THE DEVELOPMENT OF SEGMENTAL PHONOLOGY IN A MIXED LANGUAGE ENVIRONMENT: A CASE STUDY FROM NORTHERN EAST CREE

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The Development of Segmental Phonology in a Mixed Language Environment: A Case Study from Northern East Cree

by

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Abstract

In this thesis I discuss the segmental development of a child (code-named Ani) learning Northern East Cree throughout ten sessions documenting the acquisition of her speech (ranging in age from 2;01.14 to 3;08.24). Although Ani was not a native speaker of English, she was exposed to some English through media sources (i.e. television and radio) and attempted to produce both Cree and English words in her spoken utterances. I describe Ani's word productions in both languages in order to obtain a clear picture of her phonological development as a whole. Building on previous research (e.g. Pearson et al. 1997; Kuhl, Tsao & Liu 2003; Kuhl 2007; Hoff et al. 2012), I hypothesize that Ani does not actually learn the phonology of English, but rather produces both Cree and English words using a single phonotactic system, that of her native language. Ani's productions of English words are thus filtered through her Cree inventory of phones and syllable structure, causing consonants or syllable positions specific to English to develop late (some of which do not develop at all), during the period covered by the corpus. To test my hypothesis, I provide a detailed description of Ani's Cree and English word productions, which I organize by phones and positions within the syllable, and then systematically compare her performance in each language. This study contributes to the documentation of phonological development within mixed language environments as well as to the literature on the acquisition of an under-documented Aboriginal language.

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Table of Contents

Chapter 1: Introduction

1. Introduction

Children learn language with accuracy and speed. While adults witness a child's impressive language abilities, they rarely consider the various aspects of language that a child must learn before s/he can even begin to speak, let alone learn to express this knowledge in spoken form. To a lay person, the process of learning language may only seem to consist of learning words and the syntactic rules that govern sentence structure. However, studies of language acquisition show that there is much more to language learning. Whichever language a child is exposed to, s/he must decipher all of the speech sounds that occur within the ambient language and must also learn how to produce these sounds in all relevant positions within a given word or phrase. Throughout the various stages in their language development, children display different patterns of production, each of which can reveal aspects of their developing system. Given that different languages present different challenges to the learner, it is important to study the acquisition of as many languages as possible in order to determine universal as opposed to language specific tendencies in acquisition.

The language learning challenges faced by children may become much more complicated in a mixed language environment. Not only do these children have to face the difficulties mentioned above, but they must do so in two (or more) potentially very different languages concurrently. In this type of language learning environment, various questions arise such as: "Is the rate of acquisition slower in a mixed language environment?"; "How does the child separate the input from multiple languages?"; and

"Is the child confused by the exposure to multiple languages?". These particular questions call for research on language acquisition within mixed language environments. It is in this area that I hope to make a contribution through the current thesis.

2. Segmental Development in a Mixed Language Environment

In this thesis, I describe the segmental development of Ani, a child learning Northern East Cree (henceforth, NE Cree). As mentioned above, in order to learn the phonology of a language a child must decipher the sounds of that language, learn how to produce them, and also figure out which position within the syllable these sounds can and cannot appear, among many other tasks (e.g. Goad & Rose 2004). For Ani, this not only includes learning her native language, but also filtering through evidence from other languages as well, in particular English, to which she was exposed in her daily life, through media sources such as television and radio.

Given Ani's mixed language environment, it is important to look at the development of sounds from words in both languages separately. I provide a detailed description of Ani's Cree and English sound development, followed by a systematic comparison of her production patterns in words from the two languages. As we will see in the detailed descriptions of both Cree and English found in Chapter 3, Ani is in fact exposed to two very different language structures. Cree, on the one hand, consists phonologically of a relatively small inventory of consonants and simple syllable structure. English, on the other hand, displays a fairly large consonantal inventory along with a more complex syllable structure. As we can see from these differing characteristics, these languages do not formally relate to one another. In a mixed-

language environment, this raises the question of whether exposure to a language unrelated to the child's native language causes difficulty in word production within the non-native language. While the current work focuses on the development of segmental phonology in particular, we will see in Chapter 6 that we can hardly dissociate this level of linguistic development to that of the system as a whole.

Although one may expect to see an influence of English in Ani's Cree development, my working hypothesis (which builds on previous work by (Pearson et al. 1997; Kuhl, Tsao & Liu 2003; Kuhl 2007; Hoff et al. 2012), in fact reflects just the opposite. First, although Ani is exposed to English, she is not learning the language. Second, her productions of English target words are "filtered" through the Cree system.

3. Aims of the Study

As alluded to above, the goal of this thesis is to study Ani's development of phonology in both Cree and English word productions. This study will offer a systematic look at the type of language learning outcomes that emerge from exposure to two very different languages (Cree and English), in particular relative to the amount and quality of exposure to these languages. In addition to this goal, this thesis also contributes to the literature on acquisition of Algonquian languages. Although there has been some research on Ani's acquisition from prosodic and morpho-syntactic standpoints (Swain 2008; Terry 2010; Johansson 2012) and the acquisition of segments and syllable types (Thorburn 2010) there has been no research done on the development of Ani's segmental phonology, or of the phonology of any other participant of the CCLAS project. This

research thus supplements the literature on the subject both for the particular participant and for the language as a whole.

4. Thesis Organization

This thesis is organized as follows. In Chapter 2, I provide background information on the Chisasibi Child Language Acquisition Study (e.g. objectives, participants, and data collection) followed by the methodology for my current study. In Chapter 3, I provide a phonological sketch of both Cree and English, focusing on the consonantal inventory and syllable structure of each language. In Chapter 4, I address segmental development based on Ani's actual speech productions. First I describe the development of her word productions in Cree, and then, in Chapter 5, I describe the development of her words in English. In Chapter 6, I compare the generalizations from both languages side by side. As we will see from this chapter, Ani filters English words through the Cree phonotactic system. Finally, in Chapter 7, I provide a summary of my findings and discuss the potential implications of this research.

Chapter 2: Background and Methodology

1. Introduction

In this chapter, I describe the methodology used in this thesis, starting with some background information on the Chisasibi Child Language Acquisition Study (henceforth CCLAS) (http://www.mun.ca/cclas). I provide information on the methodology developed within this research project for data collection. This information on CCLAS comes from a progress report of the project (Brittain et al. 2007). I then provide a description of my own work discussing the particular data set I have worked with and the preparation of these data for the current study.

2. The Chisasibi Child Language Acquisition Study

As mentioned above, the child speech productions used in this thesis come from the CCLAS. In the sub-sections that follow, I describe CCLAS, the objectives of this study, the participants involved and the procedure for data collection.

CCLAS is a naturalistic language acquisition study of NE Cree, a dialect of Cree (Central Algonquian) spoken in Chisasibi, Quebec. The speech productions of six children were collected via video recordings which occurred at approximately 2-3 week intervals over a period of 30 months (November 2004-May 2007). Each recording session lasted roughly 45 minutes and recordings were made by Darlene Bearskin, a native speaker of NE Cree and CCLAS project manager in Chisasibi during this period (Brittain et al. 2007). The following sub-section presents the objectives of the CCLAS project as a whole.

2.1 Objectives of CCLAS

According to Brittain et al. (2007), CCLAS pursues five principal objectives. The first is to expand on the literature on first language acquisition which, according to the researchers, offers little discussion of Algonquian languages. The second objective is to contribute to the literature on East Cree, more particularly literature that is directed both at "... the speech community and at an academic audience." (Brittain et al. 2007: 5). Third, the researchers aim to improve the way in which acquisition research can be conducted from a distance (i.e. research conducted remotely). The fourth and final objective of this study is to provide accessible language acquisition data to the community, for use within the educational system and health care system (particularly in the field of Speech-Language Pathology).

2.2 The Participants

Six children participated in CCLAS, divided into two cohorts – a younger cohort (Cohort A: three children) and an older cohort (Cohort B: three children). The children in Cohort A were approximately 20 months old when filming began, while the children in Cohort B were 42-44 months. Combined, these age cohorts document NE Cree development for a 30-month period, covering the major language learning years (approximately 1.5 to 6 years of age) (Brittain et al. 2007). In the following sub-section, I discuss the procedures used by CCLAS researchers in order to collect and process the data.

Because the project is based on video recordings of young children, informed consent procedures were put in place to protect the privacy of the children and their families. The CCLAS Parent/Guardian Consent Form (which can be seen on the website below) detailed guidelines to protect the individuals involved and any ethical issues raised by the study (http://www.mun.ca/cclas/methodology/ethics/index.php).

2.3 The Procedure

As mentioned above, data for this study was collected by video recordings and filmed by Ms. Bearskin. During recordings, Ms. Bearskin was the only person to interact with the children (i.e. no other family members were present). This request was made to eliminate noise, in order not to undermine the transcription process at a later date (Brittain et al. 2007). The children were filmed doing everyday activities such as playing with toys and engaging in normal speech exchanges. The recordings were filmed with a Sony MiniDV camcorder, which Ms. Bearskin placed on a tripod and oriented toward the child. The tapes were then transferred to computers and uploaded to a project server at Memorial University for data processing.

According to Brittain et al. (2007), there were various stages involved in the processing of this data. Once the videos were uploaded, they were imported into a software program called *Phon* (https://phon.ca). *Phon* is used to facilitate the investigation of phonological data for studies in areas such as phonological development, language acquisition and phonological disorders, to name a few. The recorded data were associated with a textual transcript, which included orthography, phonetic transcription and various other data fields (notes, translation, morpheme

breakdowns, etc.) by research assistants at Memorial University (Brittain et al. 2007: 8). The data were transcribed using a double-blind, consensus-based transcription protocol in which two English speakers (with training in linguistics) independently transcribed the child speech in each recording. After this was complete, the transcribers validated their transcriptions by comparing the two blind transcripts and re-assessing any areas in which their transcriptions differed. By the end of the data validation stage, the child's productions were fully transcribed in IPA. In some cases, adult speech (when directed toward the child) was transcribed in Cree and then translated into English.

3. Current Study

From the CCLAS database, I have chosen to look at the productions of one particular child, code-named Ani. In the sub-sections below, I provide some background information on this particular corpus and detail the necessary steps taken to prepare the data for my study. First, I discuss the sessions selected for this thesis. Second, I describe the process of separating Cree words from English words within the corpus. Third, I explain data processing such as phone-by-phone alignment and lastly address the data compilation as it appears in the ensuing chapters. In the section to follow (Section 4), I address important issues about Ani's language environment.

3.1 Session Selection

For this thesis, I have chosen to analyze ten sessions. These sessions range from March 8th, 2005 to October 18th, 2006, documenting approximately 19 months of Ani's language

development. During this time period, the child's age ranges from 2;01.14 (year;month.day) to 3;08.24.

3.2 Separation of Cree and English Words

Within these ten sessions, Ani's productions contain a mix of Cree and English words. For my research, it was important to look at the acquisition of Cree and English target forms separately. In order to do this, I created two parallel corpora, one for Cree and the other for English. In the Cree corpus, I excluded all the English words that showed up in the child's speech productions, while in the English corpus, I repeated the same procedure, excluding all the Cree words. At the end of this process, I had one sub-corpus with only Cree words, and one sub-corpus with only English words.

In some instances, Cree and English words occurred within the same phrase. When this arose in the Cree corpus, I removed the English word(s) from the phrase. I then went to the English corpus (the same session and record number) and removed the Cree word(s). After these adjustments were made, I was left with just the Cree portion of the utterance in the Cree corpus and the English portion of the utterance in the English corpus.

In addition to using Cree and English words in the same phrase, Ani often combined the two languages in one word. This most commonly occurred in the word ['bibiʃ] which translates into 'little baby'. In this production, Ani uses the English word 'baby' but adds the Cree diminutive suffix [ʃ] for 'little'. Because of the use of Cree morphology, I decided to treat these forms as Cree words. Ani occasionally uses this

suffix on other English words as well (which I have also marked as Cree), but 'baby' is the most common occurrence.

This separation of Cree and English allowed for searches of phonemes in particular syllable positions in each language, giving a clear picture of Ani's development of phonology from either language.

3.3 Data Processing

Phone alignment refers to the process of aligning, phone-by-phone, the child's productions with the corresponding target (adult-like) form. As shown below in Figure 1 and Figure 2, *Phon* provides the target form of a word with the child's actual speech production of the same word below. *Phon* automatically aligns the child's production with the target form on a phone-by-phone basis, using a "best guess" algorithm which may at times result in an incorrect alignment. For example, in Figure 1 below, we see the target form for the English word 'twinkle' [ˈtwɪŋkəɬ] above Ani's production [tʰikʰʌ].[1] With regard to alignment, one would expect to see [kʰʌ] in [tʰikʰʌ] of the child's production to align with [kə] in [ˈtwɪŋkəɬ] in the target form. However, in this case, the [k] is automatically aligned with [ŋ]. In the case of misaligned phones, I manually provided the correct alignment. The corrected alignment of 'twinkle' can be seen in Figure 2.

1 This example is taken from 3;01.20, record #29 (Ani).

Figure 1: Misalignment of [twɪŋkəɬ] > [$t^hik^h\Lambda$]

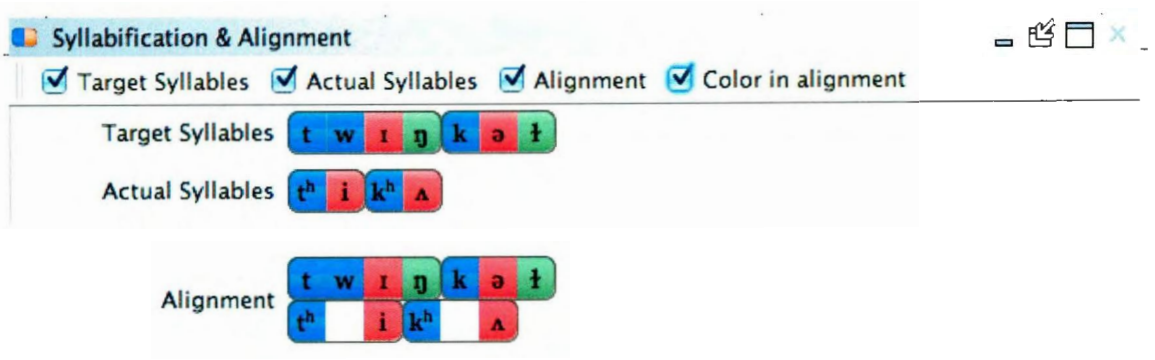
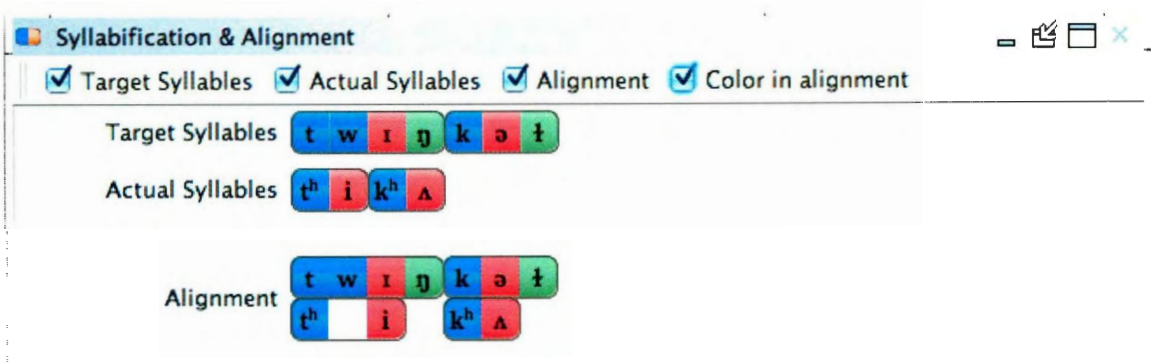


Figure 2: Proper alignment of [twɪŋkəɬ] > [$t^hik^h\Lambda$]



Once the phone alignment was completed for all 10 sessions, I was ready to conduct searches within the two corpora (Cree and English). I move to these data queries next.

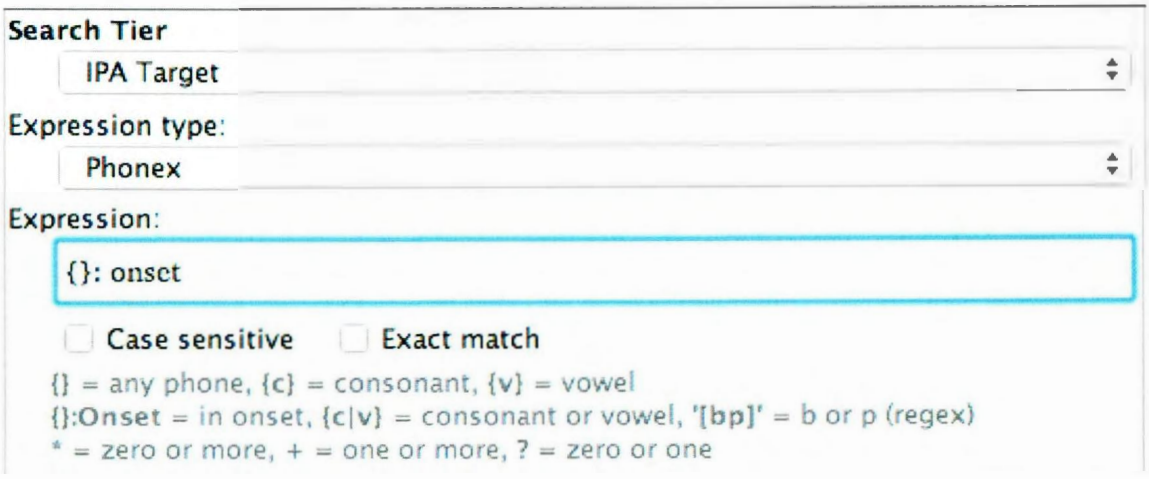
3.4 Data Queries

Because my investigation focuses on Ani's segmental development, I performed searches of phones in each language by syllable position. For Cree, I conducted searches for onsets, codas and onsets of empty-headed syllables. For English, I conducted searches for singleton onsets, second positions of branching onsets, and codas. In the

following chapter (Chapter 3), I provide a detailed description of the syllable positions, syllable shape, and consonant inventory of both Cree and English.

These searches were completed through the "Phones" query function in *Phon.* Using this search tool, I chose the language sub-corpus I wanted to query (Cree or English), the sessions in which I wanted to search (generally all ten), and then provided the syllable position I wanted to find the consonants in (i.e. onset, coda, etc.). An example of a phones query search can be seen in Figure 3 below. In this particular search, I was looking for any consonant that appears in onset (represented by '{}: onset') in all ten sessions of the English corpus.

Figure 3: "Phones" query of onsets in English



This query method returns all the consonants that appear in onset in the English corpus. Using *Phon,* I was then able to make a report of the results of the search. From this report, I sorted out the productions of each individual consonant, making charts to

represent the acquisition of the consonant over time (these charts can be seen throughout my thesis). I now turn to these data compilations.

3.5 Data Compilation

As mentioned above, once I completed my queries I exported them into a report file. This report provided me with a list of consonants that had been attempted in the searched syllable position (the target forms), alongside the corresponding child production (the actual productions). I then sorted this list of attempted and produced consonants to show correct consonant productions, substitutions that appear in the majority of produced forms, attempts that result in deletion, and finally an 'other' category. This 'other' category consists of consonant substitutions that occur sporadically, outside of any identifiable pattern. As we can see from the example below, the 'other' category consists of a compilation of these sporadic substitutions produced in a particular session. Figure 4 provides an example of such a compilation.

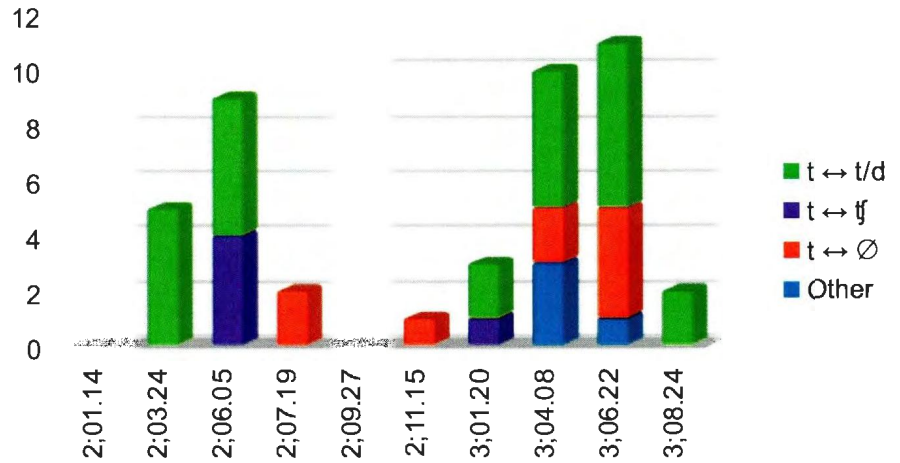
Figure 4: Data compilation of English [t] in coda

t • k	0	0	0	0	0	0	0	1	0	0
t • n	0	0	0	0	0	0	0	0	1	0
t • s	0	0	0	0	0	0	0	2	0	0
	2;01.14	2;03.24	2;06.05	2;07.19	2;09.27	2;11.15	3;01.20	3;04.08	3;06.22	3;08.24
Other	0	0	0	0	0	0	0	3	1	0
t • ∅	0	0	0	2	0	1	0	2	4	0
t • ʧ	0	0	4	0	0	0	1	0	0	0
t • ɹ̈d	0	5	5	0	0	0	2	5	6	2

This compiled data was then converted into a bar graph, which enables a visibly clear assessment of the development of any particular consonant within the corpus. An

example of these charts can be seen in Figure 5 below, which also displays the productions for English [t] in coda position.

Figure 5: English [t] in coda



As you can see from the chart above, Ani's target productions are in green, the deletions are in orange and the 'other' productions are in blue. For sake of clarity, this colour pattern remains consistent for each consonant chart throughout the thesis. The bars representing substitution patterns differ in colour according to the number of noticeable substitution patterns that occur in the data. However, the colour pattern remains the same: the most common substitution is purple, followed by yellow, and, if necessary, light blue and burgundy identify additional substitution patterns.

In addition to the individual consonant development charts, I compiled charts to address the overall development of a particular consonantal category (i.e. obstruents or sonorants). These charts are placed at the beginning of each section for both Cree and

English and show the number of attempts made at the consonants and the percentage of attempts in which Ani produces the consonants correctly.

4. Monolingual Development in a Mixed Language Environment

Throughout this thesis, I address Ani's language development in both her Cree and English word productions. As already mentioned, Ani is a native Cree speaker, although she has had some exposure to English. We will see that this has had very little influence on the development of her phonology. Although it is unclear how much English Ani has been exposed to, it was arguably a minimal amount, mostly coming from media sources (i.e. television or radio) (Pile in preparation).

Because of this type of language exposure, Ani was only passively involved with English – she was listening to the language but not actively engaged in speaking it. Importantly, Ani's exposure to English was not from social interaction. This is significant in that, according to Kuhl (2007), children cannot learn a language in the absence of social interaction within the language. In order to test this, Kuhl had American infants listen to Mandarin, either spoken by native speakers or via standard television or audio-only over an extended period of time. The children that were exposed to Mandarin in any form were then compared to a control group of infants that were exposed to English only. Children from both categories (live speaker or television/audio-only) were asked to return after a particular period of time and were tested to see if they had any recognition of Mandarin words. The children that had been exposed to Mandarin through human interaction showed "... remarkable learning from the live sessions – they performed significantly better on the Mandarin contrast when

compared to the control group that heard English only ..." (Kuhl 2007: 112). When testing the infants that had been exposed to Mandarin via television and/or audio only, the researchers concluded that they "... do not show phonetic learning, even though infants of the same age learned from a live person ..." (Kuhl, Tsao & Liu 2003: 9099).[2] This research has lead Kuhl (2007) to conclude that human interaction is critical for language learning. As Ani was not exposed to English through human interaction, she should not have been able to learn the grammar of this language.[3] Earlier research, such as Pearson et al. (1997), state that the exposure to a language must be direct in order for that child to learn the language and the learner must "... interact with speakers using the language." (p. 41).[4]

While we presume that Ani was not exposed to social interaction in English, we have reason to believe that she was exposed to a minimal amount of English on a day-to-day basis. In cases when a child only receives a small amount of exposure to a particular language, this language is deemed unlearnable. Research conducted by Pearson et al. (1997) concluded that there was "... a limit below 20% exposure in that the child appeared not to produce utterances in that language willingly or spontaneously." (p. 56). Building on this hypothesis, Hoff et al. (2012) state that "... there is a threshold of 20% of input required for language learning." (p. 22). From work by Pile (in preparation), B3 (another CCLAS participant) received less that 20% English input from adult speech in the observed video recordings. If we take this to be

2 See also Naigles & Mayeux (2001) on language exposure through television.

3 Also see Bloom (1975), Bloom & Esposito (1975), Goldstein, King & West (2003), for impacts of social interaction on speech production development.

4 See also Ervin-Tripp (1971); Sachs & Johnson (1976); Griffith (1985)

representative of every day interactions, then the child should not be expected to learn English.

As we will see in the description and comparison of Ani's phoneme development in Cree and English attempted words in the following chapters, this hypothesis is largely supported by the current study.

Chapter 3: Phonological Description of NE Cree and English

1. Introduction

As mentioned in the Introduction (Chapter 1) of this thesis, I am addressing Ani's segmental development in both NE Cree and English word productions. In this chapter, I describe the consonantal inventory and syllable structure, first for NE Cree, and then for English.

2. Northern East Cree

NE Cree is a dialect of the Cree-Montagnais-Naskapi language complex (MacKenzie 1980) which is spoken in Wemindji, Chisasibi, and Whapmagoostui Quebec (Northern Quebec). The southern dialect is spoken in Waskaganish, Nemaska, Waswanipi, Ouje Bougoumou, Mistissini and Eastmain. Together these are the nine communities of James Bay. The NE Cree data used in my thesis comes specifically from Chisasibi (http://chisasibi.org/HTML/location.html).

2.1 Consonantal Inventory

NE Cree has a relatively small consonantal inventory, consisting of only twelve consonants (Dyck, Brittain & MacKenzie 2006). These consonants can be seen in the phonemic inventory below (Table 1).

Table 1: Cree phonemic inventory

	Bilabial	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Stops	p	t			k (k^w)[5]	
Fricatives		s	ʃ			h
Affricates			ʧ			
Nasals	m	n				
Glides	w			j		

In Table 2, Table 3 and Table 4, we see the breakdown of these consonants relative to the natural classes that will be discussed in this thesis.

Table 2: Obstruents inventory

Stops	Fricatives	Affricates
p, t, k, k^w	s, ʃ, h	ʧ

Table 3: Nasal inventory

m, n

Table 4: Glide inventory

j, w

Wood (2006) states that [ʧ] can sometimes surface as [ts], although he does not discuss the distribution of these affricate variants. Other consonants are attested in the language such as the labialized [p^w, t^w, s^w, $ʃ^w$, m^w], and can be considered either complex onsets or simple onsets followed by diphthongs (Dyck, Brittain & MacKenzie 2006). We can see the use of a labialized consonant in the word [sikip^{w}a:w] 's/he roasts meat on a

5 Although [k^w] is a phoneme of Cree, Ani does not have attempt this consonant in the corpus and therefore will not be addressed further in this thesis.

string' (Marguerite MacKenzie, p.c., Oct. 2012). Finally, voicing is not contrastive in NE Cree and therefore only voiceless obstruents are present in the phonemic inventory. Voicing of obstruents is in free variation and non-contrastive; two words can thus be pronounced differently (with a voiced or voiceless consonant), yet still have the same meaning. For example, a word like *taapaa* 'not' is more often produced as *taabaa* or *daabaa* while still meaning 'not'. However, stop consonants that follow [h], [s] or [ʃ] often remain voiceless (Marguerite MacKenzie, p.c., Oct. 2012). (Although the data is well transcribed, the unavailability of acoustic measurements of the consonants, which would fall outside the scope of this thesis, makes it difficult to specifically tease apart the voiced consonants from the voiceless ones.)

Although [h] is considered a phoneme of Cree, the distribution of [h] in spoken Cree is rather difficult to determine. According to the East Cree website (www.eastcree.org), [h] is a consonant that is present in Cree orthography but appears to play a rather weak role within NE Cree phonology.[6] For example, when [h] appears before a consonant or occurs at the end of a word, it is often not produced (Dyck, Brittain & MacKenzie 2006). This is also reflected in the fact that Cree speakers often have difficulties representing the [h] in Cree orthography, and are often unable to locate where exactly it should appear in a given form (Marguerite MacKenzie, p.c., May 2013). Furthermore as O'Neill (in preparation) shows, the acoustic correlates of /h/ in word final position appear to be extremely variable and also dependent on phonological as well as morphological conditioning, the exact nature of which also relates to micro-dialectal variation. Because of all of these factors, and given that Ani shows no

6 Full web address: http://www.eastcree.org/cree/en/grammar/sounds-east-cree/sounds/consonants/fricatives/h-sounds2/

acquisition of /h/ in her productions, this consonant is excluded from further consideration. I will however address the development of [h] in English words in Chapter 5.

2.2 Syllable Structure

From the perspective of syllable structure, Cree is maximally a 'CVC' language consisting of a consonant, followed by a vowel, followed by another consonant (Dyck, Brittain & MacKenzie 2006). In word-final position, NE Cree allows for an extra consonant. This consonant is considered an onset and can consist of any of the twelve segments listed in the consonantal inventory above. These word-final onsets are syllabified as onsets of empty-headed syllables. The coda position in the syllable however, can only consist of the segments [s, ʃ, h, m, n]. The following table shows the syllable structure of NE Cree in which C = consonant, V = vowel, and # = syllable boundary.

Table 5: NE Cree syllable structure (Dyck, Brittain & MacKenzie 2006: p. 3)

#	C onset	V	C coda	C onset	#
	any consonant		s, ʃ, h, m, n	any consonant	

As we can see from Table 5, the child not only needs to acquire the sound and sound combinations of NE Cree, but s/he must also acquire the distributions of these sounds within the syllable.

I will now discuss the consonantal inventory and syllable structure of English, which has a much larger consonantal inventory, as well as a more complex maximum syllable structure, as we will see in the next section.

3. English

3.1 Consonantal Inventory

In English, the basic consonantal inventory consists of 24 consonants seen in Table 6 below (Giegerich 1992).[7]

Table 6: English phonemic inventory

	Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Stops	p b			t d[8]			k g	
Fricatives		f v	θ ð	s z	ʃ ʒ			h
Affricates					ʧ ʤ			
Nasals	m			n			ŋ	
Laterals				l			(ɬ)	
Rhotics				ɹ				
Glides	w					j		

In the 'Laterals' section of the table, the consonant [ɬ] is in brackets to indicate that it is an allophone of [l] in English. It is only found in syllable-final position (Giegerich 1992).

7 All the consonants in the Cree consonantal inventory are also present in English, but not vice versa.

8 Ani also attempts [ɾ] (an allophone of [t/d]), but produces it in very small numbers and only in the words 'water' [waɾəɹ] and 'little' [lɪɾəɬ] and therefore it will not be addressed in this thesis.

In Table 7, Table 8, Table 9 below, we see the English consonant inventory broken down into the natural classes which I will discuss in this thesis.

Table 7: Obstruent inventory

Stops	Fricatives	Affricates
p, b, t, d, k, g	f, v, θ, ð, s, z, ʃ, ʒ, h	ʧ, ʤ

Table 8: Nasal inventory

m, n, ŋ

Table 9: Approximant inventory

Laterals	Rhotics	Glides
l (ɬ)	ɹ	j, w

As mentioned in Chapter 3, Section 2.1, I will not be discussing Cree [h] in either onset or coda positions. In English, however, I will discuss [h] in onset (the only position in which it appears in English). English [h] appears in prosodically strong positions (i.e. in a stressed syllable) and is therefore a prominent sound, in contrast to its elusive status in Cree. As I have more data on English [h], I am able to make observations on the development of this consonant in Ani's productions.

3.2 Syllable Structure

The basic syllable structure of English consists of three main syllable positions: onset, nucleus and coda, but is maximally: A][CCVVCC][AA (A = appendix) (Giegerich 1992). This syllable structure is exemplified and explained in Table 10 below.

Table 10: English syllable structure

Left App	**C** onset	**C** onset	**V(V)**	**C** coda	**C** coda	**Right App**	**Right App**
[s] only	branching onset		single vowel or diphthong	branching coda		must be Coronal	
s	t ɹ		ɛ	ŋ k		θ s	

In the third row of the chart above, we can see an example of the English syllable structure from the word 'strengths' [stɹɛŋkθs]. It is important to keep in mind that this is a maximal syllable in English and, therefore, not every word is bound to display such level of complexity.

As seen above, English has both branching onsets and branching codas. I will discuss both first and second positions of onsets, but will not be discussing branching codas. When completing data searches, I discovered there were not many branching codas present, with an over-representation of the [ɹθ] coda cluster (34 out of 57 coda clusters came from 'birthday' [bɪɹθdej] alone). Because of the low numbers of examples and the repetition of one particular cluster, there were not enough examples to do a full analysis on this syllable position. Therefore, throughout my data all codas (whether in singleton or branching positions) have been uniformly referred to as 'codas'.

Throughout my English data description, the main focus will be on onset and coda positions. Singleton onsets can consist of any of the 24 consonants in the consonantal inventory mentioned above (excluding [ŋ] and [ɬ]), while the second position of onsets consist of only [l, ɹ, w]. There is distributional evidence that suggests that [j] is actually a part of the nucleus, different from the bilabial glide [w] which does

appear in the second position of onsets (Davis & Hammond 1995). In my data, I have syllabified [j] as a part of the nucleus and therefore will not be discussing it in the second position of a branching onset. In coda position, we see any of the 24 consonants above, excluding [h], and [l] but including the allophone [ɬ].

In the next chapter, I take an in-depth look at Ani's segmental development in her NE Cree word productions. I describe the development of both obstruents and sonorants in all relevant syllable positions (onsets, codas and onsets of empty-headed syllables), highlighting any particular developmental patterns that occur in these data.

Chapter 4: Segmental Development – Northern East Cree

1. Introduction

In this chapter, I discuss Ani's segmental development in NE Cree. I explore Ani's speech productions of obstruents and sonorants. First, I break down these consonantal categories by manner of articulation: stops, fricatives, and affricates for obstruents and nasals and glides for sonorants. Second, I break down these consonants according to their positions within the syllable. In Cree, as we saw in Chapter 3, Section 2.2, three syllable positions are relevant for analyses: onsets, codas and onsets of empty-headed syllables.

Branching onsets do not occur in Cree, therefore onsets only consist singleton onsets. Referring back to the Cree consonantal inventory in Chapter 3, Section 2.1, we see that any of the 12 Cree consonants can appear in both onsets and onsets of empty-headed syllables. In Ani's attempted speech productions however, only the obstruent categories of stops and affricates appear in onset of empty-headed syllable position. Codas have a more restricted distribution and can only consist of a small subset of Cree consonants: [s, ʃ, h, m, n]. Recall, however, from Chapter 3, Section 2.1, that I will not be discussing Cree [h] in either onset or coda position in this thesis.

As mentioned in Chapter 3, Section 2.1, there is no voicing contrast between obstruents in Cree. Because voiced and voiceless variants occur in free variation, voiced and voiceless counterparts can be used interchangeably while the meaning of the word remains the same. Following the consonantal inventory found in Table 2, the charts in this chapter will represent all obstruents as voiceless phonemes only.

In order to follow Ani's consonantal development, it is important to know how many times the child attempts each consonant in each position, as well as how often the child produces it correctly. Table 11, Table 12, and Table 13 below allow us to follow Ani's consonant development in this way. The production of each consonant in a particular syllable position is shown from the first session (age 2;01.14) to the final one (age 3;08.24) as listed across the top of the chart, with the list of attempted consonants along the left side. For each session, there are two columns: the first shows the number of times Ani attempts the consonant, and the second shows the percentage of attempts that result in a correct production. Consonants that are not attempted in a particular sessions are marked by '--'.

Similar charts appear throughout the thesis for both English and Cree word data, and display either obstruents or sonorants in all possible syllable positions. By displaying all syllable positions at once, I am able to compare consonants across different positions within the syllable and distinguish any particular similarities or differences that may arise in the data.

Table 11: Inventory of obstruents in onset

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
p	17	71%	56	79%	85	49%	72	76%	92	77%	58	81%	44	77%	77	77%	75	81%	47	87%
t	37	78%	50	86%	59	54%	36	58%	29	90%	24	79%	64	77%	147	66%	88	63%	152	75%
k	28	68%	16	63%	31	74%	26	69%	68	81%	16	50%	74	91%	53	57%	47	64%	68	68%
s	--	--	--	--	--	--	1	0%	--	--	3	0%	--	--	1	100%	3	67%	6	50%
ʃ	1	0%	3	67%	4	0%	2	50%	3	33%	5	80%	6	33%	23	74%	24	71%	11	64%
ʧ	16	38%	23	13%	45	71%	56	59%	48	58%	29	72%	36	58%	51	80%	33	64%	74	85%

Table 12: Inventory of obstruents in coda

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
s	--	--	3	0%	--	--	--	--	2	0%	1	0%	--	--	5	60%	15	87%	--	--
ʃ	5	80%	8	50%	4	25%	18	72%	18	50%	14	43%	13	62%	60	67%	20	45%	51	78%

Table 13: Inventory of obstruents in onset of empty-headed syllables

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
p	1	0%	5	60%	--	--	1	100%	1	0%	2	0%	--	--	2	50%	6	33%	4	25%
t	2	50%	3	33%	3	33%	16	38%	14	57%	4	50%	10	20%	25	32%	15	27%	47	64%
k	--	--	11	27%	6	33%	2	0%	5	20%	9	44%	8	50%	27	70%	16	63%	27	59%
ʧ	--	--	5	40%	4	50%	7	43%	--	--	5	60%	4	25%	13	0%	14	64%	14	0%

2. Development of Obstruents

The Cree consonantal inventory contains five obstruents: [p, t, k, ʃ, ʧ], all of which Ani attempts. Within this corpus, [ts] also surfaces in Ani's attempted productions. As mentioned above in Chapter 3, Section 2.1, Wood (2006) states that the affricate [ʧ] can sometimes surface as [ts], however he does not discuss the distribution of these affricates within the language. Following the consonantal inventory provided by Dyck, Brittain & MacKenzie (2006), [ts] is not considered a separate phoneme in the consonantal inventory of Cree. [ts] is only attempted in onset, and is never produced correctly during the period observed. Because of the uncertain status of [ts] in the language and the small number of attempts in my data, I will not discuss the development of this affricate.

2.1 Obstruents in Onset

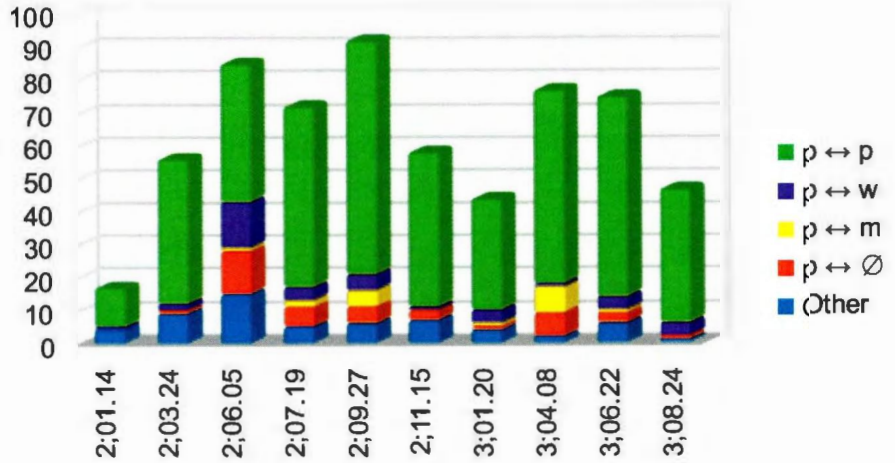
2.1.1 Stops

In onset, we see very little variability in the development of obstruent stops [p, t, k]. Ani produces stops correctly early in the data set and her productions of these consonants remain consistent throughout all ten sessions, which can be seen from Table 11 above.

Correct production of bilabial [p] is attested from the very first session as the majority (12 out of 17 attempts), as can be seen in Figure 6. Ani does occasionally substitute [p] for other consonants, most often [w] and [m]. It is important to note that these two consonants share the same place of articulation as [p] (bilabial). This means that Ani is substituting the manner of articulation of the consonant (i.e. stop for glide or

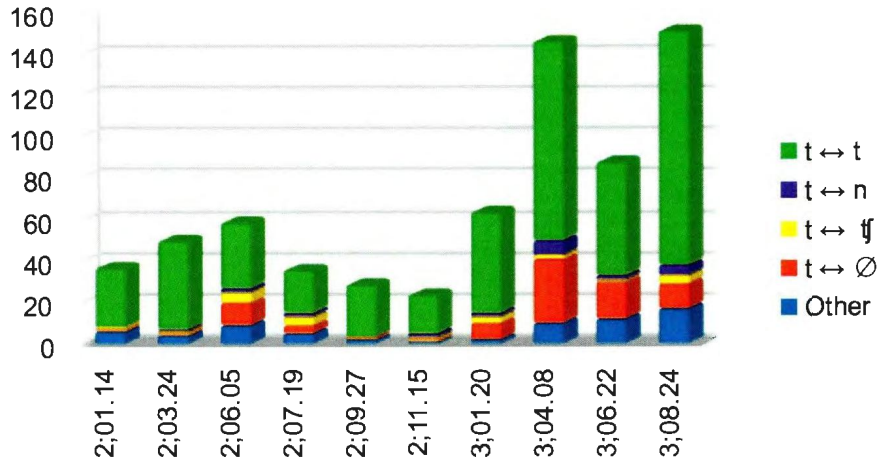
nasal) but maintaining the place dimension of the target phone. Although [p] does not display any particular pattern by 3;04.08, [t] and [k] show a noticeable rise in consonant deletion during that session, which I discuss further below.

Figure 6: Production of [p] in onset



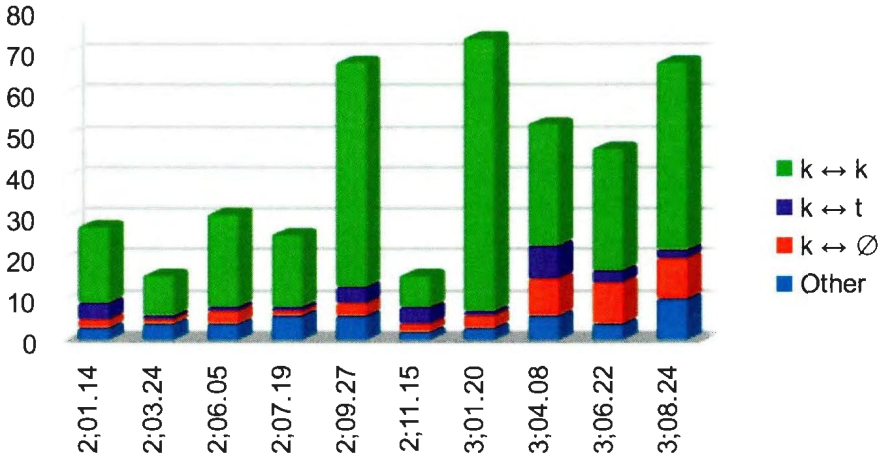
Similar to [p], both alveolar [t] and velar [k] are produced correctly early in the corpus and remain that way for all ten sessions. At 3;04.08, however, we see a noticeable rise in stop deletion for [t] and [k]. In Figure 7 below, we can see that [t] deletion spikes at 3;04.08 and continues to be higher than normal in the following two sessions (at ages 3;06.22 and 3;08.24). As we will see in subsequent sections, the same pattern of consonant deletion manifests itself across all obstruent classes during the last three sessions documented by the corpus.

Figure 7: Production of [t] in onset



The production of [k] shows a very similar trend as [t] as can be seen below.

Figure 8: Production of [k] in onset



Although stop deletion does occur in onset throughout the corpus, it is noteworthy that the percentage of deletion increases at 3;04.08. For example, [t] deletion

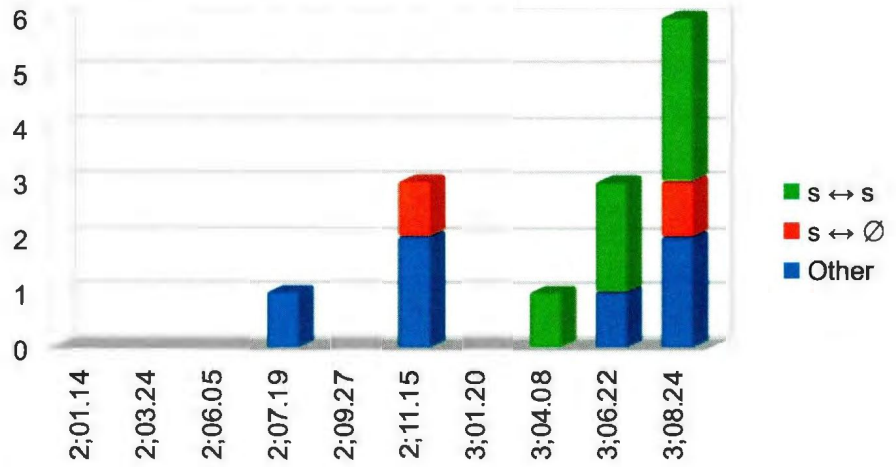
only accounts for 13% of the data (8 deletion out of 64 attempts) in 3;01.20, while at 3;04.08 (the session to follow) [t] deletion increases to 21% of Ani's productions (31 deletions out of 147 attempts). A similar trend occurs in [k] production as well: 4% at 3;01.20 (3 deletions out of 74 attempts) vs. 17% at 3;04.08 (9 deletions out of 53 attempts).

2.1.2 Fricatives

Throughout the corpus, Ani attempts both of the fricatives that are found in onset in Cree: [s, ʃ] (Chapter 3, Section 2.1).

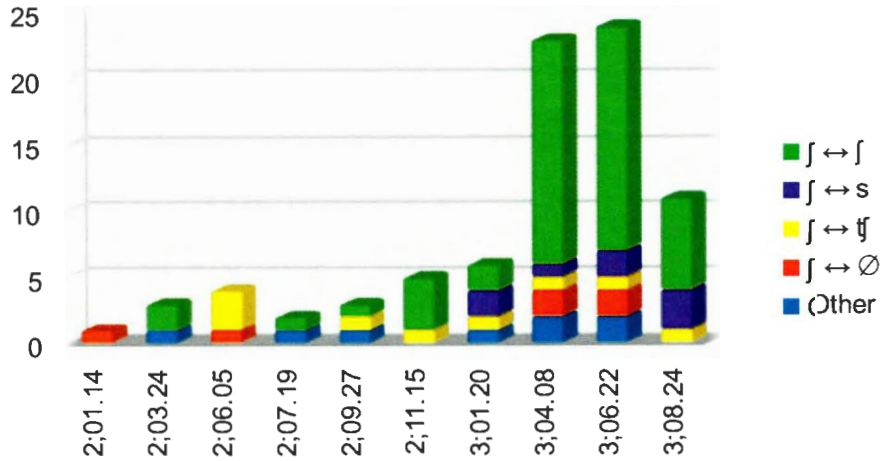
Attempts at [s] are relatively scarce: Ani does not attempt [s] until 2;07.19, and does not produce it correctly until 3;04.08 (1 correct production of out 1 attempt). In the following session (3;06.22) Ani's correct production of [s] is stronger (2 correct productions out of 3 attempts) and continues into the last session.

Figure 9: Production of [s] in onset



Ani attempts [ʃ] more often than [s], although the number of attempts still remains low. However, at 3;04.08 we see an increase in the number of attempts at [ʃ]. This consonant surfaces correctly for the first time at 2;03.24. Although in this session the correct production of [ʃ] is the majority (2 correct productions out of 3 attempts), Ani does not attain the correct production of [s] or [ʃ] in a consistent fashion until 3;04.08. We also observe [ʃ] produced as [s] in a small number of attempts. Finally, similar to what we saw with obstruent stops above (Section 2.1.1), we see a small rise in deletion of [ʃ] at 3;04.08 and 3;06.22. Figure 10 below displays Ani's production of target [ʃ].

Figure 10: Production of [ʃ] in onset

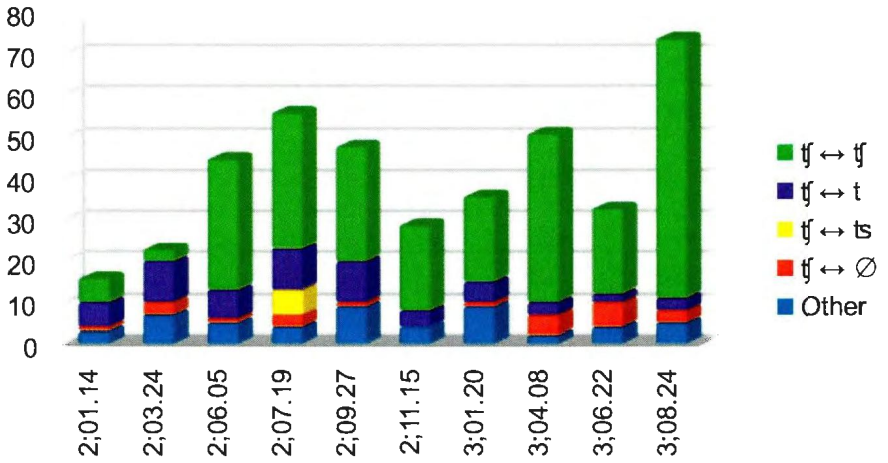


2.1.3 Affricate [ʧ]

Ani produces [ʧ] correctly in the first session, but target productions do not become the norm until 2;06.05. After Ani begins to produce [ʧ] accurately, she remains consistent

throughout the rest of the corpus (as seen in Figure 11 below). We also see instances of stop substitution, with [ʧ] produced as [t]. According to Bernhardt & Stemberger (1998), the substitutions of an affricate for stops or fricatives are the most common substitution patterns. This substitution pattern is referred to as 'deaffrication' (e.g. Ingram 1989; Bernhardt & Stemberger 1998). Although we only see the example of an affricate being substituted for a stop in this case, we will see affricates being substituted for fricatives later.

Figure 11: Production of [ʧ] in onset



As we saw with other obstruents, [ʧ] displays an increased pattern of deletion at 3;04.08 and onward. Although the rise in [ʧ] deletion is not drastic here, it is the most [ʧ] deletion we see among all ten sessions. It appears that stops, fricatives and affricates in onset all follow this deletion trend within the same session (with subsequent sessions affected as well).

2.1.4 Summary of Obstruents in Onset

Our study of Ani's development of stops in onset, reveals that stops are acquired early in the corpus and remain relatively consistent in all ten sessions. Fricatives, on the other hand, are attempted less often and are produced correctly only later in the corpus (generally between 3;04.08 and 3;08.24. [ʧ], the only affricate in onset, is produced correctly and consistently early in the corpus.

Across all three obstruent categories (stops, fricatives, affricates), we see a rise in consonant deletion starting at 3;04.08. This rise in deletion is also attested in the following two sessions.

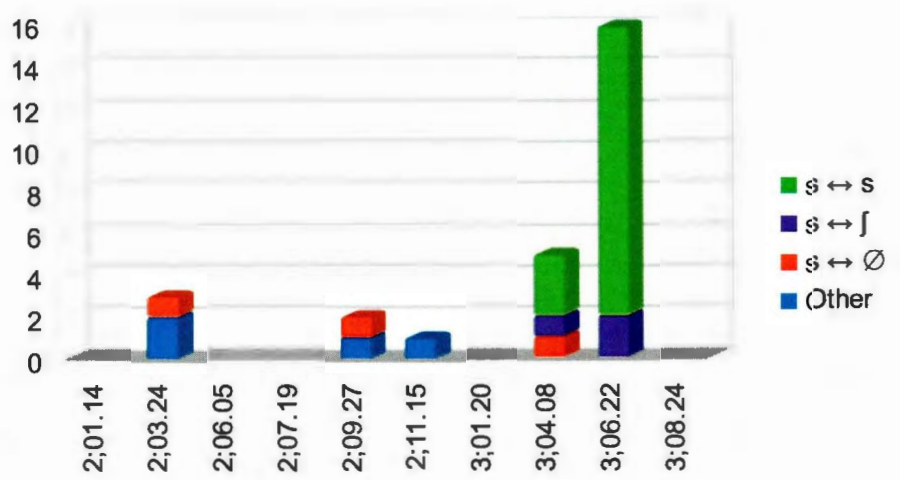
2.2 Obstruents in Coda

As mentioned in Chapter 3, Section 2.2, Cree allows for only three obstruents in coda: [s, ʃ, h], two of which I discuss in this thesis: [s, ʃ]. These two obstruents are both fricatives and are both attempted by Ani during the period observed.

2.2.1 Fricatives

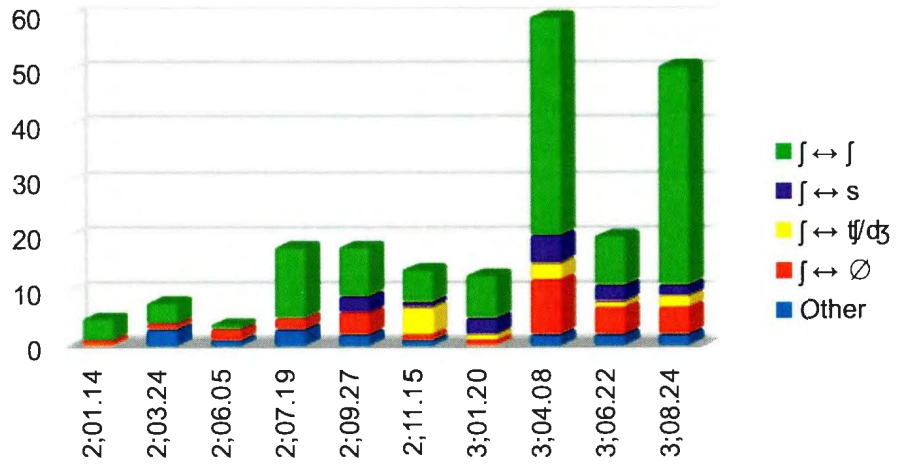
Similar to what we observed in onsets, Ani scarcely attempts [s] in coda. In session 3;04.08, correct productions of [s] are found in 3 out of 5 attempts. In the next session (3;06.22), Ani produces the sound correctly 13 out of 15 attempts. This is the session in which she masters [s]. (The child however does not attempt [s] in the final session.) Figure 12 illustrates Ani's production of target [s].

Figure 12: Production of [s] in coda



Concerning [ʃ], we see in Figure 13 below a much larger number of attempts than for [s]. Ani produces [ʃ] correctly in the first session (4 out of 5 attempts) and continues to produce the consonant correctly for the majority of the corpus. The acquisition of [ʃ] occurs much earlier than [s]. However, we also observe a slight rise in consonant deletion at 3;04.08, which continues through the following two sessions, similar to other obstruents in onset.

Figure 13: Production of [ʃ] in coda



2.2.2 Summary of Obstruents in Coda

Much like fricatives in onset, fricatives in coda (particularly [s]) are scarcely attempted throughout the corpus. Ani attempts [ʃ] the most often of the two and produces it correctly early in the corpus. Accurate productions of [s], on the other hand, only emerge later in the corpus.

While [ʃ] follows the increase of obstruent deletion starting at 3;04.08, we do not see this trend with [s], presumably because of such low numbers of attempts at this consonant.

2.3 Obstruents in Onsets of Empty-Headed Syllables

As mentioned in Section 1 of this chapter, the onset of empty-headed syllables can consist of any of the 12 consonants in the Cree consonantal inventory. However, in

Ani's speech productions, we only see two categories of obstruents attempted: stops and affricates.

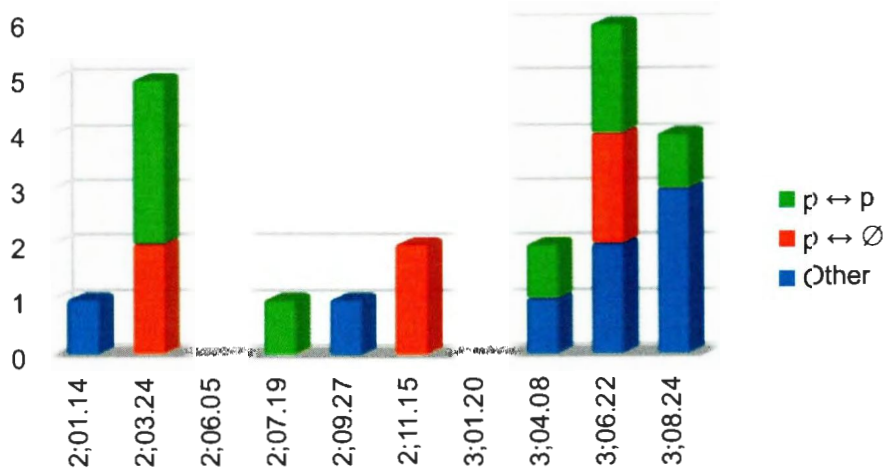
2.3.1 Stops

We observe a large amount of variability in stop consonants in onsets of empty-headed syllables. Ani attempts all three stop consonants in Cree ([p, t, k]); each of them surfaces a little differently.

Ani first produces [p] correctly at 2;03.24, but remains variable in her productions of this consonant throughout the remaining sessions. This is very different from stop productions in onsets where, as we saw in Section 2.1.1, Ani produced target-like stops throughout the majority of the corpus. From looking at Figure 14 below, at 3;08.24 we see 3 out of 4 of Ani's attempts result in 'other' productions. These 'other' productions consist of [t, h, k, n],[9] each of which occur in very low numbers.

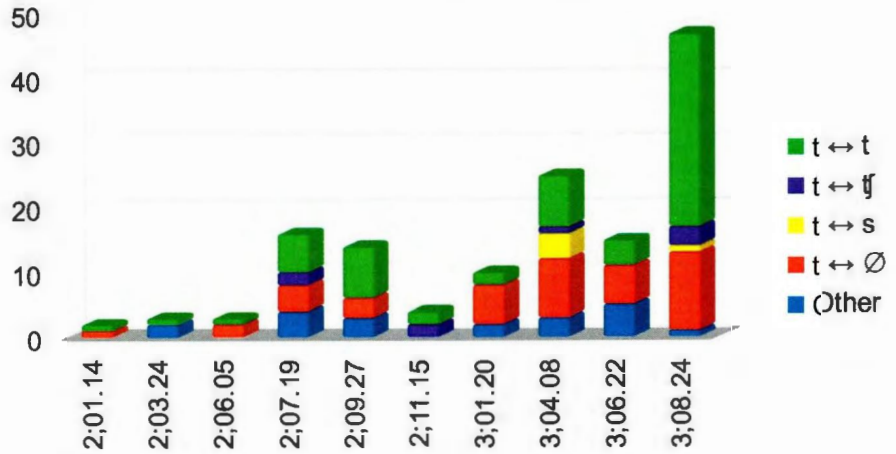
9 The order of presentation ranges from most to least common substitution, with [k] and [n] both attested in just one production each.

Figure 14: Production of [p] in onset of empty-headed syllable



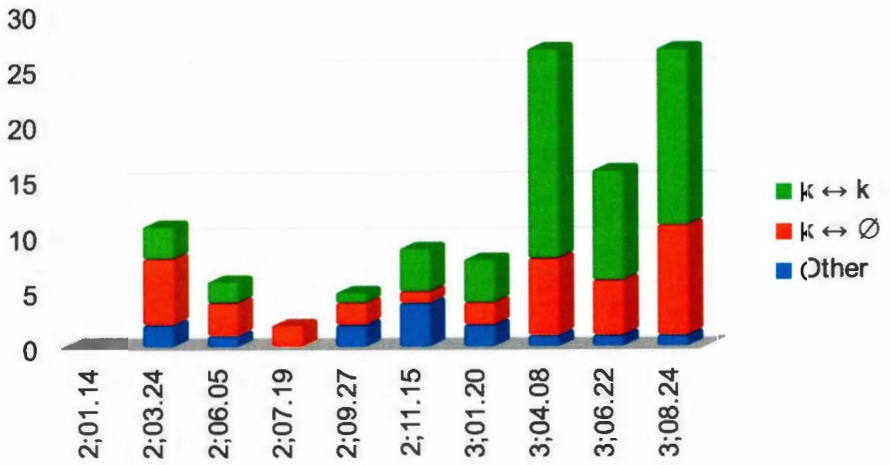
Moving on to [t], this consonant is attempted more often than [p] and also displays more variability. Ani produces [t] correctly from the very first session (only 1 correct production out of 2 attempts), yet she performs inconsistently throughout the data set. We see some substitution and deletion in Ani's attempts at [t]. As we can see in Figure 15, Ani substitutes [tʃ] or [s] for [t] most often. In the last four sessions, we can see that the amount of [t] deletion rises slightly. This rise in deletion fits the common trend of consonant deletion seen in onset and coda position during this period.

Figure 15: Production of [t] in onset of empty-headed syllable



Ani's attempts at [k] most often result in either correct production or deletion. Correct productions of [k] become the majority at 3;04.08 (19 correct productions out of 27 attempts) and continue through the last two sessions, as seen in Figure 16. There is also a slight rise in consonant deletion at 3;04.08 and in the following two sessions. Due to the larger amount of consonant deletion in onsets of empty-headed syllables this pattern does not stand out as much for these sessions as it does for onset consonants (discussed in Section 2.1).

Figure 16: Production of [k] in onset empty-headed syllable

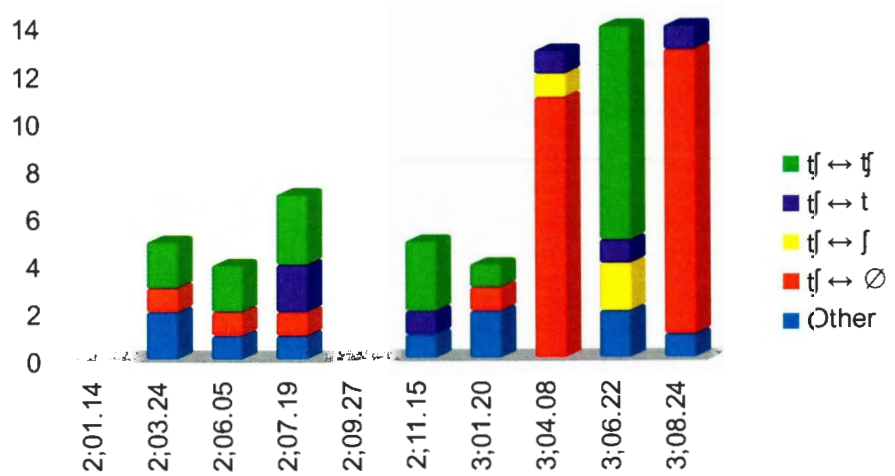


2.3.2 Affricates

Similar to stops, Ani does not attempt [ʧ] in onsets of empty-headed syllables as frequently or as consistently as in onset. While this affricate first emerges at 2;03.24, we see some instances of [ʧ] being produced as [t] or [ʃ]. Although these substitutions occur in small numbers, they are common substitutions patterns for affricates (see Section 2.1.3).

At 3;04.08, we see a very noticeable rise in consonant deletion, accounting for 85% of the target data (11 deletions out of 13 attempts). This rise in consonant deletion at 3;04.08 follows the trend we have been seeing throughout Ani's Cree word productions in various positions. Although we do not see consonant deletion in the following session (3;06.22), we do see in Figure 17, a large amount of consonant deletion in the final session (3;08.24) accounting for 86% of the target data (12 deletions out of 14 attempts).

Figure 17: Production of [ʧ] in onset of empty-headed syllable



2.3.3 Summary of Obstruents in Onsets of Empty-Headed syllables

Thus far we have seen that Ani does not attempt obstruents in onsets of empty-headed syllables as often as she attempts obstruents in syllable onsets. When looking at stop productions, we see variability between the three consonants produced. First, [p] is rarely attempted and when Ani does attempt it, she either produces it inconsistently or deletes it altogether. Second, [t] is attempted more often than [p] and shows more variability in the consonants produced. Third, Ani attempts and does produce [k] correctly at times, but this does not become the norm until the final three sessions. For Ani's affricate production, we also see variability. Ani produces [ʧ] correctly early in the data set, but does not remain consistent with the correct production. Throughout the corpus, [ʧ] is often substituted for either [t] or [ʃ], which is a common substitution pattern for affricates. From 3;04.08 to 3;08.24, we see a noticeable rise in consonant deletion.

3. The Development of Sonorants

I now move on to describe the development of sonorant consonants. In Cree, there are two categories of sonorants: nasals [m, n] (in onset and coda) and glides [j, w] (in onset only).

In the sub-sections to follow, I first address the development of nasals in both onset and coda positions. Second, I address the development of glides, which only occur in onset in Cree. Below are two tables that display Ani's sonorant development in the two syllable positions just mentioned.

Table 14: Inventory of sonorants in onset

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
m	42	40%	49	41%	53	42%	42	21%	91	67%	28	36%	41	71%	123	70%	87	69%	152	65%
n	30	77%	82	72%	71	72%	52	81%	42	71%	21	52%	65	77%	174	80%	60	75%	144	75%
j	9	33%	74	55%	18	50%	22	77%	4	25%	43	65%	10	40%	33	33%	13	69%	54	80%
w	4	0%	20	30%	22	55%	17	53%	19	37%	7	71%	27	59%	27	37%	51	24%	29	59%

Table 15: Inventory of sonorants in coda

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
m	9	0%	9	22%	20	50%	8	25%	1	0%	1	0%	11	55%	7	57%	6	50%	4	25%
n	18	39%	34	18%	20	35%	41	37%	30	23%	21	52%	42	64%	115	37%	86	42%	84	52%

3.1 The Development of Nasal Stops

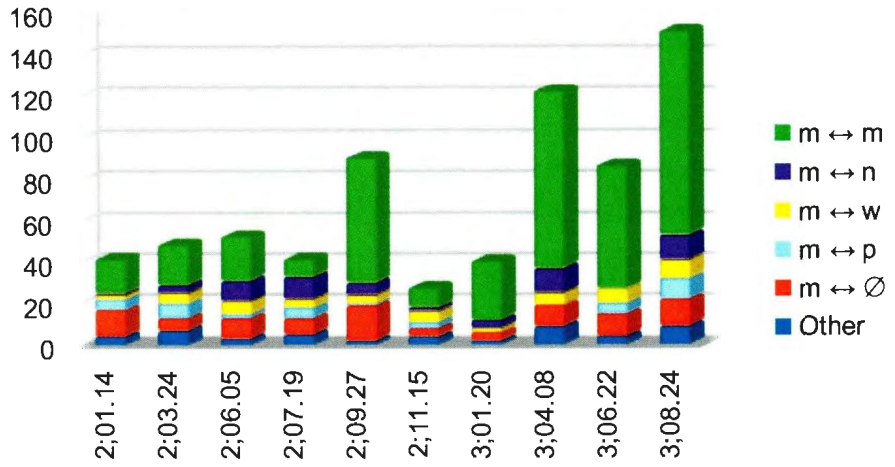
Cree has two nasals stops, [m, n], both of which Ani attempts in the ten sessions. As mentioned in Section 2.2, [m] and [n] are two of the five consonants that can appear in coda in Cree. In addition, although it is possible in the language (see Section 2.2), Ani does not attempt any nasals in onsets of empty-headed syllables, and therefore only attempts nasals in onsets and codas.

3.1.1 Nasals in Onset

Ani attempts [m] and [n] in high numbers throughout the corpus. She produces both nasals correctly from the very first session and continues to do so for the remainder of the period observed.

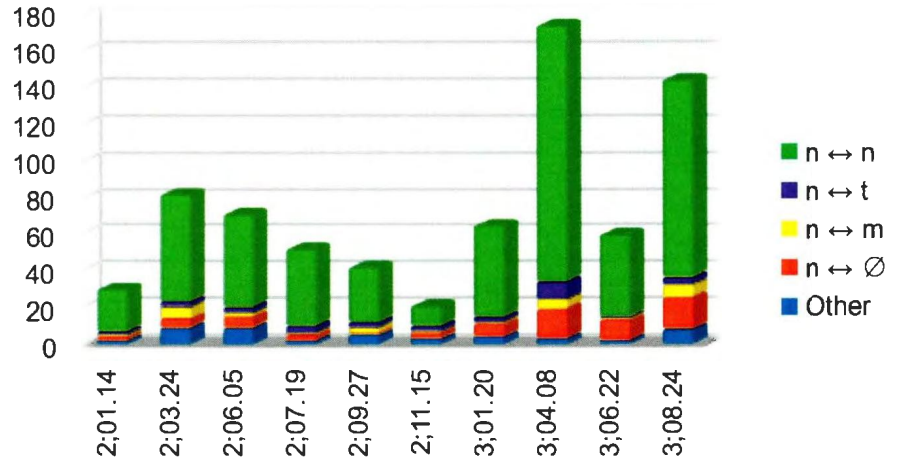
Although [m] and [n] are acquired in a similar way, we observe more variability in the production of [m] in comparison to [n]. As we can see from Figure 18 below, Ani substitutes [n, w, p] for [m] most commonly, however substitutions account for only a small percentage of productions. For example in 3;08.24, when substitution rates are at the highest, substitutions account for only 26% of the productions (40 out of 152 attempts), with other sessions having much lower numbers. In addition to a higher number of substitutions for [m], this consonant also undergoes a higher number of deletions, which are observed throughout the corpus. Although there appears to be a slight rise in deletion at 3;04.08 and the following two sessions, it is difficult to determine whether there is a noticeable rise in consonant deletion like we saw in obstruents, due to the higher amount of overall [m] deletion.

Figure 18: Production of [m] in onset



With regards to [n] production, Ani remains very consistent with correct productions throughout the period observed. However, we do see a rise in consonant deletion beginning at 3;04.08 and continuing into the following two sessions. This a similar trend of deletion to that found in obstruent production in Section 2. Ani's pattern of [n] production is illustrated in Figure 19.

Figure 19: Production of [n] in onset



3.1.2 Summary of Nasals in Onset

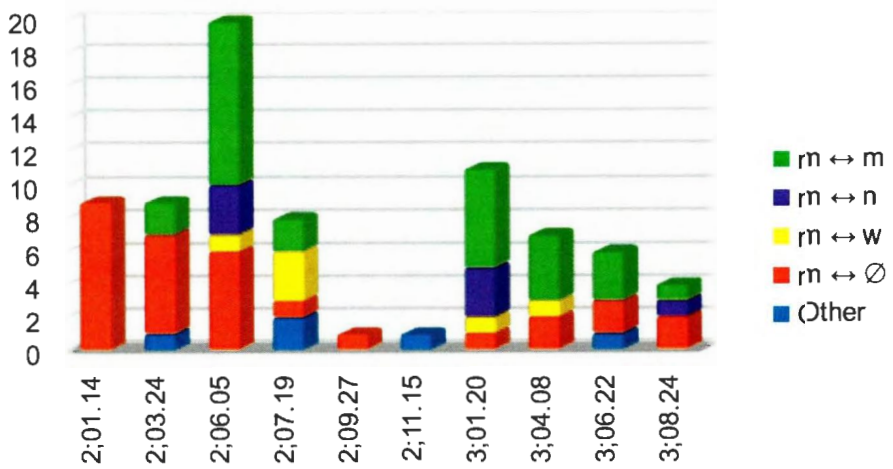
As we can see from the section above, Ani's development of [m] and [n] are relatively similar. [m], however, displays more variability as well as a higher rate of consonant deletion than [n]. Correct [n] productions develop early and remain consistent through all ten sessions, however with the same rise in deletion at 3;04.08 onward, as we saw in obstruent production (Section 2).

3.1.3 Nasals in Coda

As in onset, there are only two nasals in coda, [m] and [n]. However, unlike in onsets, Ani is not consistent with correct production from the beginning of the corpus and attempts the coda nasals less often. In the first session, all potential attempts at [m] result in deletion (9 deletions in total), along with a large number of deletions at 2;03.24 as well (6 deletions out of 9 attempts). The majority of these deletions result from attempts at one particular word *kûhkûm* [gʊkum] 'grandmother'. Correct production of

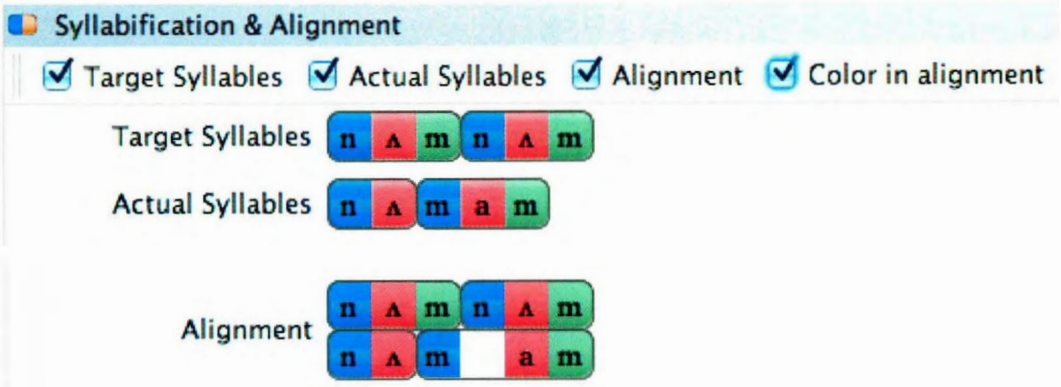
[m] increases in the following session (2;06.05), however Ani does not remain consistent. Also, a closer look at the data in Figure 20 reveals that these correct productions mostly come from expressive forms such as 'um' [ˈʌm], 'num num' [ˈnʌmnʌm] and 'um-hum' [əmhəm] throughout the remaining sessions.

Figure 20: Production of [m] in coda



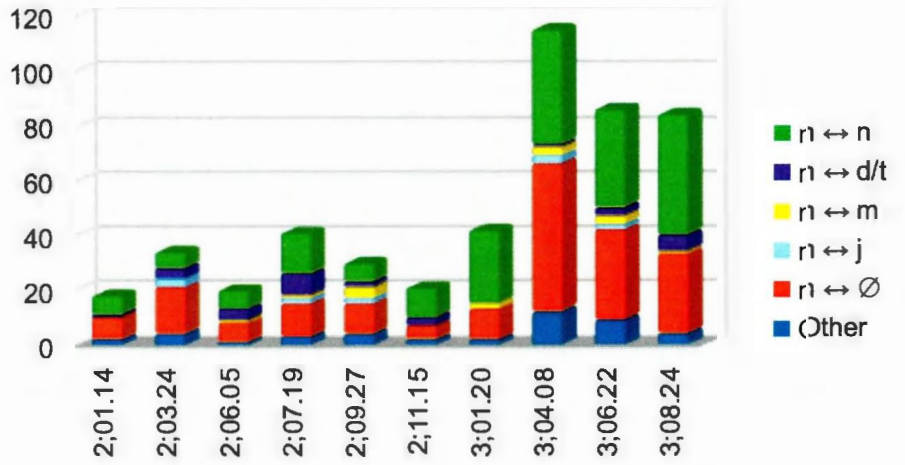
In addition to Ani's production of expressive forms, her attempts at target [m] in coda result in two different syllable positions in actual production: [m] coda produced either in onset or in coda. This is exemplified in Figure 21, below, with the example of [ˈnʌmnʌm] (target) produced as [nʌmam] (actual) (from 3;01.20, record #179), where we see coda [m] in the target produced as an onset. The correct production of [m] in coda position (i.e. [m] coda produced as [m] coda) accounts for approximately one third of attempted productions (2 out of 6 attempts) at 3;08.24. The general observation, however, is that coda [m] is not acquired by the end of the corpus.

Figure 21: Syllabification of [m] in coda



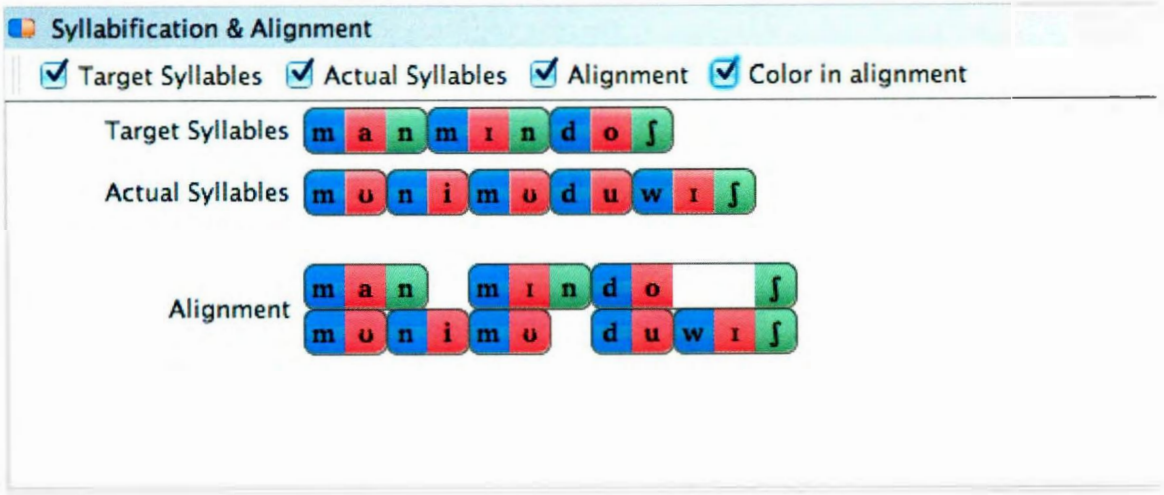
Ani's production of coda [n] is very similar to that of coda [m]. Although Ani does produce coda [n] correctly as of the first session, her productions are variable throughout the corpus, as we can see in Figure 22 below.

Figure 22: Production of [n] in coda



Much like what we saw with coda [m], Ani often produces coda [n] as an onset. From looking at Figure 22 above, it may appear that while Ani is producing coda [n] correctly throughout the corpus, she is actually producing the consonant in onset. This is exemplified in Figure 23 below in *mân minitûsh* (from 3;04.08, record #162), in which we see coda [n] in ['man] get resyllabified to onset [n] in [ni].

Figure 23: Syllabification of [n] in coda



This resyllabification accounts for the majority of 'correct' productions of coda [n] in the data. At 3;06.22 Ani produces [n] in coda position correctly (i.e. [n] coda as [n] coda) in approximately one third of her attempted productions (28 out of 86 attempts).

3.1.4 Summary of Nasals in Coda

Nasals in coda develop quite differently than in onset. There are far fewer attempts in coda than in onset (especially for [m]). For both [m] and [n], Ani most commonly produces the target coda as an onset. Although she does produce [m] and [n] correctly

when resyllabified as an onset, she has difficulties with producing the nasals correctly in the appropriate syllable position. For [n], we also see a rise in consonant deletion at 3;04.08 which continues into the following two sessions.

3.2. The Development of Glides

Differing from English, glides are the only category of approximants in Cree. There are two glides in the consonantal inventory ([j, w]), both of which are attempted by Ani in the ten sessions but only in onset. In this particular corpus, Ani only attempts glides in onset, although it is possible for them to occur in onsets of empty-headed syllables as well.

3.2.1 Glides in Onset

Glides [j] and [w] develop in a similar way in onsets. Ani produces [j] correctly in the first session, however in only 3 out of 9 attempts, and produces [w] correctly in the second session, but in only 6 out of 20 attempts. From these sessions on, Ani produces the glides rather inconsistently. Despite this inconsistency, Ani acquires [j] at 2;03.24 and [w] at 2;06.05. [j] is most commonly substituted for alveolar nasal [n] (and sometimes [w]), while [w] is most commonly substituted for bilabial nasal [m]. Here we see Ani substituting glides for nasal consonants, yet maintaining the place of articulation of the target phone (coronal and bilabial, respectively).

Because consonant deletion is scattered throughout the ten sessions for both [j] and [w], the rise in consonant deletion at 3;04.08 and the two sessions to follow is not as

apparent as it is in other obstruent or sonorant consonants in different syllable positions. Ani's productions of [j] and [w] are displayed in Figure 24 and Figure 25 below.

Figure 24: Production of [j] in onset

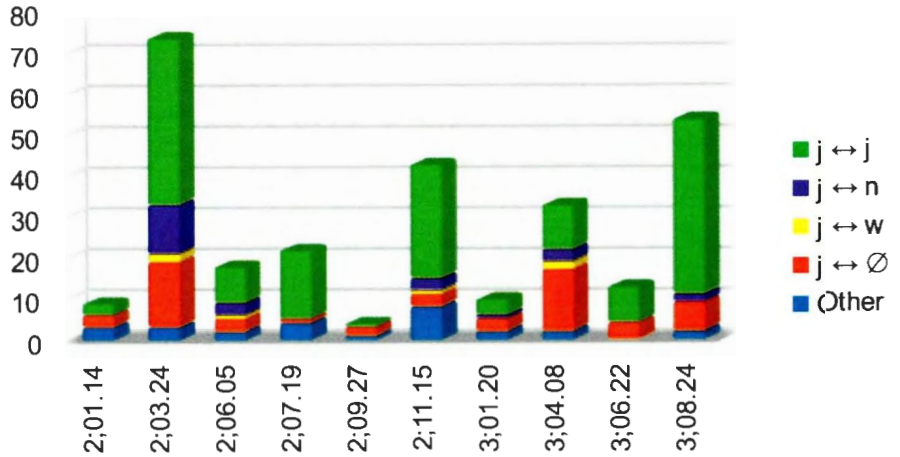
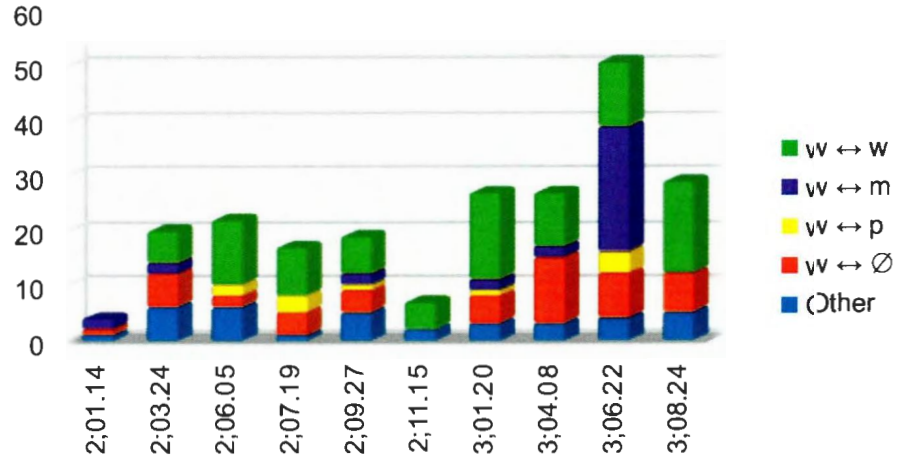


Figure 25: Production of [w] in onset



3.2.2 Summary of Glides in Onset

As we can see from the description above, glides [j, w] appear in onset only in this corpus and develop in a similar fashion. Both glides are produced correctly early in the corpus but with inconsistent production. Both glides are substituted throughout the corpus, with nasals being the most common substitute. The nasal that gets inserted depends on the place of articulation of the consonant being attempted ([n] for [j] and [m] for [w]).

4. Summary of Cree Development

I separated the Cree consonantal inventory into two categories: obstruents [p, t, k, s, ʃ, ʧ] and sonorants [m, n, j, w].

In the development of Ani's Cree obstruents, I considered three syllable positions: onset, coda and onset of an empty-headed syllable, along with three manner categories: stops, fricatives and affricates. As mentioned in Chapter 3, Section 2.2, the only Cree obstruents that appear in coda for our purposes are [s, ʃ]. Also, although onsets of empty-headed syllables can consist of any consonant in the Cree inventory, only stops [p, t, k] and the affricate [ʧ] were attempted in Ani's Cree word productions.

First, stop consonants do not develop along the same lines across syllable positions. In onsets, Ani develops stop consonants [p, t, k] early in the corpus, and remains consistent with the correct production. In onsets of empty-headed syllables however, Ani often deletes these three stops. When she does produce them, we observe a high degree of variability in the consonants that surface.

Second, fricative consonants appear in only onset and coda, and develop in similar ways across syllable positions. In onset and coda, the two fricatives [s, ʃ] are rarely attempted. [ʃ] occurs more often in both onset and coda, and shows the most variability in production, as it often surfaces as a substitution for [s] or [tʃ].

Third, only one affricate appears in the Cree consonantal inventory: [tʃ]. In onsets, Ani produces [tʃ] early in the corpus, with correct productions as the majority from 2;06.05 onward. We however observe a number of instances of stop substitution. Ani attempts [tʃ] less often in the onset of an empty-headed syllable than in onset, and is less consistent with the correct production. In onsets of empty-headed syllables we also see substitutions for [tʃ], which can be produced as either [t] or [ʃ]. As mentioned in Section 2.1.3, these are common substitution patterns for affricates. There is also a very noticeable spike in consonant deletion between 3;04.08 and 3;08.24.

For sonorants, I looked at two categories: nasals and glides, which occur in only two of the three possible syllable positions: onsets and codas.

Nasal consonants [m] and [n] develop in similar ways in onsets. Ani produces [m] and [n] correctly early in the corpus and remains largely consistent with correct productions across all sessions. We however see relatively more substitutions in attempts at [m], along with more cases of deletion. In coda, the production of both [m] and [n] is variable. Coda [m] and [n] are often resyllabified to be produced as onsets in the child's actual productions. Because of this resyllabification process, Ani does not seem to truly acquire [m] or [n] in coda by the end of the examined period.

Finally, two glides [j, w], are observed in onset. Both glides are produced correctly early in the corpus, but remain inconsistent throughout. Ani substitutes each glide for a nasal, in accordance with the place of articulation of the glide.

In addition to the patterns of consonant development mentioned above, there is a trend of consonant deletion that occurs within various consonant categories and across various syllable positions. This deletion begins at 3;04.08 and often continues on into the following sessions (3;06.22 and 3;08.24). As we will see in following chapter which describes Ani's development of English, the same rise in consonant deletion occurs in target English words as well. This particular pattern of consonant deletion across both languages supports the hypothesis of one phonological system governing word production in both languages. In addition to this evidence, this rise in deletion was previously attested in other areas of Ani's language development (Swain 2008; Terry 2010), and therefore may be linked to a more general U-shaped developmental pattern, as I discuss later, in Chapter 6, Section 6.

Chapter 5: Segmental Development – English

1. Introduction

In this chapter, I explore the segmental development of Ani's productions of English words. I discuss the development of two different consonant categories: obstruents (stops, fricatives and affricates) and sonorants (nasals and approximants, which include laterals, rhotics and glides). Keeping with the methodology employed in the previous chapter, I classify the consonants based on the various positions in which they appear within the syllable. First, I address obstruents in onset (either as a singleton onset or the first consonant in a branching onset) and coda positions. For the purpose of this thesis, I treat singleton onsets and onsets that appear in the first position of a branching onset as a single category. Second, I look at sonorants. I begin with nasals in both onset and coda positions, then explore approximants in first and second positions of onsets and then in codas.

Recall that there is no voicing contrast between obstruents in Cree (Chapter 3, Section 2.1). Presumably because Cree is Ani's first language, we observe a lot of voicing variation among obstruents in the English data. Given this, while I kept the voiced and voiceless consonants as two separate phonemes (consistent with the English phonological system), I merged the voiced and voiceless counterparts of each obstruent produced by Ani n my charts. In the actual production data, an attempted [t] will thus show up as [t/d], as Ani can produce either consonant interchangeably.

2. The Development of Obstruents

In this section, I address Ani's development of obstruents. As shown in Chapter 3, Table 7, English has 17 obstruents in its consonantal inventory: [p, b, t, d, k, g, f, v, θ, ð, s, z, ʃ, ʒ, h, ʧ, ʤ]. In the following subsections, I break down these obstruents according to position within the syllable as well as by manner of articulation. I focus on stops, fricatives and affricates, first as they appear in onset and then in codas.

As we will see in the next subsection, stops are attempted very frequently and are acquired early in comparison with other obstruent categories. Fricatives, on the other hand, are attempted in much smaller numbers and only a few of them are mastered by the child by the end of the corpus. Affricate development falls somewhere between stops and fricatives, as one affricate is acquired early, yet the other shows more variability.

As mentioned above, I collapsed both singleton onsets and the first position of branching onsets within the same category. For example, when I look at [t] in a word like [ti] 'tea' as a singleton onset, it will show up in the same data set as [t] in a word like [tɹi] 'tree' in which [t] is the first consonant in a branching onset.

2.1 Obstruents in Onsets

As mentioned in Section 2 above, Ani attempts all 17 obstruents in the English consonantal inventory. As for Ani's Cree development (Chapter 4, p. 28), I have developed charts to show Ani's developmental progress from the first session (2;01.14) to the final one (3;08.24), based on natural classes and positions within the syllable. Table 16 below displays Ani's development of obstruents in onsets.

Table 16: Inventory of obstruents in onset

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
p	11	91%	36	92%	33	88%	23	87%	26	77%	14	71%	5	60%	43	42%	4	75%	24	96%
b	9	89%	16	81%	31	81%	37	95%	23	74%	34	88%	9	44%	63	84%	28	82%	8	75%
t	1	100%	3	67%	--	--	16	94%	2	50%	2	100%	32	44%	48	88%	40	60%	27	67%
d[10]	19	84%	1	100%	--	--	12	75%	6	67%	19	84%	16	81%	94	79%	16	38%	15	87%
k	2	100%	1	0%	3	100%	26	85%	3	100%	15	67%	34	85%	64	78%	67	84%	40	65%
g	2	50%	3	67%	--	--	3	100%	5	80%	1	100%	2	50%	1	100%	8	75%	4	75%
f	5	0%	5	0%	--	--	--	--	--	--	--	--	5	0%	8	25%	6	0%	2	50%
v	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0%	1	0%	2	0%
θ	1	0%	4	0%	--	--	--	--	2	0%	--	--	1	0%	1	0%	2	0%	3	0%
ð	--	--	3	0%	--	--	1	0%	--	--	--	--	--	--	2	0%	--	--	1	0%
s	--	--	--	--	--	--	--	--	12	8%	--	--	2	100%	7	14%	17	71%	7	71%
z	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0%	1	0%
ʃ	--	--	--	--	--	--	--	--	--	--	1	0%	2	50%	1	0%	32	78%	2	100%
ʒ	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	100%	--	--
h	2	0%	9	0%	5	100%	5	80%	5	60%	15	73%	2	100%	53	79%	13	62%	5	20%
ʧ	--	--	6	67%	--	--	--	--	9	56%	--	--	17	88%	23	91%	1	100%	3	100%
ʤ	8	13%	--	--	7	100%	8	25%	9	22%	--	--	1	100%	14	71%	8	88%	8	50%

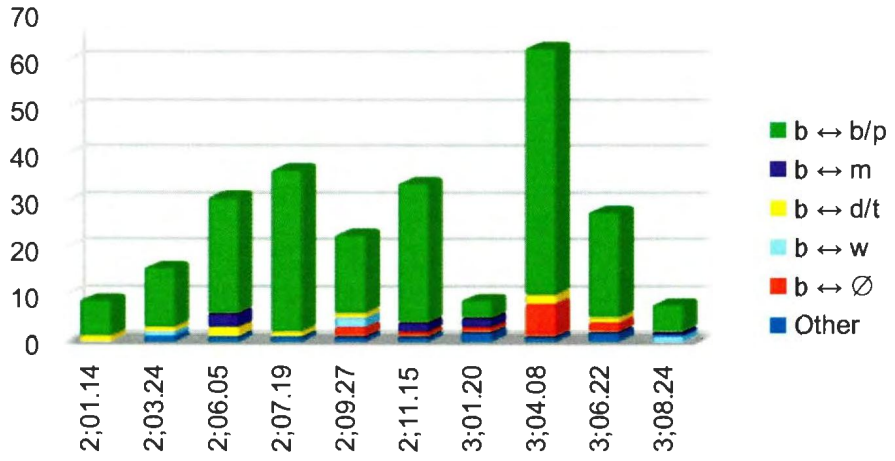
10 This is the production of [d] in onset without 'Dora' (see Section 2.1.1).

2.1.1 Stops

Ani attempts all six stops in the English consonantal inventory: [p, b, t, d, k, g].[11] Ani generally produces stop consonants correctly early in the data set, with an increase in stop deletion during 3;04.08.

In Ani's attempts at English words, stops emerge early, with correct productions in the majority of cases. Throughout the rest of the corpus, the correct production of stops remains consistent. Referring to Table 16 above, we see that this early emergence of correct stop production is the general trend across all six stop consonants. Figure 26 below illustrates Ani's productions of target [b], which is generally representative of the full data set for stops, except in the two cases discussed below.

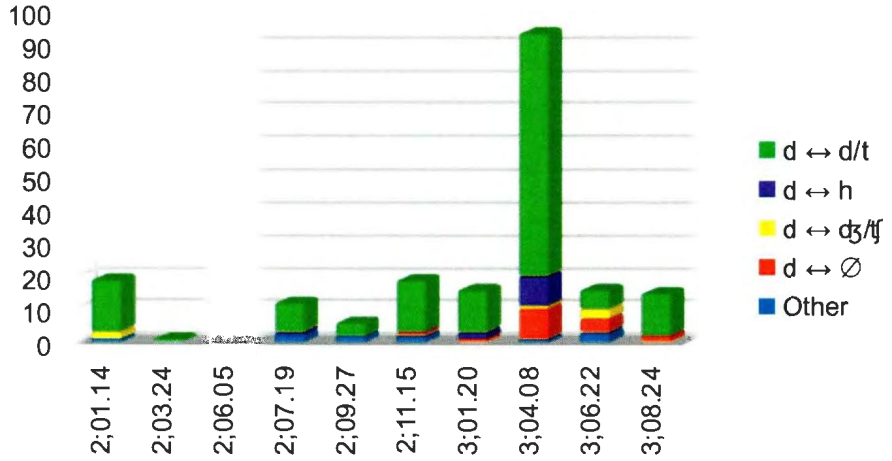
Figure 26: Production of [b] in onset



11 [ʔ] also sporadically appears in the English data, but only in small numbers and will not be addressed specifically in this thesis. This decision is also motivated on the grounds that [ʔ] is not contrastive in English (e.g. Chomsky & Halle 1968; Giegerich 1992).

Although Ani acquires [d] early and consistently, as she does with all other stops, the data also reveal a large number of cases of substitution of [l] for [d] during the first four sessions. However, the vast majority of these substitutions occur in a single word, the proper noun 'Dora'. Ani generally produced ['dɔɹa] as [lVlV], where V represents different vowel realizations (e.g. ['lɛlə], [lʌlʌ] from 2;01.14, record # 203 and 211). Because of this vast amount of substitution in just one word, I decided to remove 'Dora' from my searches and continued to study the development of [d] without this word. Figure 27 below shows Ani's production of [d] without 'Dora'.

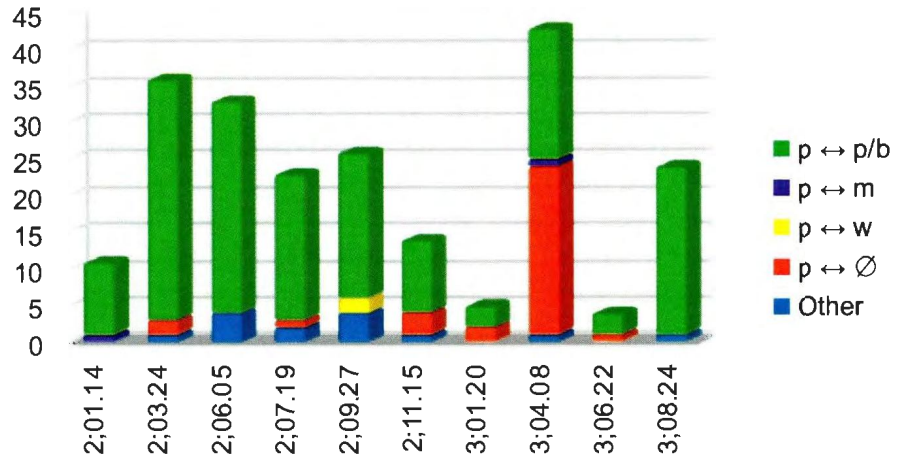
Figure 27: Production of [d]



From the revised chart above, we can see that Ani rarely substitutes [d], and is quite consistent with the correct production from the beginning of the corpus. At 3;04.08, we also see a large spike in correct production, along with the now-familiar rise in consonant deletion.

This noticeable rise in stop deletion is particularly prominent in the case of [p], for which over half of the attempts were deleted at 3;04.08, as seen in Figure 28 below.

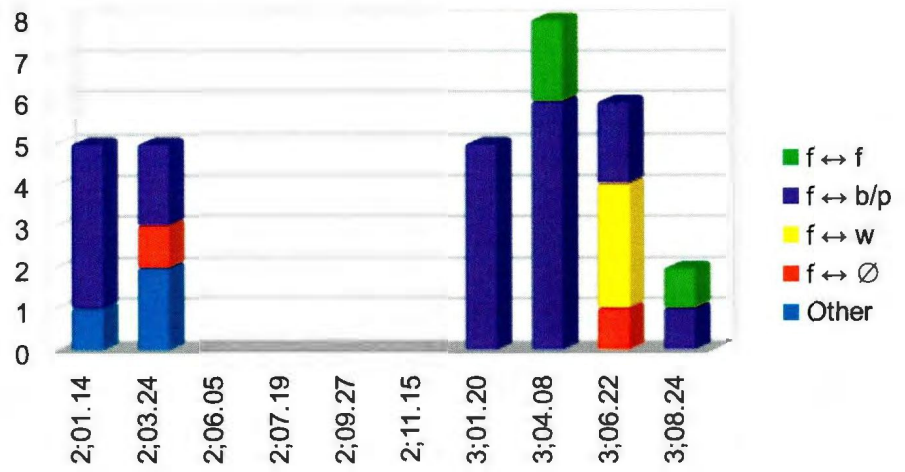
Figure 28: Production of [p] in onset



2.1.2 Fricatives

Ani attempts all nine fricative consonants found in the English consonantal inventory [f, v, θ, ð, s, z, ʃ, ʒ, h] (from Chapter 3, Table 7). Of this set, the consonants [v, θ, ð, z, ʒ] only occur in a very small number of attempts. During the developmental period covered by the current investigation, Ani never produces these consonants correctly. The remaining fricatives display a high degree of variability. The child only produces the labio-dental fricative [f] correctly in two sessions, for a total of three correct productions. In fact, [f] most commonly surfaces as bilabial stops [p] or [b], as we can see in Figure 29.

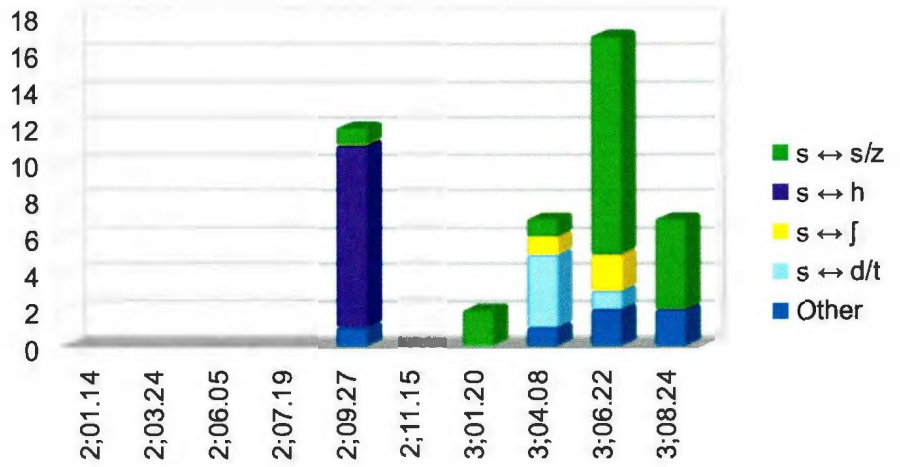
Figure 29: Production of [f] in onset



This substitution of a stop for a fricative seen in the [f] productions above is referred to as 'stopping' (e.g. Dinnsen 1996, Edwards 1996, Bernhardt & Stemberger 1998). Stopping reportedly occurs more prominently in strong prosodic positions such as syllable onsets (Marshall & Chiat 2003, Inkelas & Rose 2007). Although we do see some instances of stopping in coda [s] in Section 2.2.2 (Figure 37), these substitutions only occur in 7 productions, 2 of which result in resyllabification from a coda to an onset.

Ani does not attempt the alveolar fricative [s] at all in the first four sessions. When she does attempt this consonant, she only produces it correctly in high numbers during the last two sessions (shown in Figure 30). At 2;09.27, we see [s] produced as [h] in a very high number of attempts (10 out of 12).

Figure 30: Production of [s] in onset

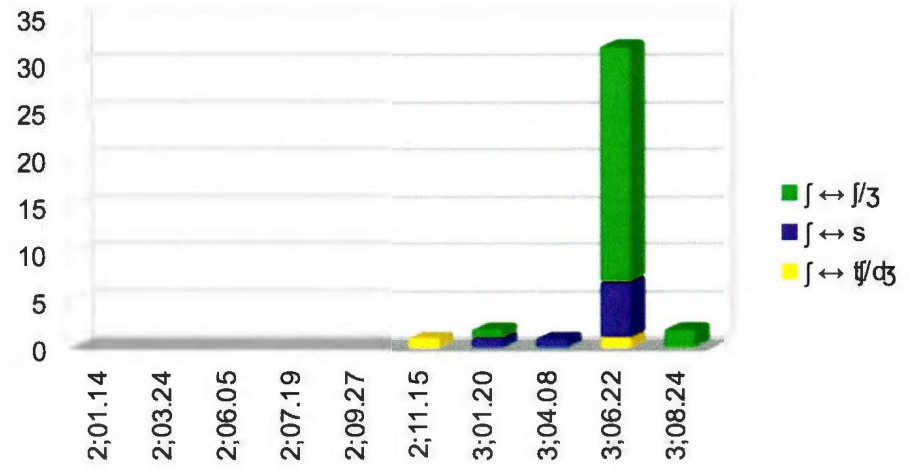


According to McCarthy (1988), debuccalization (a process whereby [s] is produced as [h]) "… is essentially the loss of the supraglottal articulation with retention only of the open glottis gesture." (p. 88).

A further look at the development of [s], reveals some correlation with the development of [ʃ] (Figure 31). At 3;04.08, Ani produces [s] as [ʃ] once, while also producing [s] correctly once. In the following session, 3;06.22, Ani produces [s] as [ʃ] only 2 out of 17 attempts, but produces it correctly (as [s]) 12 out of 17 attempts. This is the session in which Ani acquires [s].

Turning to the development of [ʃ], at 3;04.08 (below in Figure 31) we see [ʃ] produced as [s] the one time Ani attempts it. In the following session (3;06.22), [ʃ] surfaces as [s] a mere 6 out of 32 attempts, while Ani produces the target consonant correctly 25 out of 32 attempts. Just as we saw in [s], Ani appears to acquire [ʃ] during this session.

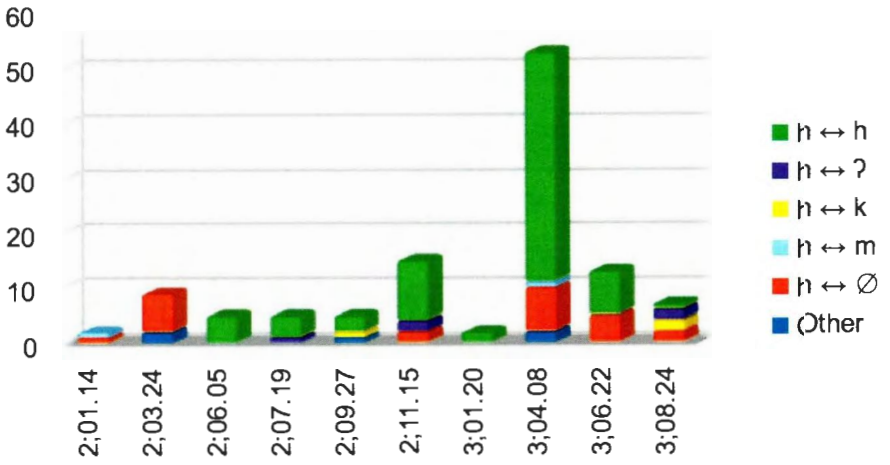
Figure 31: Production of [ʃ] in onset



Combining the observations from Figure 30 and Figure 31, it seems as though, until 3.04;08, Ani does not have a phonological contrast between [s] and [ʃ] and therefore uses them interchangeably. At 3;06.22 however, the contrast is established as Ani can now produce each consonant appropriately.

Referring back to Table 16, we see that Ani produces [h] correctly at 2;06.05 and continues to produce the consonant correctly in high percentages throughout the rest of the data set. There is however some variability at 3;08.24 in which [h] is only produced correctly in 20% of her attempts, but this figure is based on 5 attempts in total. Figure 32 illustrates Ani's productions of target [h].

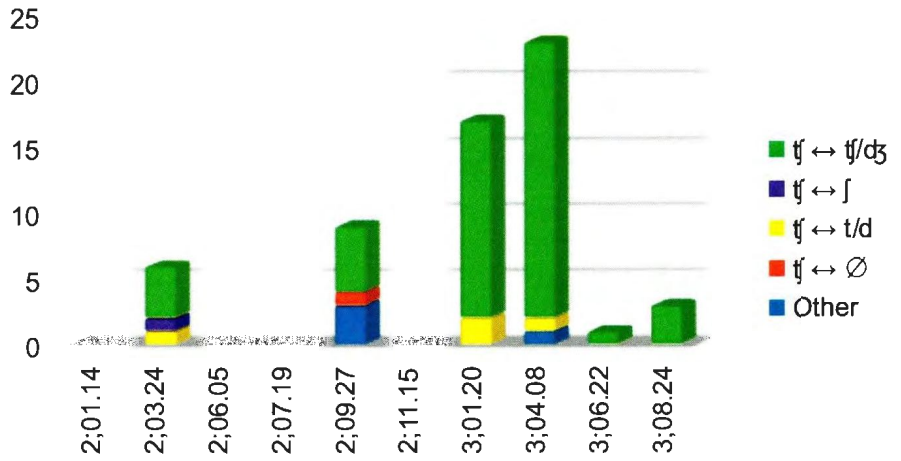
Figure 32: Production of [h] in onset



2.1.3 Affricates

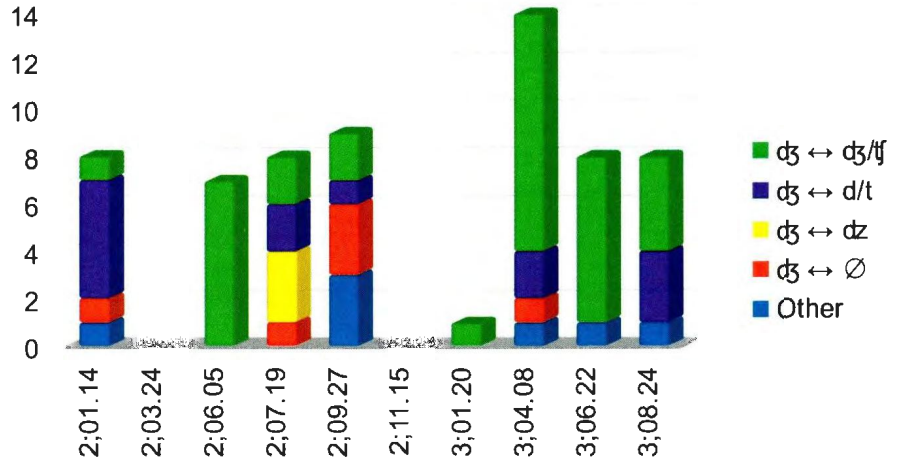
Ani first attempts [ʧ] in session 02;03.24, and produces the consonant correctly in 4 out of 6 attempts. Referring back to Table 16 and looking at Figure 33 below, we can see that the production of [ʧ] remains strong from 2;09.27 onward, while she did not attempt this consonant at all at 2;06.05 and 2;07.19. We also observe a small amount of substitution of [ʧ] throughout the corpus, which can be produced as [t/d] or [ʃ]. As mentioned before in Chapter 4, Section 2.1.3, according to Bernhardt & Stemberger (1998), these are two very common substitution patterns for affricates.

Figure 33: Production of [ʧ] in onset



The development of [ʤ] is similar to that of [ʧ]. Although Ani does produce [ʤ] correctly from the first session (1 correct production out of 8 attempts), she often produces [ʤ] as the alveolar stop [d]. As mentioned above, this is a common substitution pattern and appears most commonly in the first and last sessions. At 2;06.05, Ani produces [ʤ] in 7 out of 7 attempts, however, in the next session she only produces the consonant correctly 2 times out of 8 attempts. A more in-depth look at Ani's productions reveals that she is producing [ʤ] as [ʣ]. As mentioned in Chapter 3, Section 2.1, affricate [ʧ] can sometimes be produced as [ts], therefore it is not surprising to see Ani following the same pattern of Cree in her English productions and appears to be acquired at 2;06.05. Referring back to Section 2.1.2 above, we see a similar fluctuation in anteriority for the productions of [s] and [ʃ], which can also be linked to a lack of phonological distinction between [ʧ]/[ʤ] and [ts]/[ʣ].

Figure 34: Production of [ʤ] in onset



2.1.4 Summary of Obstruents in Onset

Stop consonants develop quite early in onsets and target-like productions remain the norm throughout all ten sessions, in spite of the noticeable increase in consonant deletion observed (starting at 3;04.08). Fricative consonants follow a different developmental pattern from stops. Ani only attempted [v, θ, ð, z, ʒ] a very small number of times, leaving only [f, s, ʃ, h] to address. Ani's target [f] was often stopped to [p/b]. The other three fricatives were attempted in small numbers during the first half of the corpus, and began surfacing as the correct production in higher numbers during in the latter half of the corpus.

The affricate [ʧ] developed early in the corpus, with target-like productions remaining the norm throughout the observed period. On the other hand, while [ʤ] is also produced correctly from the first session, its production remained variable throughout the ten sessions.

2.2 Obstruents in Coda

As mentioned in Section 2, English allows for 16 consonants in coda: [p, b, t, d, k, g, f, v, θ, ð, s, z, ʃ, ʒ, ʧ, ʤ]. Out of these, Ani attempts 14 of them: [p, b, t, d, k, g, f, v, θ, s, z, ʃ, ʧ, ʤ], leaving [ð] and [ʒ] unattested in her attempted forms.

Table 17 below shows the general patterning of the 14 consonants Ani attempts across the ten observed sessions.

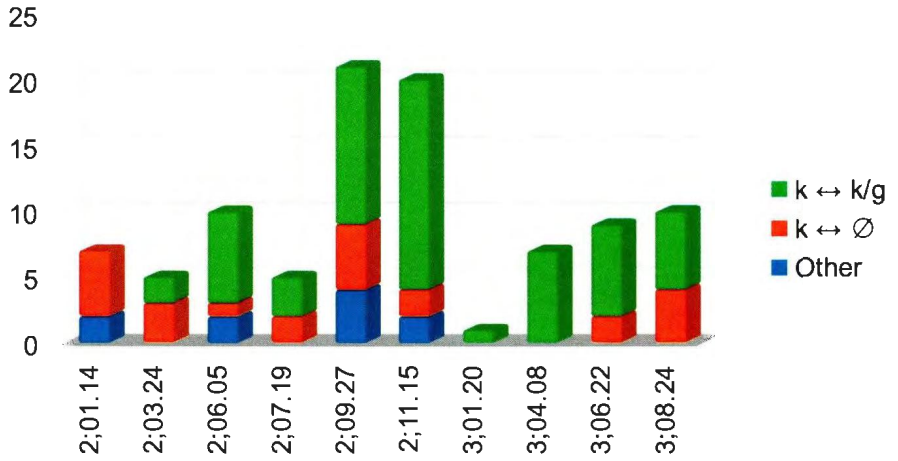
Table 17: Inventory of obstruents in coda

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
p	1	100%	1	100%	--	--	1	0%	--	--	--	--	12	67%	1	100%	1	0%	4	50%
b	--	--	2	50%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
t	--	--	5	100%	9	56%	2	0%	--	--	1	0%	3	67%	10	50%	11	55%	2	100%
d	1	100%	--	--	--	--	--	--	--	--	--	--	1	0%	2	50%	11	55%	3	33%
k	7	0%	5	40%	10	70%	5	60%	21	52%	20	80%	1	100%	7	100%	9	78%	10	60%
g	1	0%	--	--	--	--	3	67%	2	100%	1	100%	--	--	1	0%	--	--	1	100%
f	--	--	--	--	--	--	--	--	--	--	--	--	1	0%	2	0%	5	0%	1	0%
v	--	--	3	0%	--	--	--	--	--	--	--	--	--	--	2	0%	1	0%	--	--
θ	2	0%	--	--	--	--	--	--	8	0%	--	--	--	--	32	0%	--	--	1	0%
s	8	0%	2	0%	8	25%	4	0%	9	22%	2	0%	2	100%	21	14%	13	31%	3	67%
z	--	--	2	0%	5	0%	3	0%	8	38%	--	--	8	25%	20	20%	27	15%	4	25%
ʃ	--	--	--	--	--	--	6	67%	--	--	1	100%	1	100%	1	100%	5	60%	6	83%
ʧ	--	--	10	70%	2	100%	7	100%	--	--	3	33%	--	--	4	50%	2	50%	5	60%
ʤ	1	0%	2	0%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

2.2.1 Stops

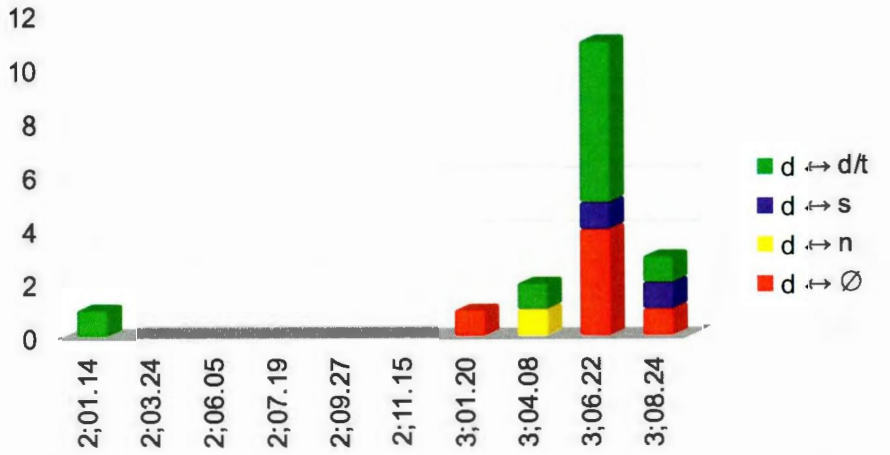
In English coda position, Ani attempts all six stops [p, b, t, d, k, g]. In the majority of attempts, Ani either produces the consonant correctly or deletes it altogether. This is a common trend for coda stops throughout the entire corpus. Figure 35 below exemplifies this trend in Ani's [k] production.

Figure 35: Production of [k] in coda



In addition to the small amount of variation in stop production, we generally see much fewer attempts at stops in coda in general (refer to Table 17), with proportionally more stop deletion in coda than in onset. This can be seen from Figure 36 below, in which [d] is deleted a number of times in three particular sessions, but is also rarely attempted overall, compared to [d] in onset (Section 2.1.1, Figure 27).

Figure 36: Production of [d] in coda



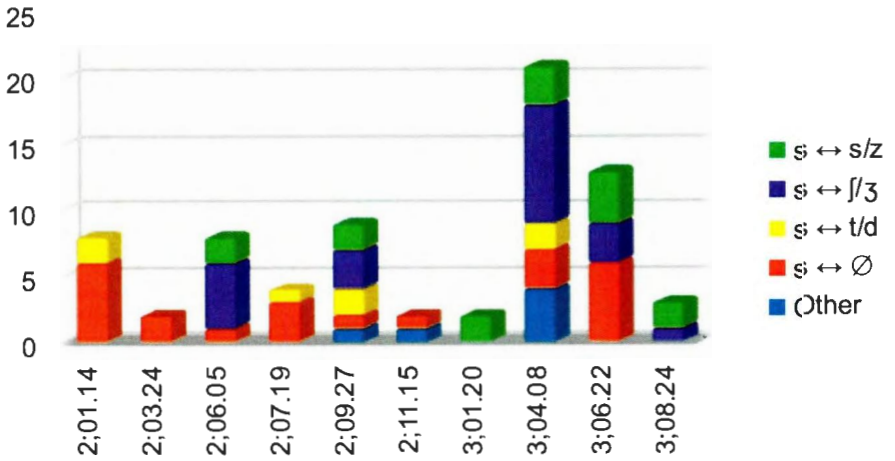
In addition to low number of attempts and high rate of stop deletion, we fail to observe the trend of deletion at 3;04.08 (as we did for onsets). Referring back to Ani's production of [k] in (Figure 35) and [d] in (Figure 36) above, a rise in stop deletion does not occur in these data. Because there is more stop deletion in codas in general, a rise in consonant deletion would not be as apparent as we saw in onset. Deletion for stops in coda in fact follow a much more general pattern.

2.2.2 Fricatives

As we saw in Table 17 above, Ani rarely attempts the labio-dental fricatives [f, v] in coda and fails to produce them correctly throughout all ten sessions. [θ] also fails to surface correctly and is either produced as a stop (through fricative stopping) or, even more commonly, deleted altogether. Alveolar fricatives [s, z] vary greatly when attempted, as shown in Figure 37 and Figure 38 below. We see some instances of [s] stopping (to [t/d]) but this substitution process is not apparent in the production of [z]

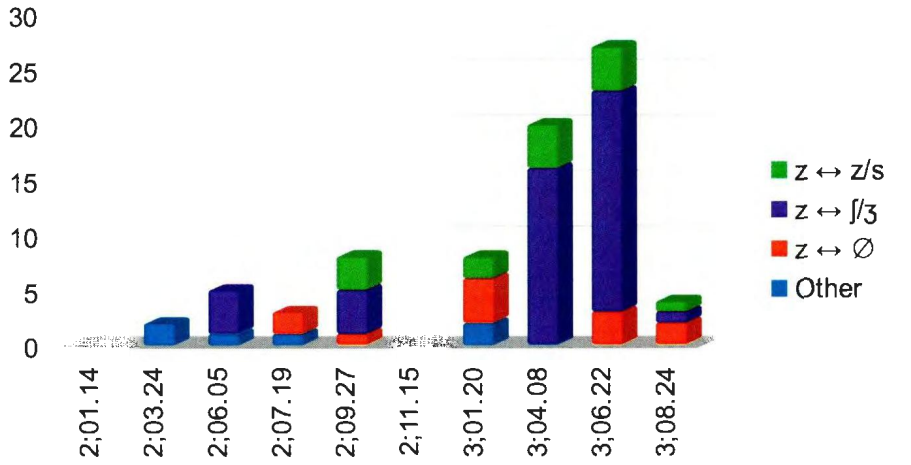
and only occurs in 7 attempted productions (2 of which result in resyllabification to an onset).[12] In sum, Ani most commonly produces [s] and [z] as [ʃ] or deletes the sounds altogether.

Figure 37: Production of [s] in coda



12 See also McAllister Byun (2009) on the relationship between substitution patterns and voicing in child phonology.

Figure 38: Production of [z] in coda

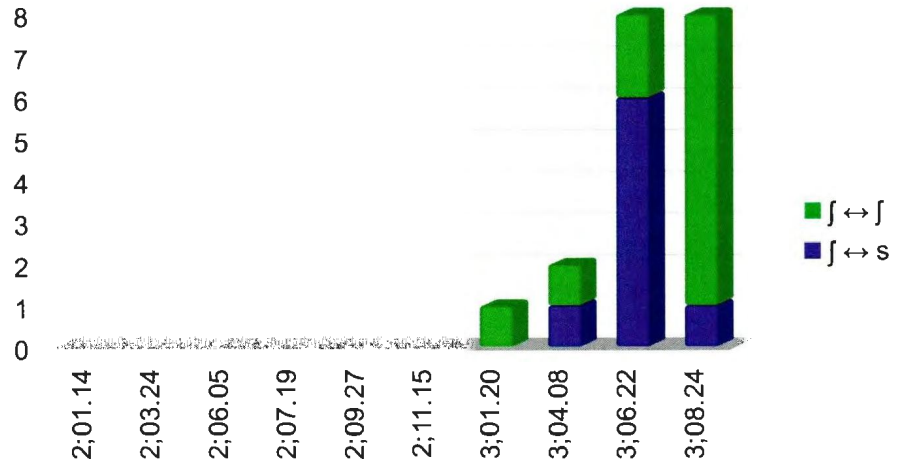


As mentioned above in Section 2.1.2, there appears to be a relationship between the productions of both [s] and [ʃ] in onset. In Figure 30 and Figure 31 above (Section 2.1.2), we saw that at 3;04.08 Ani produces onset [s] as either [s] or [ʃ] and produces onset [ʃ] as [s]. At 3;06.22, onset [s] and [ʃ] are both produced correctly in the majority of attempts. Keeping this is mind, we see [s] and [z] produced as [ʃ] in coda in a high number of attempts. I hypothesize once again that Ani does not initially have a phonological distinction between the alveolar fricatives [s] and [z] and the post-alveolar fricative [ʃ], just as we saw in onset position. Because of this difficulty with phonological distinction, Ani interchangeably substitutes these sounds. In spite of this substitution pattern, Ani generally acquires coronal fricatives at 3;06.22, with the majority of the productions of these fricatives being [s].

Moving on to [ʃ], we observe substitution of [s] for [ʃ] as well, through the last three sessions. However, as we can see in Figure 39, Ani attempts [ʃ] in coda a total of

19 times, with the child producing [ʃ] correctly at 3;01.20. From this session on, it appears that Ani has acquired coronal fricatives, as we saw above, fluctuating between the production of [ʃ] and [s].

Figure 39: Production of [ʃ] in coda

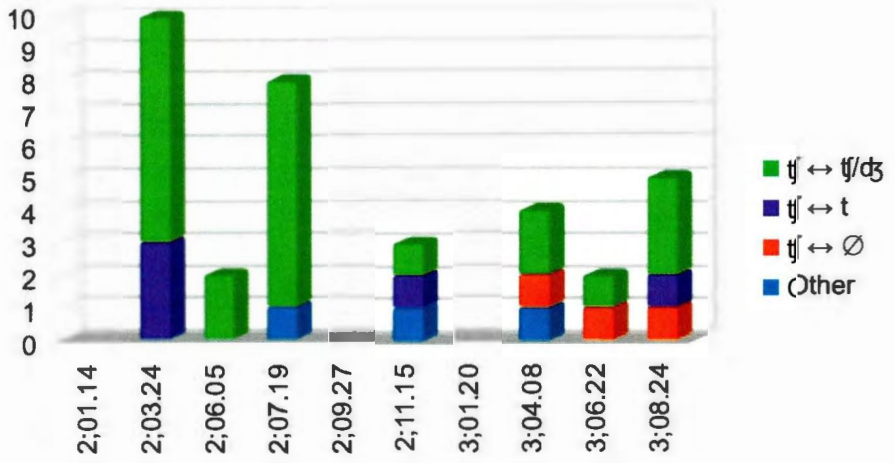


2.2.3 Affricates

As shown in Table 17 above, coda [ʤ] only appears in the target forms three times (in the first two sessions), and Ani deletes the consonant each time. [ʧ], on the other hand, is produced correctly at 2;03.24 and is consistent, at least in appearance, throughout the corpus. However, 64% of these attempts at [ʧ] in coda (21 out of 33 attempts in the entire corpus) come from the production of one word, 'ouch'. In the 12 other attempts, Ani fails to produce [ʧ] in coda correctly until 3;04.08, when she produces this consonant correctly in 2 out of 4 attempts. [ʧ] is also produced as [t] in three sessions, but only in small numbers (i.e. 3 out of 10 attempts at 2;03.24). We thus see the same

tendency towards stop substitution (or deaffrication) of [ʧ] in coda as we did for [ʤ] in onset (refer to Section 2.1.3). Figure 40 illustrates the production of [ʧ].

Figure 40: Production of [ʧ] in coda



2.2.4 Summary of Obstruents in Coda

Ani attempts stop, fricative and affricate consonants in coda less often than she does in onsets. In codas, stops are generally produced correctly or deleted altogether, with very little substitution.

Moving on to fricatives, Ani rarely attempts [f, v, θ] and fails to produce them correctly throughout the corpus. Alveolar fricatives [s, z] are attempted in higher numbers and are often produced as [ʃ] or deleted altogether. [ʃ], however, is produced correctly in the majority of attempts made, the bulk of which are towards the end of the period documented by the corpus, when Ani masters the contrast between [s/z] and [ʃ].

Finally, concerning affricates, [ʤ] surfaces only twice and is deleted both times, while correct productions of [ʧ] arise early in the corpus but are mainly related to the production of the word 'ouch'.

3. The Development of Sonorants

I now move on to the development of sonorant consonants. As mentioned in Section 3.1, there are 7 sonorants in English ([n, m, ŋ] for nasals and [l, ɹ, j, w] for approximants), with the addition of the allophone [ɬ] of the phoneme /l/.

Three syllable positions will be considered: onsets (including singleton onsets and the first position of branching onsets), the second position of branching onsets and codas. As in Section 2, consonants in singleton onsets and the first position of branching onsets generally develop in a similar fashion and are therefore analyzed within the same charts. For the second position of branching onsets, English only allows for three consonants [l, ɹ, w] (as stated in Chapter 3, Section 3.2).

Below are three tables that display Ani's development of the three syllable positions mentioned above. Table 18 displays Ani's productions of sonorants in the first position of branching onsets, Table 19 Ani's production of sonorants in the second position of branching onsets, and finally Table 20 Ani's production of sonorants in codas.

Table 18: Inventory of sonorants in onset

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
m	91	82%	51	69%	31	84%	24	67%	65	62%	61	92%	49	78%	219	79%	79	61%	33	82%
n	3	100%	3	67%	12	100%	4	100%	10	90%	2	100%	27	85%	19	84%	10	70%	11	91%
l	14	79%	11	18%	3	33%	3	67%	1	100%	1	0%	12	8%	8	0%	18	44%	9	78%
ɹ[13]	2	0%	2	0%	--	--	--	--	--	--	2	0%	1	0%	5	0%	8	38%	10	40%
j	11	0%	2	0%	--	--	--	--	3	67%	4	50%	8	75%	25	76%	18	61%	3	33%
w	1	100%	3	0%	13	100%	2	50%	--	--	2	50%	3	67%	9	56%	12	67%	7	43%

Table 19: Inventory of sonorants in second position of a branching onset

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
l	1	100%	1	0%	1	100%	1	100%	--	--	1	0%	--	--	--	--	--	--	--	--
ɹ	1	100%	4	0%	--	--	--	--	1	0%	--	--	17	0%	7	0%	6	0%	11	18%
w	--	--	--	--	--	--	--	--	--	--	--	--	11	0%	2	0%	12	8%	11	0%

Table 20: Inventory of sonorants in coda

	2;01.14		2;03.24		2;06.05		2;07.19		2;09.27		2;11.15		3;01.20		3;04.08		3;06.22		3;08.24	
m	1	100%	--	--	9	11%	10	0%	1	0%	4	50%	--	--	12	67%	7	57%	9	89%
n	7	43%	6	0%	--	--	3	33%	5	0%	2	0%	15	13%	36	42%	36	19%	26	73%
ŋ	1	0%	--	--	1	0%	--	--	--	--	--	--	11	0%	5	0%	2	0%	13	15%
ɬ	--	--	--	--	5	0%	3	0%	--	--	11	0%	20	0%	17	0%	24	0%	17	0%
ɹ	2	0%	4	0%	14	43%	49	73%	1	100%	14	36%	19	47%	67	33%	32	47%	17	82%

13 This is the production of [ɹ] in onset without 'Dora' (see Section 3.2.1.2).

3.1 The Development of Nasal Stops

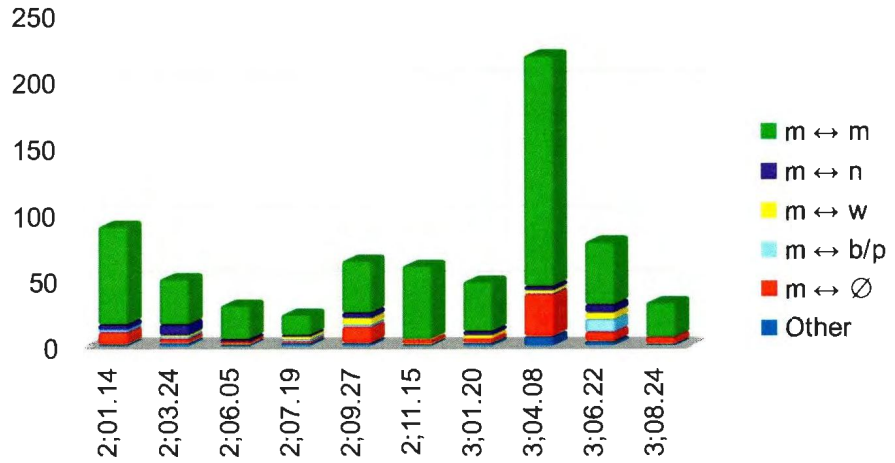
Recall from Chapter 3, Table 8 that English has three nasal stops in its consonantal inventory: [m, n, ŋ]. [m, n] can appear in both onset and coda, while the velar nasal [ŋ] only appears in coda. As mentioned in Section 3, nasals cannot show up in the second position of a branching onset.

Throughout the corpus, Ani attempts all three nasal stops in onset and coda (where appropriate). As we will see in the next sub-sections, Ani displays good mastery of nasal production in onsets, but has more difficulty with nasals in codas. Nasal codas are deleted more frequently than in onset, and [ŋ] shows a high percentage of substitutions.

3.1.1 Nasals in Onset

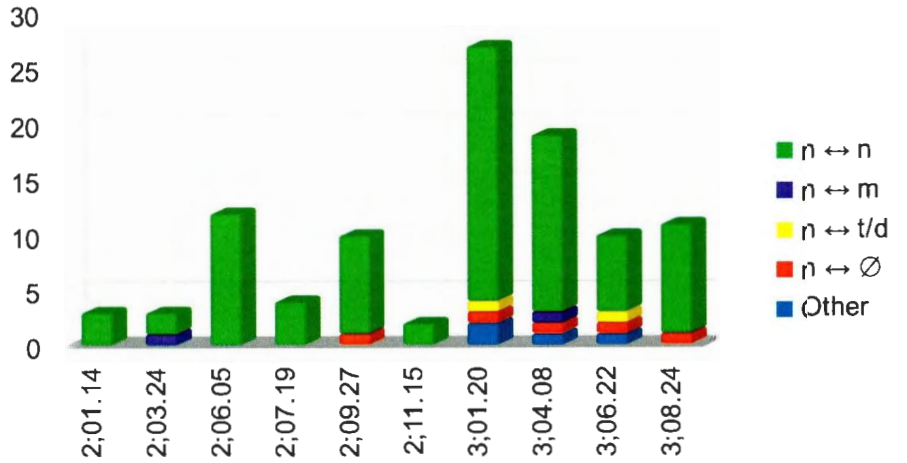
In onset, we observe correct productions of both [m] and [n] from the very first session. Throughout all ten sessions, the vast majority of Ani's attempts at [m] and [n] result in correct productions, as illustrated in Figure 41 and Figure 42 below.

Figure 41: Production of [m] in onset



As we can see in Figure 41, Ani's productions however show a noticeable rise in [m] deletion at 3;04.08. In the following session (3;06.22) we see more variability in [m] production than in preceding sessions. This trend is similar to that observed for obstruents in onsets, as we saw in Section 2.1.1.

Figure 42: Production of [n] in onset



Similar to [m], [n] surfaces in the very first session (2;01.14) as 3 correct productions out of 3 attempts, and remains the majority for the rest of the corpus. There are very few substitutions or deletions of [n].

3.1.2 Summary of Nasals in Onset

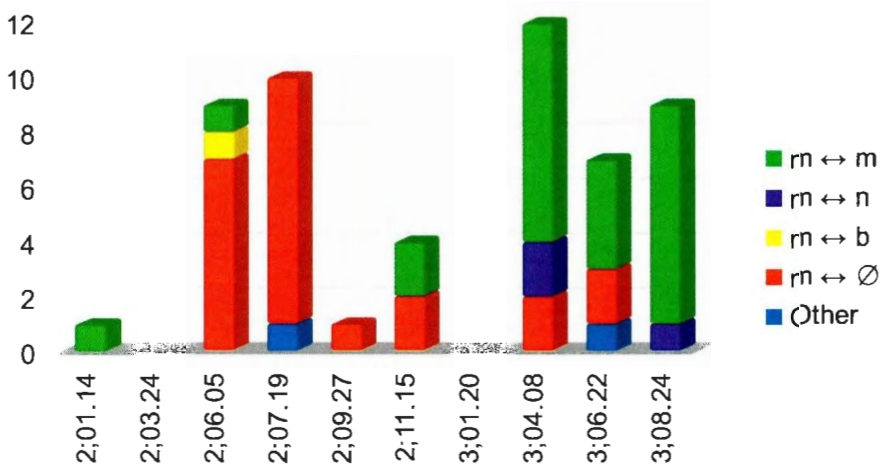
Ani develops nasals very early in the corpus, and generally produces them in a target-like fashion throughout all ten sessions. We however see an increase in consonant deletion at 3;04.08 for [m] production, which is a similar trend observed in obstruent stops in onsets.

3.1.3 Nasals in Coda

All three nasals present in the English consonantal inventory are attempted in coda ([m, n, ŋ]). Ani mainly deletes [m] at 2;06.05 and 2;07.19, a pattern which mostly occurs in a

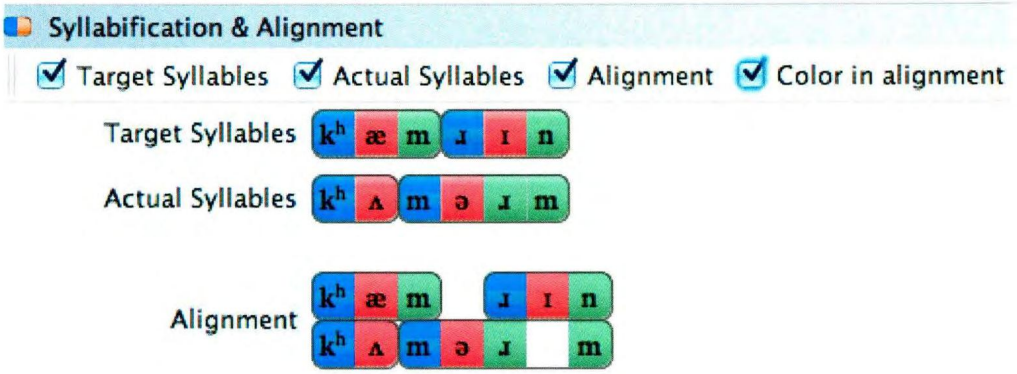
single word 'pamper'. [m] surfaces as the target-like form in higher numbers at 3;04.08 (Figure 43). We also observe some marginal substitutions throughout the corpus.

Figure 43: Production of [m] in coda



While the chart above might suggest that target [m] in coda is acquired as of 3;04.08, it is important to note that these productions actually involve the production of [m] as an onset in the actual form produced by the child. This is most noticeable with the name 'Cameron'. In this example, the target form [ˈkʰæmɹɪn] is often produced as [kʰʌməɹm], in which the coda [m] in the target gets produced as an onset in the actual form. This is exemplified in Figure 44 below, which shows the syllabification of this word.

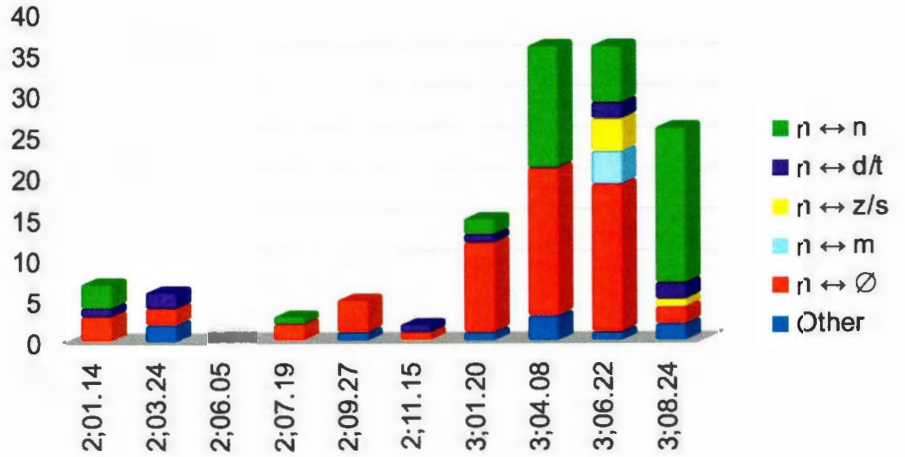
Figure 44: Syllabification of [m] in coda



In addition to Ani's resyllabification of coda [m] in onset, the corpus sporadically displays a few correct productions of [m] in coda. However, we cannot determine that coda [m] was ever acquired during the time span documented by the corpus based on these examples.

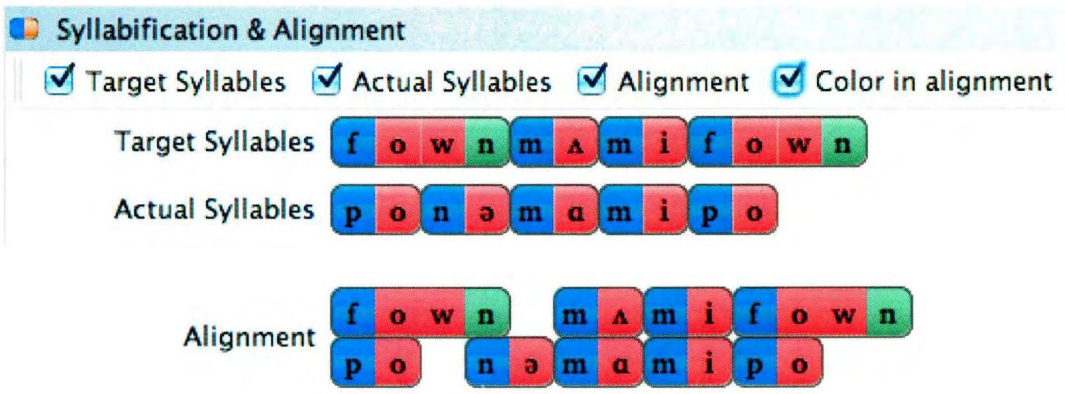
In comparison to [m], [n] displays more variability in production, but also emerges correctly in higher numbers at 3;04.08 (shown in Figure 45). In Ani's attempted productions, [n] is most commonly substituted for three different consonants: [d/t], [z/s] and [m]. The most common substitution of the three is [d/t] occurring in six out of the ten sessions, however only accounts for 9 substitutions in total.

Figure 45: Production of [n] in coda



Just as we saw with [m], the apparent 'correct' productions of [n] mentioned above, arise from the resyllabification of coda [n] in onset, as exemplified in Figure 46 below. In this example, the word ['fown] 'phone' in the target form gets produced as [ponə] in which the [n] is now an onset as opposed to a coda (from 3;01.20, record #212).

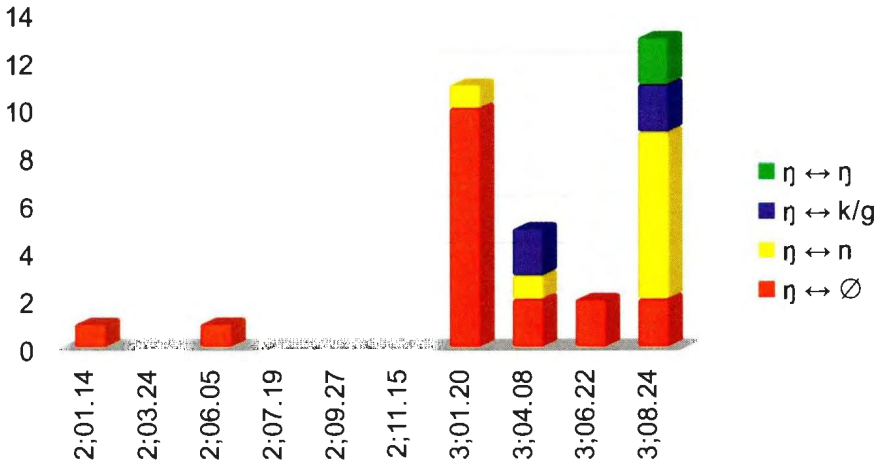
Figure 46: Syllabification of [n] in coda



Ani begins to master [n] in coda by the last session (3;08.24), where we observe 16 correct productions of coda [n] as coda out of 26 attempts.

Ani very rarely attempts [ŋ] until age 3;01.20. In the following three sessions (3;04.08, 3;06.22 and 3;08.24), [ŋ] mainly surfaces as the alveolar nasal [n], is deleted altogether or produced as the velar stop [k/g]. [ŋ] surfacing as [n] is most common in the last session. As we can see in Figure 47 below, [ŋ] is produced correctly in the very last session, but only in 2 out of 13 attempts.

Figure 47: Production of [ŋ] in coda



3.1.4 Summary of Nasals in Coda

Up until 3;04.08, Ani most often deletes nasal stops [m] and [n]. From 3;04.08 onward, the correct productions of [m] and [n] surface but are resyllabified as onsets. Ani deletes the velar nasal [ŋ] until 3;01.20 when she begins substituting the consonant for [k/g] and, later, [n]. Ani does produce [ŋ] correctly in the final session, but in a very low number of productions.

3.2 The Development of Approximants

As mentioned in Section 3, English has four approximants, along with the lateral allophone [ɬ] in coda. Ani attempts all of these five approximants [l, ɬ, ɹ, j, w], which I address according to three different manner types: laterals, rhotics and glides.

3.2.1 Approximants in Onset

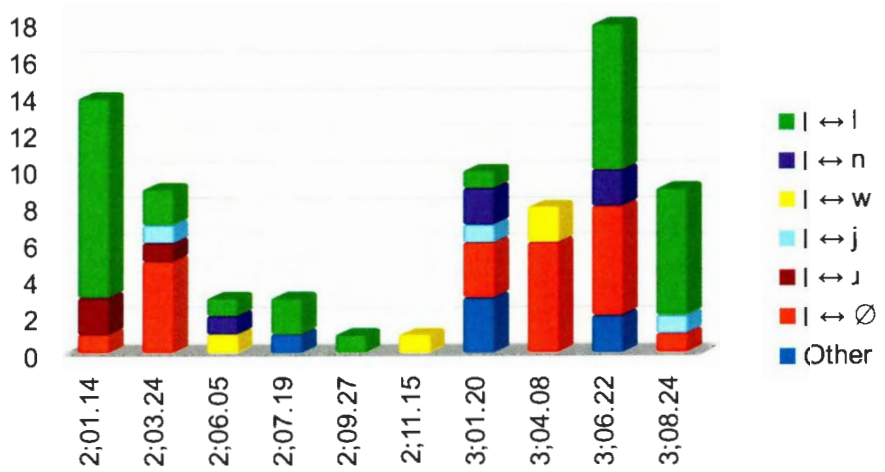
In singleton onsets, English allows for all three categories of approximants: the lateral [l], the rhotic [ɹ] and the glides [j, w].

3.2.1.1 Lateral [l]

In singleton onsets, Ani produces [l] correctly 11 out of 14 times in the first session. From there, while the child occasionally produces [l] correctly, we observe a high number of substitutions. It is not until the last session (3;08.24), when we see the correct production of [l] establishes itself as the norm.

As we can see from Figure 48 below, Ani's attempts at [l] result in substitutions by different approximants such as [w], [j] and [ɹ], along with a relatively high number of deletions. Deletions are found throughout the corpus, with a noticeable rise at 3;04.08 and 3;06.22, just as we saw in obstruent and nasal stops.

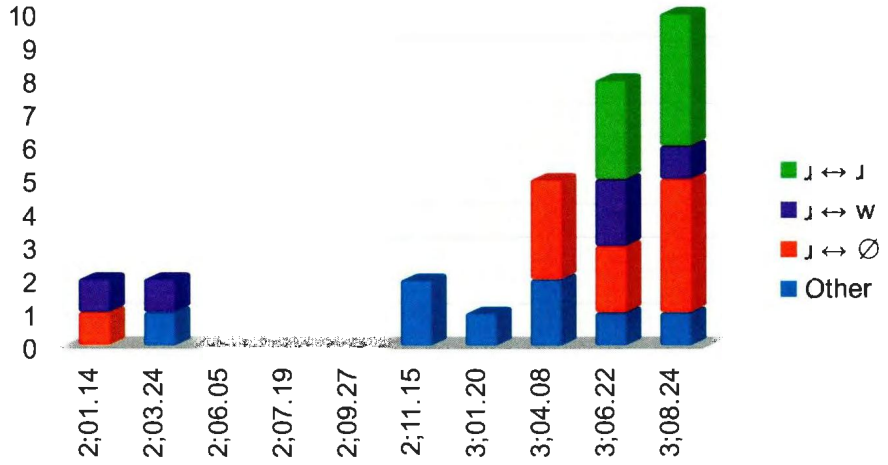
Figure 48: Production of [l] in onset



3.2.1.2 Rhotic [ɹ]

As discussed in Section 2.1.1, I found a great deal of substitution of [ɹ] for [l] in the word 'Dora'. As mentioned before, Ani often produced the word [dɔɹɑ] as [lVlV], causing both the [d] and the [ɹ] to be substituted for [l]. Because of the widespread substitution across just one word, I have removed 'Dora' from the [ɹ] searches as well. Figure 49 below shows Ani's production of [ɹ] without this word.

Figure 49: Production of [ɹ] in onset

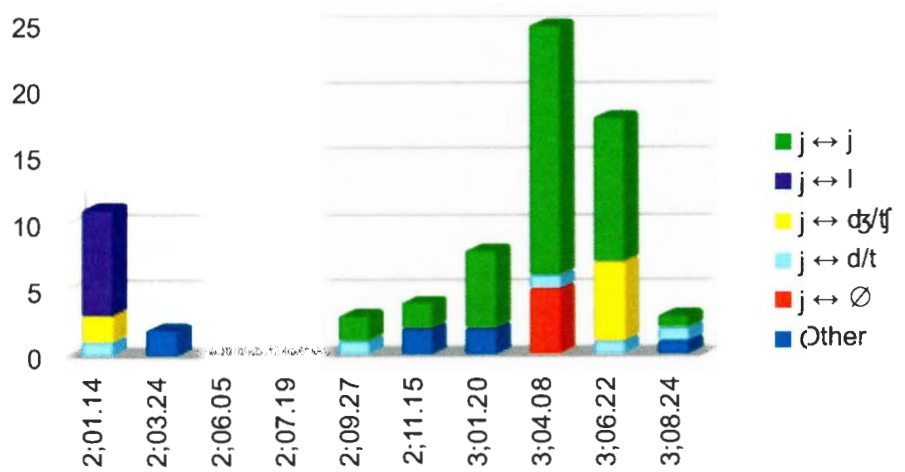


From the chart above, we can see that Ani does not attempt [ɹ] in high numbers. There are some substitutions to [w] in the first and last two sessions, but these occur in low numbers. Ani most frequently deletes [ɹ], but displays a few correct productions during the last two sessions (3;06.22 and 3;08.24).

3.2.1.3 Glides

In Ani's productions, [j] emerges correctly by 2;09.27 with 2 out of 3 attempts resulting in target-like productions, as illustrated in Figure 50 below.

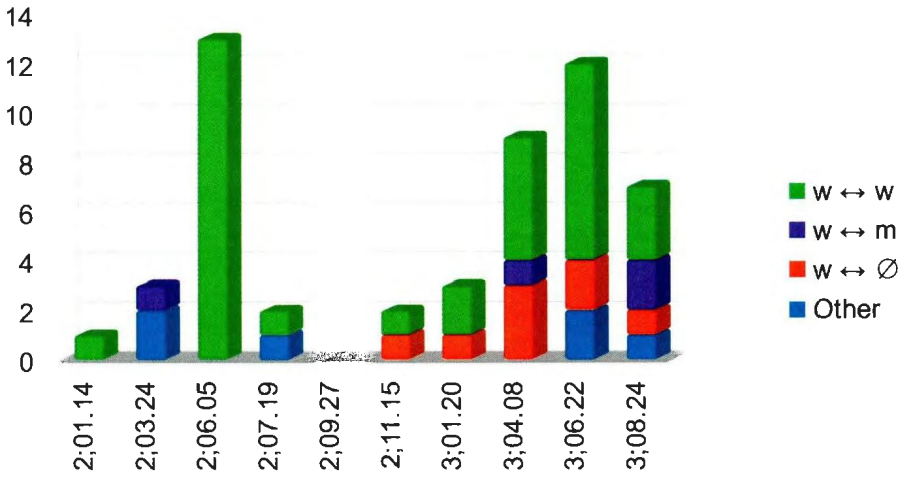
Figure 50: Production of [j] in first position onset



At 3;04.08, however we observe the familiar trend of consonant deletion, in fact the only session in which [j] is deleted altogether.

Correct productions of the glide [w] occur early in the data set, with the target-like production constituting the majority of attempts from 2;06.05 onward. As we can see in Figure 51, [w] continues to be produced correctly throughout the remainder of the data set, with occasional substitutions for the bilabial nasal [m] (which share the same place of articulation).

Figure 51: Production of [w] in onset



3.2.2 Summary of Approximants in Onset

As mentioned above, approximants in onsets consist of [l, ɹ, w, j]. Ani produces [l] correctly in the first session but fails to remain consistent, with a high number of substitutions accompanied by an increase in deletion at 3;04.08 and 3;06.22.

Similar to [l], [ɹ] displays variability throughout all ten sessions. In the final three sessions, correct productions of [ɹ] are attested, but are often overshadowed by deletions or substitutions.

Glides [j] and [w] emerge in a slightly different way. Correct productions of [j] are attested early in the corpus, but do not remain consistent until 2;09.27. In comparison, Ani displays target-appropriate productions of [w] more consistently from 2;06.05 onward, with the exception of some substitutions (mainly by [m] for [w]). We also see a slight increase in consonant deletion at 3;04.08 for both [j] and [w], similar to that found in onset stop consonants.

3.2.3 Approximants in Second Position of Branching Onset

As stated in Chapter 3, Section 3.2, English allows for three consonants in the second position of a branching onset: [l], [ɹ] and [w]. I address the development of these consonants in the next sub-sections.

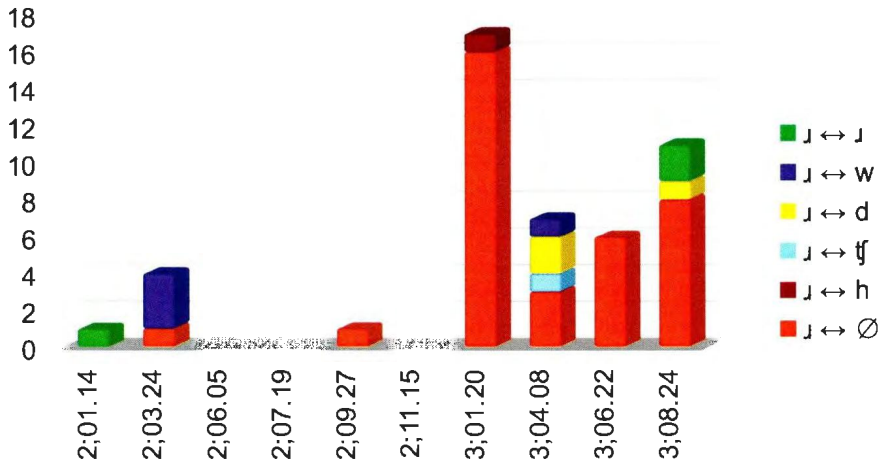
3.2.3.1 [l]

Ani only attempts [l] in the second position of onsets a small number of times throughout the entire corpus (5 attempts in total). Ani does appear to produce [l] correctly 3 out of the 5 attempts, however 2 of these attempts also involve vowel epenthesis. For example, in the word 'blue' [blu], Ani produced [bəˈlu] (at 2;01.14, record #121). This insertion of the vowel [ə] results in two separate singleton onsets [b] and [l]. In the other two productions, Ani deletes the [l], producing just the first consonant in the branching onset (as a singleton onset), or deletes the first consonant in the branching onset and substitutes [l] in the second position for another consonant (in this case [w]).

3.2.3.2 [ɹ]

Ani produces [ɹ] correctly in the very first session, but does not do it again until the very last session. There are few attempts at [ɹ] in the first six sessions and in the final four sessions, the majority of [ɹ] attempts result in deletion. This is illustrated in Figure 52 below.

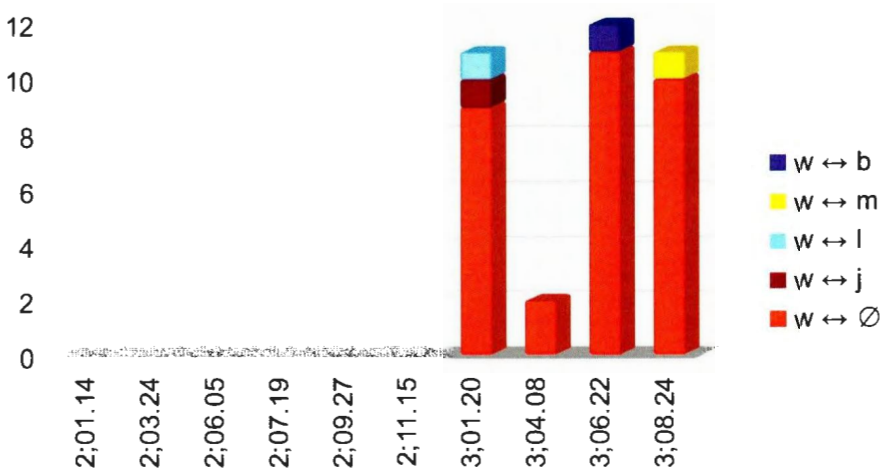
Figure 52: Production of [ɹ] in second position of a branching onset



3.2.3.3 [w]

Attempts at [w] are attested in the last 4 sessions (starting at age 3;01.20) but only in small numbers, during which [w] is never produced in a target-like fashion. The vast majority of attempted productions result in deletion. For example, in session 3;06.22, 9 out of 11 attempts result in deletion (Figure 53). Note finally that all attempts at [w] in the second position of branching onsets arise from a single word: [twɪŋkəɬ]. These data must therefore be viewed with some caution.

Figure 53: Production of [w] in second position of a branching onset



3.2.4 Summary of Approximants in Second Position of a Branching Onset

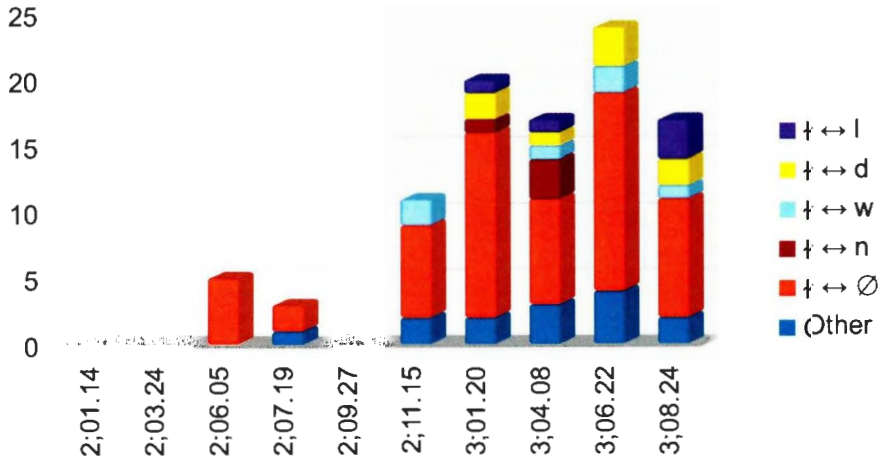
Three consonants were attempted in the second position of a branching onset: [l, ɹ, w]. All were attempted in relatively low numbers, and none were acquired during the period documented by the corpus.

3.2.5 Approximants in Coda

3.2.5.1 Lateral [ɬ]

As mentioned in Section 3.2, English only has one possible lateral in coda, the velarized allophone [ɬ]. Ani fails to produce [ɬ] correctly throughout the entire corpus. The majority of attempts result in deletion, as can be seen in Figure 54. In the last session, however, we observe a slightly higher number of attempts, resulting in a few cases of [l] production (3 out of 17 attempts).

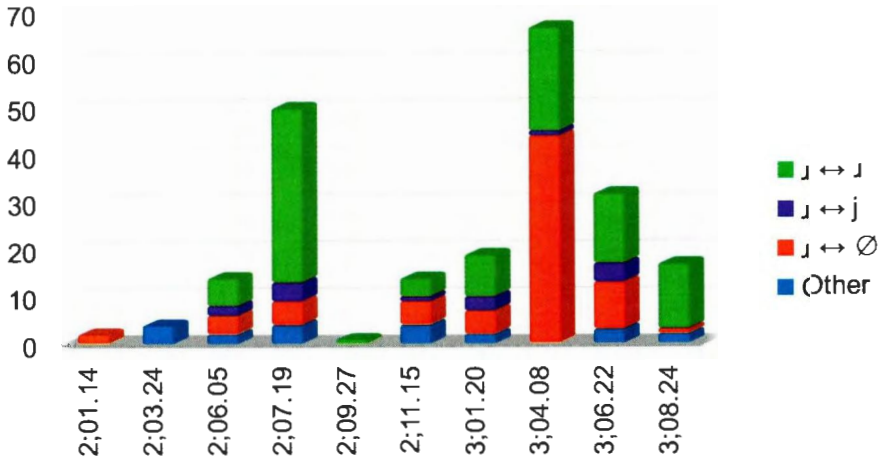
Figure 54: Production of [ɬ] in coda



3.2.5.2 Rhotic [ɹ]

[ɹ] emerges correctly starting at 2;06.05, with 6 correct productions out of 14 attempts. Although there is some fluctuation in the production of [ɹ], Ani seems to acquire the consonant at 2;07.19. At 3;04.08 we see a noticeable rise in the number of deletions of [ɹ]. Upon a closer look into the data, it appears that this rise in deletion is mainly due to the word [ˈbɪɹθdej], which accounts for 26 of the 44 deletions. After this spike in consonant deletion, correct productions of [ɹ] become the majority.

Figure 55: Production of [ɹ] in coda



3.2.6 Summary of Approximants in Coda

Throughout the observed period, Ani scarcely attempts [ɬ]. This consonant generally undergoes deletion and never surfaces as the correct production. In contrast to this, Ani produces [ɹ] correctly early in the corpus and masters it at 2;07.19.

4. Summary of English Development

In order to study Ani's productions of English target words, I divided the consonants of the English inventory into two manner categories: obstruents ([p, b, t, d, k, g, f, v, θ, ð, s, z, ʃ, ʒ, h, ʧ, ʤ]), and sonorants ([n, m, ŋ, l, (ɬ), ɹ, j, w]).

Concerning the development of English obstruents, I looked at two particular positions within the syllable: onset and coda, and three different manner categories: stops, fricatives, and affricates. We observed similarities and differences for each category of obstruents when comparing across syllable positions. First, stop consonants

develop quite differently in onsets than in codas. Stops in onsets are produced correctly early in the corpus, with a rise of consonant deletion at 3;04.08. Stops in codas, however, are attempted much less often and show generalized patterns of deletion.

Second, fricatives are variable in both onsets and coda. Only a small number of attempts at fricatives are found in both syllable positions. Ani rarely attempts [v, θ, ð, z, ʒ] in onsets and [f, v, θ] in codas. Fricative consonants [s, ʃ] in onsets begin to be produced correctly by the end of the corpus, while [f] is generally produced as bilabial stop [p/b]. In codas, [s, z, ʃ] are attempted in higher numbers, with [s, z] being substituted by [ʃ] or deleted and [ʃ] being produced correctly early in the corpus.

Third, affricates [ʧ] and [ʤ] develop a little differently across onsets and codas. On the one hand, Ani correctly produces [ʧ] early in the corpus for onsets and remains fairly consistent (with the exception of the pattern of deaffrication). [ʧ] in coda, on the other hand, is not acquired until 3;04.08. [ʤ] shows greater variability in onset, with more instances of deaffrication. In coda, [ʤ] is only attempted three times, and Ani deletes it each time.

Moving on to sonorants, I considered their development in three syllable positions: singleton onsets, the second position of branching onsets, and codas. Within the sonorants category I looked at nasal stops and approximants, which I broke down into three categories: laterals, rhotics and glides.

In Ani's English data, we observe a difference between the development of nasals in onset and coda positions. In onsets, Ani masters nasals correctly very early in the corpus. In codas, Ani fails to produce [n] correctly until 3;06.22 and [m] until 3;08.24.

Finally, [ŋ] is rarely attempted until 3;01.20. It is produced as [k/g] in the majority of attempts.

Approximants are attempted in much lower numbers than any other consonant category in Ani's English data. In singleton onsets, both lateral [l] and rhotic [ɹ] are attempted in small numbers and show variable patterns of substitution. Glides [j] and [w], on the other hand, are attempted and produced correctly more often than [l] and [ɹ]. For both glides, we also observe a rise in consonant deletion at 3;04.08, similar to what we saw in onset stops. In the second position of branching onsets, laterals, rhotics and glides are all attempted in low numbers and generally deleted. Finally, in coda, Ani most commonly deletes [ɬ] altogether, while [ɹ] undergoes patterns of substitutions.

Throughout Ani's attempts at English consonants, there was a noticeable rise in consonant deletion at 3;04.08 for different consonant categories in onsets. As we saw in the previous chapter which dealt with Cree development, this pattern of consonant deletion also occurs at 3;04.08 with the deletion carrying into the following two sessions as well (3;06.22 and 3;08.24). As mentioned in Chapter 4, Section 4, deletion occurs in Cree word productions as well, and is apparent in other areas of Ani's language development such as prosodic development (Swain 2008) and morpho-syntactic development (Terry 2010).

Chapter 6: Comparison of Cree and English Word Development

1. Introduction

Building on the detailed description of Ani's development of both Cree and English words in the previous chapters, I now turn to a systematic comparison of these results (e.g. similarities and differences; developmental patterns). As stated in Chapter 2, Section 4, Ani's first language is Cree. However she does have some exposure to English and also attempts to produce English words. As we will see, Ani's development of English words seems to be governed by her Cree grammar; when she utters an English word, the production of this form appears to be mediated through Cree phonotactics.

The chapter is organized as follows: first, I return to the fact that Ani is not a bilingual speaker. Although her productions contain many English forms, she arguably cannot be considered to be bilingual. Second, I compare the sounds that are present in both Cree and English. Similarities in the development of these sounds across both languages support the hypothesis that Ani truly operates from a single phonological system. This hypothesis is reinforced by the fact that consonants of English which are absent from the Cree system develop only during late stages, if at all. Next, I address English sound distributions that do not occur in Cree. This includes sounds of Cree in syllable positions that violate Cree phonotactics (e.g. stops and affricates in coda) as well as sounds and positions which are not available in Cree (e.g. liquids in branching onsets). Again here, these structures of English which have no counterparts in Cree do not display much development during the period covered by the corpus. Finally, I

address the systematic pattern of a rise in deletion that occurs in Ani's productions of both Cree and English words at 3;04.08 and onward.

2. Ani's Language Learning Context

In Chapter 2, Section 4, I discussed the influence of English on Ani's language learning. Although Ani was exposed to English within her home, it was only through media sources (such as television or radio), which accounted for a relatively small amount of overall input. As Kuhl (2007) demonstrates, children cannot learn a language from television or radio alone, because of lack of social interaction. Along with this, Pearson et al. (1997) and Hoff et al. (2012) have hypothesized that children who receive less than 20% exposure to a language are unlikely to learn that language. Ani's language learning context fits within this description. From the evidence available in the literature and knowledge of the amount of exposure Ani had to the English language at the time when the recordings were made, she arguably was not a bilingual learner. This fact predicts the relative absence of the development of an English phonological system. As we will see in the section below, this prediction is largely borne out by the data.

3. Comparison of Cree and English Development

In this section, I discuss the consonants that are found both within Cree and English. This breakdown reveals how the consonants that occur in both English and Cree develop in ways that differ from the consonants that occur in English only.

3.1 Development of English Sounds also Present in Cree

3.1.1 Obstruent Stops

As mentioned in Chapter 3, Section 2.1, there is no voicing contrast in Cree. Because of this, I compare the voiced and voiceless consonants of English to their equivalents (transcribed as voiceless) in Cree. Obstruent stops appear in onset for both languages and develop in similar ways. As we see in Table 21 below, stops develop early, as they are acquired at 2;01.14. These stops are consistently produced correctly throughout the remainder of the corpus.

Table 21: Obstruent stops in onset

	Cree	English
[p/b]	• $n=623$ • Acquired at 2;01.14 • Substitutions: [w, m]	• $n=477$ (219 + 258)[14] • Acquired at 2;01.14 • Substitutions: [w, m, d/t]
[t/d]	• $n=686$ • Acquired at 2;01.14 • Substitutions: [ʧ, n]	• $n=369$ (171 + 198) • Acquired at 2;01.14 • Substitutions: [ʧ/ʤ, h]
[k/g]	• $n=427$ • Acquired at 2;01.14 • Substitutions: [t]	• $n=284$ (255 + 29) • Acquired 2;01.14 • Substitutions: [t]

We also observe similar trends in substitution patterns, whenever such patterns occur in the data. For example, in the production of [p] in Cree and [p/b] in English, most substitutions involve bilabial [w] or [m].[15] These manner substitutions remain faithful to

14 The numbers between parentheses provide a breakdown of the attempts at voiceless and voiced obstruents.

15 As we can see from Table 21, there are also some substitutions of [t/d] for English [b], but these only occur in 9 attempts out of 258.

the place of articulation of the target phones. Much like [p/b], we observe similarities in substitution patterns, for both [t/d] and [k/g].

3.1.2 Fricatives

Recall that the fricatives from the Cree consonantal inventory, [s, ʃ], occur in two syllable positions in both Cree and English: onset and coda. In contrast to stop consonants, relatively few attempts at fricatives in either Cree or English are found in this corpus, and these consonants appear to develop differently than other consonants. Because there is so little data available, one can only speculate the exact developmental pattern of these fricatives in Ani's phonology. Table 22 provides a comparison of the available data.

Table 22: Fricatives in onset

	Cree	English
[s/z]	• $n=14$ • Acquired at 3;06.22 • Substitutions: Some stopping	• $n=47$ (45+2) • Acquired at 3;06.22 • Substitutions Stopping, debuccalization
[ʃ/ʒ]	• $n=82$ • Acquired at 3;04.08 • Fluctuation between [s]/[ʃ] pronunciations until 3;01.20 • Substitutions: [ʧ]	• $n=40$ (38+2) • Acquired at 3;06.22* • *Few attempts before 3;06.22 • Fluctuation between [s]/[ʃ] pronunciations until 3;04.08 • Substitutions: [ʧ]

In onset, [s] is acquired at 3;06.22. Before [s] is fully acquired, it is rarely attempted and seems to be generally avoided by the child. [z] follows the same logic:

Ani only attempts [z] twice, with neither attempt resulting in the correct production ([z] was deleted in one case and stopped as [d] in the other).

Moving on to [ʃ], until 3;01.20 Ani shows fluctuation with the place of articulation of [ʃ] in her attempts, which often results in [s] productions. Ani's productions of [ʃ] become stable in Cree at 3;04.08. In English, however, only 3 attempts at [ʃ] are made before 3;06.22. When Ani attempts the consonant, the same fluctuation of place occurs as with the production of [s]. Ani's productions of [ʃ] in English stabilizes at 3;06.22. Although Ani seems to have trouble with the place of articulation of [ʃ] throughout the corpus, she is consistent with this substitution across words in both languages. She thus masters the correct production of [ʃ] in each language just one session apart, a difference which may have more to do with the sample available than phonological development per se. [ʒ], like [z], is only attempted twice, and is produced as [ʃ] both times. This overall similarity once again supports the hypothesis that Ani generally operates from a unique phonological system, which applies to words originating from both languages.

In both Cree and English, two fricatives can appear in coda: [s] and [ʃ]. Table 23 below provides an overview of these coda fricatives.

Table 23: Fricatives in coda

	Cree	English
[s/z]	• $n=26$ • Acquired at 3;06.22 • Very few attempts before 3;04.08 (gap in data) • Substitutions: [ʃ, n, t]	• $n=149$ (72 + 77) • Acquired at 3;06.22 • Fluctuation between [ʃ]/[s] pronunciations until 3;06.22 • Substitutions: [ʃ, n, t]
[ʃ]	• $n=211$ • Acquired at 2;01.14 • Substitutions: [s, tʃ]	• $n=19$ • Acquired at 3;01.20* • *Data gap between 2;01.14 and 3;01.20 • Substitutions: [s]

As we can see, coda [s] develops in a similar way across the two languages. In Cree, [s] is very rarely attempted until 3;04.08 and is acquired in the session that follows (3;06.22). In English, [s] is attempted more frequently but is also not acquired until 3;06.22. Until then, attempts at English [s] often result in a fluctuation between the production of [s] or [ʃ], similar to my observations of onset [ʃ] above. [z], on the other hand, emerges later in the corpus (2;09.27) and is not fully acquired during the period covered by the corpus. In addition to the similarities in the acquisition of [s/z] in Cree and English, we also observe the same substitution patterns.

Coda [ʃ] patterns similarly across Cree and English, although the attested dates of acquisition are different. In Cree, [ʃ] is acquired in the first session (2;01.14), while in English [ʃ] is acquired much later at 3;01.20. However, going back to Chapter 5, Figure 39, we can see that Ani does not attempt coda [ʃ] in English until this date. In addition, the substitution patterns of coda [ʃ] in Cree and English pattern similarly. In both languages, Ani substitutes [s] for [ʃ].

3.1.3 Affricates

In Cree, affricates only occur in onset, where their development is very similar to that observed in English words. Table 24 provides an overview of this development.

Table 24: Affricates in onset

	Cree	English
[ʧ]/[ʤ]	• $n=411$ • Acquired at 2;06.05 • Substitutions: [ʧ] produced as [ts] • Deaffrication to [t]	• $n=122$ (59+63) • [ʧ] acquired at 2;09.27*; [ʤ] acquired at 2;06.05 • *Data gap between 2;03.24 and 2;09.27 for [ʧ] • Deaffrication to [t/d] for both

The age of emergence for [ʧ] in Cree is 2;01.14 (the first session) and 2;03.24 for English (the following session), as [ʧ] is not attempted in English words at 2;01.14. The acquisition of [ʧ] is separated by two sessions as (2;06.05 for Cree and 2;09.27 for English). Note again in this context that there is a period during which Ani does not attempt [ʧ] in English, between 2;03.24 and 2;09.27. Given the parallel between her Cree and English productions observed elsewhere in the data, it is thus possible that Ani acquired [ʧ] in English at the same time as she did in Cree. This hypothesis is also supported by the observation that Ani acquires [ʤ] in English during the same session she acquires [ʧ] in Cree.

Concerning the production of [ʧ] in Cree, in Chapter 4, Section 2.1.3, we observed a lot of deaffrication (substitution of an affricate for a stop, particularly [t]). This substitution pattern is also found in English (Chapter 5, Section 2.1.3) for both the

voiced and voiceless affricates. Deaffrication to [t/d] is more common for [ʤ] than for [ʧ] in English but does occur in both cases.

3.1.4 Nasals

Nasal stops [m] and [n] appear in both Cree and English in two syllable positions: onset and coda. Table 25 provides an overview of these nasals in onset, while Table 26 summarizes the data in coda.

Table 25: Nasals in onset

	Cree	English
[m]	• $n=708$ • Acquired at 2;01.14 • Substitutions: [n, w, p/b]	• $n=703$ • Acquired at 2;01.14 • Substitutions: [n, w, p/b]
[n]	• $n=741$ • Acquired at 2;01.14 • Substitutions: [m, t]	• $n=101$ • Acquired at 2;01.14 • Substitutions: [m, t]

In onset, [m] and [n] pattern similarly in Cree and English, as they are both acquired at 2;01.14. We also observe similar substitution patterns for these consonants. Ani substitutes [m] in Cree and English for [n], [w] or [p/b]. For [n], the number of substitutions is much lower, with the most prominent substitutions by [m] or [t]. As previously mentioned, these parallels in substitution patterns across the words attempted in the two languages provide further supporting evidence for the hypothesis that Ani has a single phonological system which applies to words from both languages present in her surroundings.

Table 26: Nasals in coda

	Cree	English
[m]	• $n=76$ • Not acquired • Substitutions: [n, w]	• $n=56$ • Not acquired • Substitutions: [n, p]
[n]	• $n=491$ • Not acquired • Substitutions: [d/t, m, j]	• $n=136$ • Suspected acquisition at 3;08.24 • Substitutions: [d/t, m, z/s]

Similar to [m] in onset, [m] in coda behaves in the same way in Cree and English, as it is not acquired by the end of the ten sessions covered by the corpus. In both languages, Ani often resyllabifies coda [m], producing it as an onset.

In Ani's speech productions, attempts at coda [n] yield variable outcomes across the two languages. As mentioned in Chapter 4, Section 3.1.3 and Chapter 5, Section 3.1.3, Ani resyllabifies coda [n] as an onset in both Cree and English. Coda [n] in Cree does not seem to be acquired by the last session (3;08.24) and therefore I cannot pinpoint an acquisition date. Coda [n] in English appears to be acquired by 3;08.24, however this is the first time Ani produces the consonant correctly in the correct syllable position and therefore we can only speculate on this being the date of acquisition.

From a more general perspective, the substitution patterns for [m] and [n] are similar in Cree and English. For [m], Ani substitutes [n] and [w] in Cree, and [n] and [b] in English. Ani thus remains faithful to the manner of articulation (i.e. nasal for [n]) or the place of articulation (i.e. bilabial for [w] or [b]) of the target consonant. We observe a similar pattern for [n]. In Cree words, [n] may be substituted by [d/t], [j], or [m] while

in English we see [d/t], [z/s] or [m]. Again here, Ani remains faithful either to the place or the manner of articulation of the target nasal.

3.1.5 Glides

Cree and English share two glides in onset: [j, w]. Table 27 below provides an overview of the development of these glides across the two languages.

Table 27: Glides in onset

	Cree	English
[j]	• *n*=280 • Acquired at 2;03.24 • Substitutions: [n, w]	• *n*=74 • Acquired at 2;09.27* • *Data gap between 2;03.24 and 2;09.27 • Substitutions: [l, ʤ/ʧ, d/t]
[w]	• *n*=223 • Acquired at 2;06.05 • Substitutions: [m, p]	• *n*=52 • Acquired at 2;06.05 • Substitutions: [m]

[j] is acquired two sessions apart in Cree and English (2;03.24 for Cree and 2;09.27 for English). Note however that Ani only attempts onset [j] in English twice at 2;03.24, and then does not attempt it again until 2;09.27, when she acquires the consonant. This lack of data along with the parallels seen in the development of other consonants in Cree and English suggests that Ani may have in fact developed [j] in English at the same time she acquired [j] in Cree. Although the most common substitution patterns of [j] in Cree and English differ (Table 27 above), we do see some similarities when looking at the 'other' category of [j] substitutions. In Cree, Ani does

substitute [l], [ʧ], and [t] for [j] in a small number of attempts in Cree and, in English, Ani substitutes [n] and [w] for [j] in a small number of attempts.

In both Cree and English words, [w] is acquired at 2;06.05 and share similar substitution patterns. Ani substitutes [w] for other bilabial consonants: [m] and [p] in Cree, and [m] in English, thereby maintaining the place of articulation of the target glide.

4. Development of English Sounds Not Found in Cree

In this section, I address the consonants that are found in English words but absent from Cree. These consist of the fricatives [f, v, θ, ð], the nasal [ŋ], and the approximants [l, ɬ, ɹ]. (Recall from Chapter 3, Section 3, that there are no Cree sounds that do not have a counterpart in English.) As I hypothesized in previous sections, if Ani's English productions are governed by her Cree phonological system, we expect her to have difficulty producing consonants that are not part of this system. As we will see in the sub-sections below, this prediction is also borne out in the data.

4.1 Fricatives

English has four fricatives which do not occur in Cree: [f, v, θ, ð], with [f, v, θ] appearing in both onset and coda and [ð] in onset only in this corpus. In Ani's English word productions, these fricatives are very rarely attempted. [v, θ, ð] are never produced correctly in onset or coda throughout the observed period. The majority of attempts at these target fricatives result in deletion (for example: 36 out of 43 possible attempts at [θ] result in deletion in coda). [f] is produced correctly in only 3 out of 31 attempts in

onset (2 correct productions out of 8 attempts at 3;04.08 and 1 correct production out of 2 attempts at 3;08.24). Ani never produces [f] correctly in coda. Most commonly, [f] is stopped to [p/b] in both onset and coda.

4.2 [ŋ]

While Cree and English have two nasals in common, [m, n], English has a third nasal that occurs in codas only, [ŋ]. Throughout the ten sessions, Ani rarely attempts [ŋ], with the first attempted production attested at 3;01.20. From this moment onward, Ani mainly produces target [ŋ] as either [n] or [k/g], when a consonant is produced at all. This kind of substitution pattern is similar to those seen earlier in the chapter: Ani remains faithful to either the place of the nasal or to its manner of articulation. Ani finally begins to produce [ŋ] correctly in the final session (3;08.24), however in only 2 out of 13 attempts.

4.3 Liquids

In Cree, there is only one category of approximants (glides), while English has two additional approximant categories referred to as liquids, which consist of both laterals [l, ɬ] and rhotic [ɹ]. [l] and [ɹ] occur in singleton onsets and in second positions of branching onsets, while [ɬ] and [ɹ] occur in codas. Approximants (including glides) in the second position of branching onsets will be addressed in Section 5, as this syllable position is irrelevant to Cree.

In singleton onsets, Ani's production of [l] is inconsistent until 3;06.22 when the target sound is finally acquired. Similarly, [ɹ] is not produced correctly until 3;06.22,

when Ani manages 3 correct productions out of 8 attempts. However, Ani does not fully acquire this consonant by the end of the corpus.

In coda Ani fails to produce [ɬ] correctly throughout the ten observed sessions. The majority of attempts result in deletion, with a higher substitution rate for [l] in the last session (3;08.24). [ɹ], however, emerges as the correct production at 2;06.05 and is acquired at 2;07.19.

4.4 Summary

In sum, throughout the course of Ani's language development as documented by the current corpus, these particular groups of fricatives, nasals and liquids are among the last consonants to be acquired, if they develop at all. This observation is in line with the fact that Ani was not exposed to these consonants through her native language. Because Ani has arguably not acquired the English phonological system, she often substitutes English consonants for Cree alternatives, or deletes them altogether.

5. English Sound Distributions Not Attested in Cree

In this section I address English sound distributions that are not attested in Cree. For example, Cree has stops and affricates in onset, but not in coda, while English has both stops and affricates in coda. As mentioned in Section 4 above, neither laterals nor rhotics occur in Cree. While I have already discussed these consonants in onset and coda, they also occur in the second position of branching onsets, a position which is not available in Cree. This particular position displays an interesting developmental pattern because not only are liquids not phonemes of Cree, but the second position of a

branching onset is also not a possible syllable position in the language. As we would expect, Ani had great difficulty with this position, which I address in more detail below.

5.1 Stops in Coda

As discussed above in Section 5, stops appear in onset in Cree, but not in coda. In contrast to this, English allows for all stops in its inventory to occur in coda.

Stops in codas develop differently than in onsets. First, coda stops are rarely attempted. For example, Ani attempted coda [b] only twice throughout the entire corpus, as opposed to 258 attempts at [b] in onsets. While this may be an artefact of the phonological content of Ani's attempted words, we must also note that stops are deleted much more often in codas than in onsets.

5.2 Affricates in Coda

As we saw with stops in coda above, affricates are attempted less often in coda than in onset. Ani acquired affricate [ʧ] much earlier in onset than in coda. As discussed in Chapter 5, Section 2.2.3, [ʧ] in coda is acquired at 3;04.08, which is much later than onset [ʧ] (acquired at 2;03.24). In coda, Ani only attempted [ʤ] three times, and deleted the affricate each time.

5.3 Approximants in Second Position of a Branching Onset

As mentioned in Chapter 3, Section 3.2, English approximants [l, ɹ, w] also occur in the second position of branching onsets, which is not a valid syllable position in Cree. Ani attempts these consonants in very small numbers and in the vast majority of cases, the

position is deleted altogether. Moreover, in cases when a consonant is produced, it occurs in the context of vowel epenthesis. Because of this epenthesis, Ani is effectively not producing a branching onset, but is producing two singleton onsets, each followed by a vowel.

6. Overall Drop in Performance from 3;04.08 Onward

Throughout Chapter 4 and Chapter 5, we observed a noticeable rise in consonant deletion at 3;04.08, which in many cases continued to manifest itself through the last two sessions. This drop in overall accuracy was often accompanied by a rise in productivity. It occurred in both Cree and English word productions.

A decrease in accuracy is attested in other areas of Ani's language development, both concerning her prosodic development (Swain 2008) and her morpho-syntactic development (Terry 2010). As Rose & Brittain (2011) suggest, this pattern of consonant deletion may reflect a period of grammatical reorganization in Ani's language learning. Indeed, grammatical reorganizations are often characterized by a U-shaped learning curve, and have been widely attested in various studies of language development (e.g. Leopold 1939; Leopold 1947; MacWhinney 1978; Bowerman 1982; Fikkert 1994; Freitas 1997; Bernhardt & Stemberger 1998; Inkelas & Rose 2003; Becker & Tessier 2011; Rose & Brittain 2011; McAllister Byun 2012).

While it remains difficult at this stage to pinpoint what exactly was behind Ani's fluctuations in performance toward the end of the period covered by the corpus, we can minimally observe that this decrease in performance occurred in both her Cree and her

English word productions. This observation is itself in line with the central hypothesis of my thesis that Ani was developing a single phonological system.

7. Conclusion

Although Ani was exposed to English in her daily life, she was arguably not a bilingual learner. This claim, which follows from previous literature on the topic (such as Pearson et al. 1997; Kuhl, Tsao & Liu 2003; Kuhl 2007; Hoff et al. 2012), is substantiated by the evidence uncovered by the current study: Ani's productions of English words are governed by the phonemic inventory and syllable structure of her native language.

First, I addressed sounds that are found in both English and Cree in the syllable positions shared by these two languages, second, sounds that are found in English but not in Cree, and finally English consonant distributions that are not found in Cree. While exploring this data, I expected the consonants that appear in both Cree in English to develop similarly, the consonants that are phonemes of English only to develop late (if at all), and the development of distributions found in English only to differ from that of these sounds in other positions in Cree. This is what my comparative results have shown.

When looking at consonants that appeared in both Cree and English, we observed strong similarities in their developmental patterns. Acquisition often occurs in the same session across languages (or very close to) and consonants often share substitution patterns. Ani's substitution patterns across target words in the two languages suggest that she has a single phonological system, which applies to the production of words in both languages.

Consonants that are specific to English developed much later (if at all) in comparison to consonants that are present in both languages. These English consonants are also attempted in very low numbers, and only a few of these consonants are actually acquired by the end of the period studied.

Concerning English sound distributions which are not possible in Cree, I showed that stops in coda (not possible in Cree), developed quite differently from stops in onset (possible in Cree). Stops in codas were attempted in much lower numbers and attempts resulted in a higher rate of deletion. Approximants in the second position of a branching onset also showed the predicted developmental pattern. As expected, attempts at the approximants [l, ɹ, w], which occurred in relatively low numbers, resulted in widespread deletion with few actual consonant productions.

Finally, I addressed the noticeable rise in consonant deletion in productions of Cree and English words at 3;04.08 and often continuing into the following two sessions (3;06.22 and 3;08.24). This decrease in accuracy is also characterized by a rise in productivity. I followed Rose & Brittain's (2011) hypothesis that this phenomenon may be linked to grammatical reorganization. The uniformity in which it applies to both Cree and English word productions supports the current hypothesis about Ani's development of a unique phonological system.

Chapter 7: Discussion

1. Introduction

The main goal of this thesis was to describe Ani's segmental development in both her Cree and her English word productions. Working towards that goal, I engaged in a systematic comparison of consonant development in Ani's word productions from target words in both languages. In this chapter, I first summarize the main findings of this thesis in light of the working hypothesis I presented in Chapter 1. I then address some potential implications of this research, focusing on two particular areas: phonological development and CCLAS.

2. Thesis Summary

As stated in Chapter 1, I hypothesized that Ani's development of English words are governed by her Cree grammar. Therefore, any time the child attempted an English word, it would get filtered through the phonotactics of her developing Cree phonological system. When comparing the development of Cree and English words side by side, it became apparent from various developmental patterns that this was in fact the case. I address these developmental patterns in more detail below.

First, development of consonants that appear in both Cree and English words (in the same syllable position) occurred largely at the same time for each attempted consonant. For consonants that did not develop across languages in the exact same session, the discrepancies observed were generally be related to gaps in the data (e.g. a

session in which the child did not attempt the relevant consonant in words from a particular language).

Second, we observed various substitution patterns in Ani's productions. When comparing Cree and English, we noticed these substitution patterns to be the same in words from both languages. This is further evidence to support that Ani has a single phonological system and is applying it to her words productions from both languages.

Third, I looked at consonants of English which do not occur in Cree as well as consonants that occur in syllable positions that are allowed in English but not in Cree. The consonants that are solely phonemes of English developed much later than the consonants that are a part of the Cree system, if they were acquired at all during the period covered by the corpus. These consonants were often deleted, or substituted for possible Cree consonants. Consonants that occur in syllable positions that are allowed English but not in Cree also developed differently. The development of these consonants took place much later than in syllable positions allowed in Cree, and often resulted in more deletion and substitution. Once again, this is evidence that Ani was producing English words through her Cree phonological system.

Finally, I noticed a particular pattern of consonant deletion occurring at 3;04.08 (and often extending into the sessions to follow) in both Cree and English. This systematic deletion across languages is further evidence to support my working hypothesis of one phonological system driving word productions in Cree and English.

3. Potential Implications

Although this thesis only addresses the language development of one child, it provides evidence that Ani's first language development is not 'confused' by a mixed language environment (a question raised in Chapter 1, Section 1). The child may be exposed to two languages, however, her native language remains largely dominant from a systematic standpoint, and governs her production of English words.

3.1 Phonological Development

From the perspective of phonological development, these findings are important for studying acquisition in a mixed language environment. This thesis shows that, at least for this particular child, growing up in a mixed language environment does not have a negative impact on the systematicity of the child's native language. While normative data are currently not available to assess this in detail, Ani displayed no noticeable issues with the development of her native language. It is also clear that Ani did not actually learn English, although she had some exposure to it. In this case, the absence of language learning is understandable given the previous research on the amount and quality of exposure to language in a mixed environment.

3.2 CCLAS

In addition to the contribution of research on a mixed language environment, this thesis supplements the current literature on the phonological development of polysynthetic languages both within the scope of CCLAS and beyond.

The ten sessions that are the focus of this thesis are the same as those used by

Terry (2010), five of which were also used by Swain (2008). By working on the same sessions as both Terry and Swain, I provided additional information on Ani's language acquisition, this time through a systematic investigation of her phonological development. With this additional information, we are able to attain a more complete picture of Ani's overall linguistic competence, directly benefiting the CCLAS project and more importantly, our understanding of NE Cree language development. The current thesis is also, to my knowledge, the first ever to focus on the segmental development of Cree.

As mentioned in Brittain et al. (2007), one of the principal goals of CCLAS is to provide literature on language acquisition that can be accessible to the speech community for the use of education and health related practices (e.g. Speech-language Pathologists). This particular study reveals that a mixed language environment does not necessarily have a negative impact on a child's native language development. In fact, this thesis sheds light on the types of behaviour that Cree-learning children may display when assessed using diagnostic tools geared toward "official" languages such as English or French. Each time a test item focuses on a language structure that transcends that of Cree, the child is likely to under perform, something which may be problematic for referrals in both clinical and educational contexts.

4. Limitations of the Current Study

As with any study of this type, however, the results are based on the developmental pattern of just one child, and may not necessarily reflect the development of the Cree-learning population as a whole. A case-study approach to language acquisition allows us

to see how language develops for one particular child, in hopes that we can find similar trends of development in other children learning the language as well. This study is also limited to just ten sessions of data, also with a relatively low number of word productions in both Cree and English. In order to make more conclusive statements about the acquisition of the language and generalizations of language development within this type of mixed language environment, we would ideally need to conduct more studies, and also aim at a denser data sample.

5. Conclusion

In spite of these limitations, this study offers a step in the right direction to understanding the language development of Northern East Cree and of language learning in a mixed language environment more generally. The methodology employed in the data descriptions offered throughout Chapters 4 and 5, and especially the systematic separation of word productions in both languages (to get a clear picture of each acquisition pattern separately), sets the stage for further research on other comparable language learning contexts.

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