations emerge from phonetic exemplars which are gathered from both the ambient language and the child's own productions and stacked into memory. Within this approach, frequency and

salience are seen as playing a significant role: the more often a given word is used, the more exemplars of this word are memorized, each of which strengthening the word's representation in the lexicon. In early word forms, only salient aspects of the words are memorized (e.g., stressed syllables), while less salient aspects gradually emerge as they become reinforced through further stacking of phonetic exemplars. Crucially, no distinction is drawn between competence and performance: as Bybee (2001) states, storage *is* processing. Vihman & Croft somewhat depart from this claim by positing analogically-derived prosodic templates, which emerge from commonalities across words (Vihman & Croft, 2007). This is still a far cry from the type of grammatical constituency assumed within generative approaches.

2.3. *Predictions*

As mentioned above, several additional flavours exist for each of these theories. For example, within the generative framework, which draws a formal distinction between competence and performance, entire accounts of phonological development build on rules (e.g., Smith, 1973) or constraints (e.g., Gnanadesikan, 1995/2004; Bernhardt & Stemberger, 1998) to encode formal relationships between lexical representations (generally assumed to be adult-like) and child outputs (see Rose & Inkelas, 2011, for further discussion). Similarly, the degree of sophistication of lexical representations varies across variants of exemplarism: while Bybee (2001, p. 29ff) explicitly claims that the word is the basic unit of phonological representation, thereby rejecting linguistic constituency altogether, Vihman & Croft (2007, p. 717) posit some degree of abstraction, through phonotactic templates encoding similarities across word forms (with segments used as melodic labels whenever needed). More abstract constituents such as the metrical foot or the segmental feature are, however, rejected outright.

Such differences in formal approaches unavoidably yield different predictions. Starting with the generative framework, in which acquisition is seen as grammatical generalization, the most central predictions revolve around the notion of grammatical complexity, often referred to as markedness: basic units are predicted to be acquired first, while the more complex units of which the system is comprised are predicted to emerge progressively, through a combination of the more basic units they are made of. For example, as discussed in Fikkert (1994), Gnanadesikan (1995/2004), Barlow (1997), Freitas (1997) and Rose (2000), syllables sporting complex constituents such as branching onsets (e.g., CCV syllables) are predicted to emerge after syllables starting with singleton onsets (e.g., CV syllables). Similarly, at the level of stress, the most basic units, for example the metrical foot, are predicted to be acquired before more opaque or variable aspects of the stress system such as syllable weight or extrametricality. At the segmental level, the same logic applies. For example, a labial fricative consonant such as [f] is predicted to emerge only after the features [labial] and [continuant] are mastered by the child (e.g., Levelt, 1994; Levelt & van Oostendorp, 2007). While the very origin of phonological features is still subject to debate within this body of literature (as emergent or innately available), the formal units of analysis are claimed to have a psychological reality. Factors influencing this development include idiosyncratic properties of the ambient language, which must be memorized and, thus, are predicted to emerge in gradual fashion. Frequency effects of all kinds (e.g., input frequency, token and type) are generally considered as a potential influence on the developmental path, but not as a driving force behind acquisition. More central is the prediction that the child's emerging forms may exhibit over-generalizations of the most basic (or transparent) aspects of the developing system. Also crucial to current approaches, generalizations may occur at various levels of lexical representations, as opposed to clearly top-down or bottom-up elaboration. This implies, for example, that not all sounds or features need to be acquired before the child attains an analysis of larger constituents; early words are made of partial analyses (segmental and prosodic) of the ambient language (see Goad & Rose, 2004; Levelt & van Oostendorp, 2007; Fikkert & Levelt, 2008, for explicit proposals). Developmental stages embody changes in these analyses as the child further uncovers the units of his/her language and their combinatorial principles.

Exemplar-based approaches, on the other hand, predict simpler (or, arguably, over-simplistic) learning paths. The relative development of the lexical representations, and of the surface phonotactics they display, is correlated with the frequency of occurrence of each relevant phonetic exemplar, with

each form used (in perception or production) reinforcing the lexical entry to which it belongs. As virtually no abstractness is allowed into the system, learning takes place in the absence of analyses or generalizations beyond analogies drawn from semantic and/or phonological similarity. Repetition of the relevant forms is thus central to learning, with early word productions predicted to reflect salient and/or frequent properties of the memorized forms, but with low-level articulatory issues potentially hindering initial word productions.

The two approaches thus differ significantly with regard to the role of grammatical (analytical) complexity versus usage frequency. While the former, central to generative approaches, has no place in exemplar-based models, the latter, which is the most central driving force behind exemplar-based approaches, merely adds noise to learning under the generative view. While both approaches make similar predictions in contexts where grammatical simplicity correlates with high frequency (see Rose, 2009, for further discussion), crucial empirical tests lie in contexts where grammatically complex units are highly frequent or, conversely, grammatically simple units do not occur frequently in the ambient language.

In the next section, we discuss these general predictions in light of acquisition data from NE Cree. This language, which exhibits a fairly high degree of analytical complexity, offers a number of crucial empirical tests. Because of their relative opacity, basic metrical and morphological properties cannot be correlated with high frequency. Consequently, the two approaches we are pitting against one another predict clearly distinct developmental paths. As we will see from the two developmental perspectives (metrical and morphological) addressed in our case study, basic grammatical properties of the language appear to emerge first, in spite of contradictory frequency figures. We begin with a brief description of our case study, which is part of our larger research project.

3. The Chisasibi Child Language Acquisition Study

The database is comprised of approximately 120 video recordings made between 2004 and 2007 (30 months) within the context of the Chisasibi Child Language Acquisition Study (CCLAS).¹ CCLAS is the first in-depth naturalistic acquisition study of an Algonquian language. While the majority of Cree people in Chisasibi speak English as a second language, Cree remains very much the primary community language.

The study focuses on production only. The participants recorded in the study were chosen from families self-reporting as principally speaking Cree in the home. There were six participants in total, three in the younger cohort (A), and three in the older cohort (B). At the start of the study, cohort A children were aged between 1;8 and 2 yrs, whereas cohort B was aged between 3;10 and 4 yrs. When recording ended, the oldest participants of each group were aged, respectively, 4;6 yrs and 6;6 yrs. CCLAS was thus able to gather data on just under five of the major language learning years (1;8 to 6;6 yrs) in a 30-month period. Participants were video-recorded in familiar surroundings (usually their home) at approximately two to three week intervals, with each session lasting on average 30 minutes.² In all of the recordings, participants interacted in a naturalistic manner with the (then) project coordinator, Darlene Bearskin, a native speaker of NE Cree. She engaged the children in activities conducive to language production, such as looking at pictures or playing with toys, but did not attempt to elicit specific linguistic structures.³

¹ Funding for this research is provided by the Social Sciences and Humanities Research Council (SSHRC) of Canada, Standard Research Grants #410-2004-1836 (2004, Brittain, Dyck, & Rose) and #410-2008-0378 (2008, Brittain, Dyck, Rose, & MacKenzie). The Cree School Board of Québec also provides ongoing financial and in-kind support to the project.

² Many Cree families maintain a traditional lifestyle, spending periods of time out on the land, for which reason participants were not always available for fortnightly recording. Child Ani, on whom the present study is based, was, however, available for regular recording for most of the 30-month period.

³ In order to facilitate the analysis of data, Ms. Bearskin repeated the target form(s) for any child utterances she felt might be hard for other researchers to identify. This was especially important in the case of the younger participants whose productions more often fell short of the target.

The video recordings were made using a tripod-mounted mini DV camcorder and tapes and a stationary (i.e., not attached to the child) microphone. The recordings were then processed by the research team at Memorial University by means of the following stages. Each file (video recording) was linked to a transcript in Phon, the software used to handle all the CCLAS data. Child utterances were then identified along with the recorded media and time-aligned with the transcript. (Adult utterances were not initially identified, although they remained accessible at all times.) Data records associated with each child production consist of a number of fields (e.g., orthography, IPA actual, IPA target, morphology, English translation, notes on context). Narrow IPA transcriptions were then performed following the double-blind protocol. Transcribers, native English speakers, followed project guidelines to ensure as much consistency as possible in the database. Certain phonological properties of Cree regularly pose a challenge for the English speaker; for example, voice is not a contrastive feature for obstruents. For this reason we made the (arbitrary) decision to regularly transcribe obstruent stops with their voiceless counterparts only. We followed the same checking procedure for identifying stress, since the correlates of stress in Cree differ from those of English. For each session, the two independently made transcriptions were checked against each other in order to attain a single consensus transcription. Where necessary, discrepancies between the two transcriptions were settled through the use of acoustic analysis. Records were then checked for integrity: a Cree speaker checked that the records created by the (non-Cree-speaking) researcher were capturing no more and no less than a single child utterance; adjustments were made where necessary. In addition, an oral commentary was created in order to provide information crucial to data interpretation: a Cree speaker watched the entire video recording and provided commentary on (minimally): (i) Cree-to-English translations, for all child language utterances as well as for relevant portions of adult language; (ii) elaboration on contextual information; (iii) verification of target forms; and (iv) any innovative language use (lexical or structural). The information contained in the oral commentary was then entered into the relevant field for each Phon record. A broad IPA target (model) transcription was made for the forms attempted by the child, in order to provide a baseline to assess the child's productions. (Each utterance attempted by the child was also transcribed in Cree orthography, reconstructed from the IPA target.) Finally, for each child utterance, and for its corresponding target, word boundaries and syntactic categories were identified and, at the level of morphology, morpheme glosses were provided. (IPA tiers preserve the phonological phrasing of the utterances.)

The resulting database, still under construction, provides information relevant for data interpretation at the levels of phonology, morphology, or syntax. The data discussed below come from the youngest child of our A cohort, a girl code-named Ani. In the next section, we combine results from acoustic, phonological and morphological investigations of Ani's utterances sampled at ages 2;02, 2;08, 3;04, 3;06 and 4;01. These results build on earlier work by Swain (2009), Rose, Brittain, Dyck, and Swain (2010), and Terry (2010).

4. Ani's developmental paths

We now turn to Ani's development of stress and of verbal morphology, which we address in separate subsections. In each case, we begin with a description of the properties of NE Cree that are relevant for data interpretation. As we will see, Ani's developmental path generally proceeds from the target language's most basic grammatical units to more complex or opaque ones, in ways that do not seem predictable from a statistical perspective. Note in this context that, while the descriptions of the relevant properties of NE Cree and of Ani's development are based on descriptive constructs which are typically associated with generative approaches to linguistics, our descriptions are meant to be as theoretically neutral as possible. While this is tangential to our discussion, we highlight the usefulness of highly-articulated descriptive frameworks, as they provide us with the labels required for systematic data descriptions.

4.1. Metrical development

4.1.1. Overview of the NE Cree metrical system

NE Cree displays a relatively abstract stress system which is influenced by both morphological and phonological properties of words (e.g., Dyck, Brittain, & MacKenzie, 2006; Swain, 2009). NE Cree words have one pitch accent per citation form. Accent falls on one of the last three syllables in long words, typically, the rightmost stressable syllable. However, some departures from the latter observations, which are discussed below, suggest that accent might be lexically idiosyncratic in some instances.

As we can see in (1), there are two types of accent, final and non-final. The final accent is morphologically conditioned. In contrast, the non-final accent is the default pattern for words in isolation and in context, due to final extrametricality.⁴

(1) Pitch accent

a. Final

- i. *chî.mân-h* [tʃi: 'ma:n^h] ‘boats’ (plural inanimate suffix)
- ii. *ûh.kum-h* [u:h 'køm^h] ‘someone’s grandmother’ (animate obviative suffix)

b. Non-final

- i. *chî.mân* [tʃi: ma:n] ‘boat’
- ii. *nuh.kum* ['nøh køm] ‘my grand-mother’

The words with final accent all end with a suffix, spelled as <-h>. This suffix, phonetically realized as heavy aspiration, voids the effect of final extrametricality. Historically, it derives from the plural inanimate and (the homophonous) animate obviative *-a. (All word-final short vowels are deleted in NE Cree through a regular sound change; MacKenzie, 1980, p. 119-123.)

Non-final accent either falls on the penult or the antepenult. If the penult or antepenult is long, as in the examples in (2), the rules of accent placement are clear: the penult is accented when it is long; in contrast, the antepenult is accented when it is long and the penult is short. (L, S, and F stand for long, short, and final syllables respectively.)⁵

(2) Non-final accent, long penult or antepenult

- a. Penult (...L'LF): *kâh.kâ.chiw* [ka:h 'ka: tʃu:] ‘raven’
- b. Antepenult (...LSF): *pû.tâ.chi.kin* [pu: 'ta: tʃi kin] ‘mouth organ’

However, if both the penult and antepenult are short, the rules of accent placement are unclear. As shown in (3), words with identical syllable structure (LSSF) can be accented on either the penult or the antepenult. This variation is, however, not free: the word in (3a) must have penultimate accent, while the word in (3b) receives antepenultimate accent.

(3) Non-final accent

- a. Penult (LS'SF): *pîh.tu.si.nân* [pi:hth 'sɪ na:n] ‘ammunition pouch’
- b. Antepenult (L'SSF): *pâ.yi.ku.shâp* [pa 'jɪ k^w ʃæp^h] ‘eleven’

In summary, accent in some words might be lexicalized, minimally for a subset of nouns with a short penult and antepenult. However, it is clear that the NE Cree accent placement is generally determined by quantity sensitivity ((2); and (2) versus (3)), combined with extrametricality ((1a) versus (1b)).

⁴ Syllable boundaries are indicated by periods in the orthographic representation and by spaces in the transcriptions.

⁵ Note as well that coda consonants do not contribute to syllable weight in NE Cree.

Table 1
NE Cree metrical system: One pitch accent per word

Non-final	Final
Default pattern for words in isolation and in context	Morphologically conditioned
' <i>chî.mân</i> [tʃi:ma:n] 'boat'	<i>chî. 'mân-H</i> [tʃi:'ma:n ^h] 'boats' (pl. suffix)
' <i>nuh.kum</i> [nøhkʊm] 'my grand-mother'	<i>ûh. 'kum-H</i> [u:h'kʊm ^h] 'someone's grand-mother' (obv. suffix)

NE Cree thus displays an abstract metrical system whose analysis poses its own challenges, not least among which is final extrametricality, suppressed in those cases where it yields sub-minimal or unstressable words (e.g., one-syllable words). Furthermore, an analysis involving factors such as syllable weight (vowel duration) is required to determine which of the three rightmost syllables is accented in long words. Finally, the language displays a number of idiosyncratic metrical patterns which further complicate the overall evidence available to the learner.

Presumably, the simplest way to acquire such a system should be through a highly suppletive lexicon, one in which each word form would be memorized (and, thus, produced) with its own pitch contour. However, as we will see, the child instead displays word productions that reflect the most basic aspects of the target system.

4.1.2. *Ani's metrical development*

As shown by Swain's (2009) acoustic analysis of all of Ani's productions under scrutiny, the child had mastered the acoustics of the target pitch accent system by the time of the initial data recordings, at age 2;02. This result is in line with previous research on the topic, which shows that stress cues are acquired relatively early by children (e.g., Kehoe, Stoel-Gammon, & Buder, 1995). Also relevant in this context is the fact that unstressed vowels in NE Cree may undergo reduction and/or deletion, similar to English. Interestingly, Ani also behaves like English-learning children in this regard, who generally do not reduce unstressed syllables in early word productions (e.g., Allen & Hawkins, 1980; Pollock, Brammer, & Hageman, 1993; Schwartz, Petinou, Goffman, Lazowski, & Cartusciello, 1996). She exhibited a gradual increase of vowel reduction between ages 2;02 and 4;01. These two observations suggest, from an acoustic standpoint, Ani's mastery of the general prosody of NE Cree, but also her slower learning of the variable, thus inherently complex, phonotactics related to vowel reduction.

Moving now to the location of stress, which does require some degree of abstraction if one is to account for the NE Cree metrical system in a grammatical fashion, we observe a clear distinction between target words with final stress (i.e., without extrametricality) and those with penultimate or antepenultimate stress, which imply some degree of abstraction.

Starting with target words with final stress, we can see in Table 2a that Ani showed virtually no errors in final stress production, in spite of some difficulties in segmental production. Representative examples are provided in Table 2b.

Table 2a
Word-final stress: Performance over the developmental period

Age	Attempts	Errors	Target-like stress
2;02.02	14	1	93%
2;08.28	47	0	100%
3;04.09	14	0	100%
3;06.23	16	0	100%
4;01.30	32	0	100%

Table 2b

Word-final stress: Accurate final stress realization in spite of segmental errors

Orthography	Target IPA	Actual IPA	Age	Translation
<i>chipiha</i>	[tə'ba]	[ə'ba]	2;02.02	close it
<i>ihâyû</i>	[da'jo]	[dæ'na]	2;02.02	s/he is there
<i>châkwân</i>	[tə'gʌn]	[dʌ'no]	2;02.02	what/something
<i>tâpâ</i>	[də'boe]	['bʊ]	2;08.28	not
<i>pichihtin</i>	[bits'tɪn]	['dʒʊn]	2;08.28	it falls down

However, the picture is much different in the context of target words with non-final stress. Starting with words with penultimate stress, we can see that the accuracy rate is much lower. In Table 3a, accurate productions of such target words hover around 60%, with a dip close to 50% at age 3;04, followed by a gradual increase in the last two sessions under investigation. (We return to this dip later in the discussion.)

Table 3a

Penultimate stress: Performance across the developmental period

Age	Attempts	Errors	Target-like stress	Stress shift to final σ
2;02.02	24	9	63%	9/9
2;08.28	35	14	60%	14/14
3;04.09	41	19	54%	17/17
3;06.23	33	11	67%	10/10
4;01.30	39	6	85%	6/6

Table 3b

Penultimate stress: Stress shift to final syllable

Orthography	Target IPA	Actual IPA	Age	Translation
<i>iyâwâu</i>	['jawo]	[ʔo'ʔo]	2;02.02	s/he has it
<i>chûchû</i>	['dʒodʒo]	[do'dʒo]	2;02.02/2;08.28	breast feed
<i>kâhkâm</i>	['gʊkum]	[gʊ'go]	2;02.02	Grandma
<i>pîpîsh</i>	['bibɪʃ]	[bi'biʃ]	2;08.28	little baby
<i>chîhtû</i>	[vdʒido]	[dʒi'jo]	2;08.28	it works
<i>kîkî</i>	['gigi]	[gr'gi]	2;08.28	it hurts
<i>mîmîu</i>	['mimjaw]	[mi'mi]	2;08.28	s/he sleeps

We also highlight the fact that in all of the cases of erroneous stress placement attested, the child produced final stress. This systematic pattern becomes relevant in light of the data on words with antepenultimate stress. As we can see in Table 4a-b, these words, which pose an even higher level of difficulty for the child, are also generally produced with final stress each time a stress error is observed. Here again, the developmental curve suggests a gradual mastery of these metrically more abstract words.

Table 4a

Antepenultimate stress: Performance over the developmental period

Age	Attempts	Errors	Target-like stress	Stress shift to final σ
2;02.02	7	6	14%	6/6
2;08.28	12	6	50%	7/7
3;04.09	16	12	25%	12/12
3;06.23	32	5	84%	4/5
4;01.30	12	3	75%	3/3

Table 4b

Antepenultimate stress: Stress shift to final syllable

Orthography	Translation	Target IPA	Actual IPA	Age
<i>mânitâh</i>	like that	[ˈmæn_də] ⁶	[ən'dʌ]	2;02.2
<i>âkutâh</i>	right there	[ˈaɡoda]	[e'de]	2;02.2
<i>pwâchikî</i>	boogieman	[ˈbʌdʒəgi]	[dib'di]	2;02.2
<i>ituhtâu</i>	it goes	[ˈi_dən]	[dæ'da]	2;08.28
<i>pîtihwâu</i>	put it in pocket	[ˈbit_ˈho]	[ˈdo]	2;08.28
<i>minitûsh</i>	insect	[ˈmin_doʃ]	[mi'noʃ]	2;08.28

The pattern of errors observed in Ani's productions of words with non-final stress clearly suggests an over-application of the most basic properties of the target stress system (i.e., iambic footing, with stress on the rightmost stressable vowel). We also observe the gradual acquisition of non-final stress, which seems to be acquired on a word-by-word basis. This gradual acquisition is fully expected, even in the presence of a grammatical system for stress parsing, given the obscuring factors involved. These include syllable weight, the related (and variable) tendency to reduce unstressed vowels, and, we argue, the significant fact that an understanding of particular aspects of NE Cree morphology is also required in order to attain a full understanding of the system (as summarized in Table 1).

We also note that the slight dip in this curve observed at age 3;04 in Table 3a manifests itself more prominently in Table 4a. In the next section, we suggest that this dip is symptomatic of a larger grammatical issue, as it also corresponds to qualitative changes in Ani's morphological (verbal) productions. We argue that this performance dip relates to a period of grammatical restructuring during which the child began to use her morphological system in a productive way.

4.2. Morphological development

4.2.1. Overview of the NE Cree verbal system

East Cree is spoken in nine communities along the east coast of James Bay and inland towards the provincial border with Labrador. The overview of verbal morphology we offer here for NE Cree holds good for all dialects of Cree, and most frequently for the language as a whole.⁷ Verbs in the CMN complex dialects are inflected for one of three conjugation sets or "orders", as they are known: Independent, Conjunct and Imperative.⁸ Our discussion deals principally with Animate Intransitive verbs of the Independent and Conjunct orders.⁹ Imperative inflection, used for commands/requests, is

⁶ Nuclear sites where vowel syncope may occur in NE Cree are indicated by “_”.

⁷ The reader is referred to <http://www.eastcree.org/> for further details of the grammar of East Cree.

⁸ There are a number of different inflectional paradigms within the Independent and Conjunct orders; we deal only with the Independent Indicative Neutral and the Conjunct Indicative Neutral. NE Cree has two Imperative conjugations: the “Immediate” (*nipaa-h* ‘sleep!’) and the more polite “Delayed” (*nipaa-hkin*. ‘sleep later!’). The latter is in the process of being replaced, in both southern and northern dialects, by use of the future Conjunct Indicative Neutral (Marguerite MacKenzie, p.c.).

⁹ Algonquian verbs fall into one of four principal classes: Animate Intransitive, Inanimate Intransitive, Transitive Animate, or Transitive Inanimate.

restricted to second person forms (including the first person inclusive), as illustrated in (4). The future Conjunct is frequently used instead of the Imperative, and is seen as a more polite way to issue a command.

- (4) Commands/requests¹⁰
- a. Imperative (Immediate)
 - 2SG *nipâ-h* ‘sleep!’
 - 21PL *nipâ-tâu* ‘let’s go to sleep!’
 - 2PL *nipâ-kw* ‘go to sleep!’
 - b. Conjunct (Indicative Neutral)
 - Châ api-yin*
 - PVB(FUT) sit-CIN(AI).2SG
 - ‘Sit down!’

The distribution of the Imperative is thus highly constrained. While the Conjunct has a wider distribution, it is arguably describable (and constrained) in terms of syntactic environment; Conjunct verbs occur in constructions associated with a CP level (Campana, 1996; Brittain, 2001); for example, subordinate clauses, *wh*-constructions, and relative clauses. Conjunct inflection is obligatory in subordinate clauses (5a), and in any clause containing a *wh*-element. In the latter case, a morphophonological process referred to as “initial change” applies, affecting the leftmost vowel of the verb stem (5b).

- (5) Conjunct
- a. Subordinate clause
 - Nichischâyimâu awân âh chîh nipâ-t.*
 - know(IIN).1>3 PRN PVB PVB(PST) sleep-CIN(AI).3SG
 - ‘I know someone had slept here.’
 - b. *Wh*-question (initial change)¹¹
 - Tânitâh û âshinâku(n)-hch?*
 - how this IClook.like-CIN(II).INAN
 - ‘How does this look?’

The distribution of the Independent verb, by contrast, appears to be quite different. The Independent, exemplified in (6), occurs in any environment requiring neither the Imperative nor the Conjunct (e.g., non-*wh* main clauses); it thus appears to be the default (elsewhere) inflection.¹²

- (6) Independent verb
- ni-chischâyimâ-u*
 - 1-know-IIN(TA).3
 - ‘I know him/her.’

The morphology of the Independent might be expected to be more transparent to the learner for a number of reasons. First, in the Independent, the form-meaning relationship is more agglutinating; Person is encoded by a prefix, while suffixes provide Number and Person information, as in Table 5.

¹⁰ The following abbreviations are used throughout this paper: 1=1st person, 2=2nd person, 3=3rd person, 4=obviative, SG=singular, PL=plural, 21PL=1st person inclusive; INAN=inanimate, PRN=pronoun, PVB=preverb; FUT=future, PST=past, IMP=Imperative (Immediate); AI=Animate Intransitive, CIN=Conjunct Indicative Neutral, IC=initial change, II=Inanimate Intransitive, IIN=Independent Indicative Neutral.

¹¹ Citation form: *ishinâkun* ‘it appears a certain way’.

¹² Conjunct verbs can also occur in non-*wh* main clause contexts. Brittain (2001) proposes these to be focus clauses (associated with a CP level, in other words).

Table 5

Independent morphology (AI verb mishikâu 's/he arrives by canoe')

Person prefix	Verb stem	Person	Number
1 <i>ni-</i>			1PL <i>-nân</i>
2 <i>chi-</i>	<i>mishikâ</i>	1/2 <i>-n</i>	21PL <i>-nâniu</i>
			2PL <i>-nâwâu</i>
3 \emptyset		3 <i>-u ~ -w</i>	3PL <i>-ich</i>
		4 <i>-yihh</i>	

As well, much of the same morphology is found in the possessed nominal paradigms, as in (7).

(7) Animate possessed noun (plural)

- a. my duck(s): *ni-shîshîpim(-ich)*
- b. your duck(s): *chi-shîshîpim(-ich)*
- c. our (21PL) duck(s): *ni-shîshîpim(i)-nân(-ich)*

The Conjunct, by contrast, fuses the features of Person and Number in its suffixes, as in (8).

(8) Conjunct Indicative Neutral Suffixes (AI)

<i>-yân</i>	1SG	<i>-hch</i>	1PL
		<i>-yihkw</i>	21PL
<i>-yin</i>	2SG	<i>-yâkw</i>	2PL
<i>-t</i>	3SG	<i>-ch</i>	3PL
		<i>-yichh</i>	4

With respect to the relative frequency of Conjunct versus Independent morphology in adult speech, a study of Woods Cree (Starks, 1994) shows that 75% of main clause verbs in narrative discourse are Conjunct as opposed to 45% in conversation.¹³ Given that subordinate verbs are Conjunct, even if the child is exposed more frequently to conversation (as opposed to narrative discourse), the input frequency for verbs inflected with Conjunct morphology is likely to be equal to, if not in excess of, Independent verbs. Child-directed speech may differ somewhat in nature from interaction among adults, perhaps having a higher proportion of commands, for example in contexts where adults instruct children about what (not) to do.¹⁴ In NE Cree, verbs in this functional context will be either Imperative or (future) Conjunct. Thus, in the event that the Cree-learning child is exposed to speech that has a high proportion of commands, the net result is likely to be that the relative proportion of Independent verbs to Imperative and/or Conjunct verbs alters in favour of the latter; in comparison to adult interactions, child-directed speech may thus contain a smaller proportion of Independent verbs.

As we can see from the above description, while the Independent order enjoys a higher degree of grammatical transparency, by virtue of both its default status in the language and the more transparent phonological properties of its spell out of grammatical features, the Conjunct order can be seen as statistically more prominent or, under a more prudent approach, a rough equal to the Independent. If learning corresponds to grammatical uncovering on the child's part, we thus expect the Independent order to be mastered first. On the other hand, a statistical approach to learning would predict, staying with our prudent suggestion that Independent and Conjunct may be of roughly equal prominence, that

¹³ Ideally, these figures should be based on a systematic study of child-directed speech in NE Cree. This work is currently in progress.

¹⁴ In a study of child-directed speech in English, for example, 9% of tokens were imperative forms (Cameron-Faulkner, Lieven, & Tomasello, 2003). The reader is also referred to Newport, Gleitman, and Gleitman (1977) and Clark (2003).

both orders should develop in parallel. Keeping these predictions in mind, we now turn to Ani's productions. As we will see, the emergence of productive verbal morphology clearly centres around the Independent order, an observation which we take as evidence in favour of the grammatical approach to language development (and, by extension, language processing).

4.2.2. Ani's verbal development

As we will see in this section, Ani clearly favours the Independent order in her early verbal productions. Supporting evidence comes from conspiring observations about, first, the overall developmental curve which shows a drop in performance at age 3;04, i.e., during the same session where we also observed a drop in metrical development. As we alluded to above, this drop coincides with the onset of productive inflection, a qualitative change which we interpret as the onset of productive, grammatical use of morphology. We then address this curve in light of Ani's innovative use of inflection with 'child' verbs, which are a set of verbs used in Cree child-directed speech that are rarely, if at all, inflected by adults.

As we can see in Figure 1, between 2;01 and 3;01, 67% (40/60) of Ani's attempted verbs are Independent, while only 7% (4/60) are Conjunct. Between 3;04 and 3;08, 55% (29/53) of Ani's attempted verbs are Independent, while 26% (14/53) are Conjunct. These figures generally run counter to expectation if input frequency is to be taken as a significant force in acquisition.

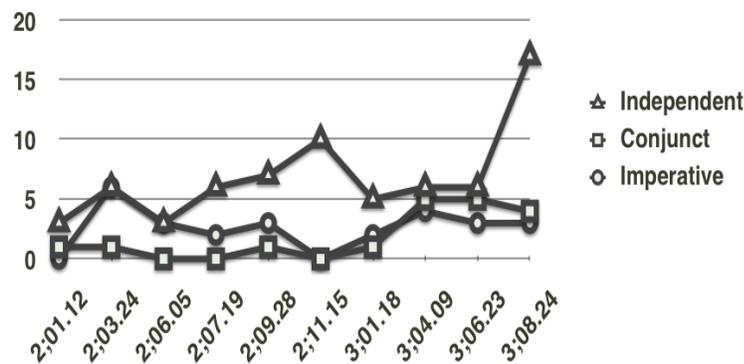


Figure 1. Ani's development of verbal orders.

A further look at qualitative aspects of her productions reveals an even more interesting picture. Of special interest are 'child' verbs, a feature of child-directed speech in Cree. Child verbs consist of verbs that generally follow a regular phonological pattern (reduplication). These forms are reportedly used with children up to around the age of 3;0 (Luci Bobbish-Salt, p.c.), an age which, according to our case study, corresponds to the emergence of productive verbal morphology with Cree children. Examples of child verbs used by Ani are provided in (9).

(9) Child forms (verbs) found in Ani's speech (Terry, 2010)

- nânâ* 'eat'
- chûchû* 'drink'
- kîkî* 'be hurt'
- mîmî* 'sleep'
- pûpûsh* 'pee'

Of particular interest in Ani's production of child verbs is the fact that she virtually never inflected them until 3;04, at which point we notice the spontaneous appearance of inflection on these verbs, as illustrated in Figure 2. This innovative use of inflection indeed suggests a form of grammatical over-generalization, which we take to be the manifestation of her emerging productive verb inflectional system.

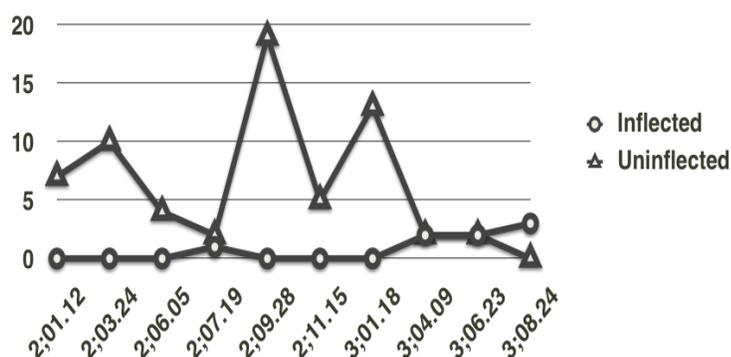


Figure 2. Ani's productions of child forms

Our interpretation finds support in other aspects of Ani's overall performance. Indeed, still at age 3;04, we note that, as Ani begins to inflect child forms, she starts making errors on forms previously produced close to target. Focussing more specifically on 1st person (Independent) forms, we note the gradual emergence of the prefix *ni-* prior to 3;04 (1/3 attempts are successfully produced at 2;11, then 1/2 attempts are produced at 3;01), followed by a performance drop down to 0% at 3;04 and 3;06. From a more qualitative perspective, we also note that prior to 3;04, Ani began to generalize her use of the language's Independent inflectional system.

In sum, the child favoured the grammatically most transparent verb order in her early productions, and over-generalized the use of this order on child forms which, despite being in the right grammatical category (verb), are typically not inflected in the input that the child was being exposed to. We interpret this observation, as well as the concomitant drop in metrical (section 4.1.2.) and inflectional performance (above) as a stage of grammatical restructuring enabling the onset of productive inflection. We further suggest that this stage corresponds to the period when the child moved from using stored amalgams (e.g., Courtney & Saville-Troike, 2002) to engaging in the types of grammatical operations required in her innovative inflection of child verbs.

5. Discussion

Explicit in our interpretation of Ani's metrical and morphological development is a rejection of lexicon building based solely on input frequency. While we do not reject this mechanism as an inherent component of learning, we claim that it only constitutes a portion of the story. We argue that language learning also involves, at a more fundamental level, the grammatical decomposition of the stored (memorized) lexical units into their smaller parts and the acquisition of the combinatorial principles regulating these parts. Under this view, we cannot restrict the lexicon (and lexical processing) to the mere stacking of exemplars in memory. Such a view is, we argue, overly simplistic, as it fails to account for anything but the most obvious facts about acquisition. While exemplar-based approaches may correctly describe basic aspects of language acquisition and use, especially in the contexts where high frequency in usage can be correlated with 'simple' grammatical properties (be they phonological or morpho-syntactic),¹⁵ any look at the more opaque systems is likely to undermine such approaches. Such is the case in NE Cree, where we observe learning not from frequency figures but rather from the identification of basic grammatical properties, over-applications of which yield patterns that cannot be driven by either exemplar learning or statistical pressure. Only an analysis taking as a starting point grammatical constituency and related organizational principles can provide an effective account of the developmental facts. This supports language acquisition as the child's uncovering of the relevant constituents and their grammatical organization.

¹⁵ See Bybee (2001) for examples of phonological reduction in high frequency usage contexts.

More generally, our study adds to a growing body of evidence that the development of productive abilities cannot be accounted for based on frequency figures only (e.g., Demuth, 2007; Levelt & van Oostendorp, 2007; Fikkert & Levelt, 2008; Rose, 2009; Vijver & Baer-Henney, 2010a,b). Perhaps the clearest common denominator to all of these studies is that statistical determinism is inherently limited by particular aspects of grammatical sub-systems, and the relative transparency (or opacity) that emerges from the combined sub-systems within each language. This view is in fact compatible with the hypothesis that aspects of linguistic constituency arise from statistical generalizations over the lexicon (e.g., Pierrehumbert, 2003), as long as these generalizations are adequate in light of domain-specific aspects of the learner's current grammar (Pearl & Lidz, 2009). Because generalizations can be made about specific aspects of the target system (for example concerning stress or featural distributions within the syllable), it follows that each of these aspects can potentially be the locus of representational constituency. This view, which highlights the crucial importance of linguistic constituency, does not, however, limit learning to statistical processing. Linguistic systems are multifaceted, and so is their acquisition (e.g., Rose, 2009). This view, which must hold true of all languages, is perhaps best supported in the context of polysynthetic languages. Following Sadock (1980) and Hankamer (1989), we note that without grammatical constituency, it would be virtually impossible to build a receptive lexicon for languages (such as NE Cree) which permit a high degree of morphological complexity. Indeed, each root in such languages can yield thousands of forms; the association of these forms with their related meanings logically requires some degree of decomposition into smaller morphological constituents and related meanings, many of which never occur in isolation.

Such observations contradict views from the exemplar-based literature such as Bybee's (2001) definition of a lexical entry as "a unit of usage that is both phonologically and pragmatically appropriate in isolation" (p. 30) as well as Vihman & Croft's (2007) claim that the word is "the smallest linguistic unit encountered in language use" (p. 716). Rather, we suggest that while early stages in language acquisition may involve the memorization of unanalyzed lexical entries (be they called exemplars, amalgams or unanalyzed chunks), this step is only required in order for the learner to perform further grammatical analyses, the latter giving rise to the types of over-generalization patterns that we observe both in Ani's production as well as in most of the relevant literature on language development. While these over-generalizations betray partial or misled analyses of the target language on the learner's part, they reveal aspects of the fundamental mechanisms involved in language acquisition and use.

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