Learning English as a second language during childhood: A longitudinal case study

by

© Alysha Cooze

A Thesis submitted to the
School of Graduate Studies
in partial fulfillment of the requirements for the degree of

Master of Arts

Department of Linguistics
Memorial University of Newfoundland

September 2020

St. John’s Newfoundland

Abstract

Since the 1950s, hypotheses have been put forth to explain developmental behaviours observed during a learner's second language (L2) acquisition. Many of these hypotheses build on language transfer, which provides a basis for the explanation of many phenomena that learners exhibit during the acquisition of their L2. However, aspects of transfer have yet to be fully understood; among others, how the critical period for language acquisition affects the relationship between a learner's first language (L1) and L2 has yet to be unfolded.

Transfer effects and the critical period are indeed potentially confounded when the L2 learner is a child. Furthermore, three questions surrounding transfer still remain. These questions are as follows: What is transferred? What are the conditions for transfer? And when does transfer occur? Further, while it is commonly observed that children are more proficient than adults at language learning, debates still exist as to whether or not a critical period for language acquisition exists at all. In relation to this, there is also the debate concerning whether children introduced to an L2 early in life behave more like a first or second language learner for that L2.

This thesis describes a longitudinal corpus documenting a child named Nura, who is a L2 learner of English with Kazakh as her L1 (also with some passive knowledge of Chinese). More specifically, we focus on Nura's development of singleton onsets and onset clusters which do not occur in her native Kazakh language. The data provides evidence for relatively immediate transfer effects through her early acquisition of her singleton onsets and onset clusters. However, the developmental patterns of a number of sounds and sound combinations also point to issues in child L2 development in contexts where transfer is not possible, if only for certain phonological dimensions of the L2.

Summary

Since the 1950s, researchers have tried to explain how people acquire second languages (L2). Many of their theories build on the notion of language transfer, which suggest that L2 learners use knowledge from their first language, which in turn contributes to shaping the way they speak in their L2.

However, aspects of transfer have yet to be fully understood; among others, how the critical period, which states that there is a narrow window of time to acquire first languages, and the effects it may have on transfer, has yet to be better understood.

Transfer effects and the critical period may affect one another when the L2 learner is a child. As well, three questions surrounding the notion of transfer still remain to be explored in more detail. These questions are as follows: What is transferred? What are the conditions for transfer? And when does transfer occur? Further, while it is common knowledge that children are better than adults at language learning, there are debates concerning whether there is a critical period of language acquisition at all. In relation to this, there is also the debate as to whether children who learn a L2 early in life acquire their L2 like a first or second language learner for that L2.

This thesis describes a long term project which followed a child named Nura, who is an L2 learner of English with Kazakh as her L1. More specifically, we focus on how Nura acquired consonants and consonant clusters at the beginning of words, which are not sounds and sound combinations that exist in her L1. The data provides evidence for transfer effects in her L2. However, there are some cases where transfer does not appear to take place, as Nura shows more difficulty with certain sounds and sound combinations.

Acknowledgements

While I was able to finish a large part of my thesis before the pandemic hit earlier this year, I wrote most of my thesis at home where e-mails, text messages, and video calls became the only way to make contact with anyone outside of my small apartment. Through the big learning curve as I transitioned from in-person to online, I learned a great deal about just how important it can be to be on campus while writing a thesis and have come to realize just how many people I need to thank for the past two years.

Thank you to all my fellow grad students, for being there when we all needed a laugh or just someone to talk to when things got rough. Through the big learning curves, knowing that there was always someone there helped me through a lot of times when I felt like throwing in the towel. I'll miss all of our chats in the lab and run-ins in the halls of the science building. I wish you all the best.

A thank you to Alex, for always being in the lab and always there when I had a question. Thank you for teaching me about Phon and fixing my issues when I couldn't. Even while you may not think it, I learned a lot from your theoretical insights as well.

Another big thank-you to everyone in the Speech Sciences and Language Acquisition Laboratory (SSLA) who worked to help make the Nura corpus what it is today. I began my time in the lab with this corpus and will be ending with it. I appreciate all the work and time that went into this corpus and all the support from everyone along the way.

Thanks to everyone in the Department of Linguistics, thank you for all your teaching and guidance. I learned just how much I loved being at MUN and in the Department thanks to you all.

Thank you to the reviewers, for your thoughtful and constructive feedback. Thank you for taking the time to review my thesis during this time when changes are happening every day.

Finally, the biggest thank-you to Yvan who played many roles during my time at Memorial. Thank you for sticking with me over the past four years, through both the last half of my undergrad and the entirety of my graduate degree. Without you, I would still be trying to figure out my favourite topics in linguistics and would definitely still be using the wrong form of “it’s”. Thank you for always pushing me to do my best and then better, and being a voice of reason when things got overwhelming. Your expertise and advice is what helped get me through the past four years, so thank you for always being there as I continued, and still continue, to better myself and move on to the next chapter of my life.

Table of Contents

Abstract.....i

Summary.....i

Acknowledgements.....ii

List of Tables.....vii

List of Figures.....viii

Chapter 1: Introduction.....9

Chapter 2: Background.....12

1 Trends in L2 acquisition: Historical survey.....12

1.1 Contrastive Analysis.....12

1.2 Error Analysis.....15

1.3 Interlanguage.....17

1.4 Current approach.....18

2 Transfer.....19

2.1 What is transferred?.....20

2.2 Conditions for transfer.....21

2.3 When does transfer occur?.....24

3 Critical Period.....25

3.1 L1 acquisition and the critical period.....25

3.2 L2 acquisition and the critical period.....27

Chapter 3: Methodology for current study.....30

1 Participant.....30

2 Aspects of English phonology to be acquired by Nura.....30

2.1 Consonants in Kazakh and English.....31

2.2 Consonant clusters in Kazakh and English.....34

3 Research questions.....36

4 Data collection.....37

5 Data editing.....38

6 Data analysis.....39

7 Significance of proposed research.....39

Chapter 4: Data description.....41

1 Introduction.....41

2 The development of consonants in singleton onsets.....42

2.1 /ɹ/ in word initial onsets.....43

2.2 /θ/ in word initial onsets.....44

2.3 /f/ in word initial onsets.....45

2.4 /v/ in word initial onsets.....46

2.5 Summary of development of consonants in singleton onsets.....47

3 The development of clusters....48
3.1 Consonant+lateral clusters....49
3.1.1 /pl/ and /bl/....49
3.1.2 /kl/ and /gl/....50
3.1.3 /fl/....51
3.1.4 Summary of Cl clusters....53
3.2 Consonant+rhotic clusters....53
3.2.1 /pɹ/ and /bɹ/....53
3.2.2 /tɹ/ and /dɹ/....55
3.2.3 /kɹ/ and /gɹ/....56
3.2.4 /fɹ/....56
3.2.5 /θɹ/....58
3.2.6 Summary of Cɹ clusters....59
3.3 Consonant+glide clusters....59
3.3.1 Consonant+w clusters....60
3.3.1.1 /kw/....60
3.3.1.2 /tw/....61
3.3.2 Consonant+j clusters....62
3.3.2.1 /kj/....62
3.3.3 Summary of CG clusters....63
3.4 s+consonant clusters....63
3.4.1 /sp/....64
3.4.2 /st/....64
3.4.3 /sk/....65
3.4.4 /sm/....66
3.4.5 /sn/....67
3.4.6 /sl/....68
3.4.7 /sv/....69
3.4.8 /sw/....70
3.4.9 Summary of sC clusters....71
3.5 s+consonant+approximant clusters....71
3.5.1 /spl/....72
3.5.2 /spɹ/....72
3.5.3 /stɹ/....73
3.5.4 /skw/....74
3.5.5 Summary of sCApp clusters....75
3.6 Summary of the development of onset clusters....76
4 General summary: singletons and onset clusters....79

Chapter 5: Discussion....82
1 Singletons in onset position....82
2 Onset clusters....83
2.1 Consonant+lateral....83
2.2 Consonant+rhotic....83
2.3 Consonant+glide....85

2.4 s+Consonant.....85
2.5 Interim summary.....86
3 Implications for theories of second language acquisition.....86
4 Limitations of study.....88
5 Conclusion.....89

List of Tables

Table 1: Kazakh consonant inventory (adapted from Abuov 1994: 40).....32
Table 2: English consonant inventory (adapted from Jensen 1993: 28).....33
Table 3: Individual phones and clusters (adapted from Goad 2011: 900).....36
Table 4: Timeline of Nura's development of /ɻ/, /θ/, /f/, and /v/ (A=Approximant).....48
Table 5: Timeline of Nura's development of onset clusters.....77
Table 6: Development of singletons and clusters in onset position.....80

List of Figures

Figure 1: Syllabification and alignment in Phon (McAllister Byun & Rose 2016: 97).....39
Figure 2: Nura's /ɹ/ productions over time.....43
Figure 3: Nura's /θ/ productions over time.....45
Figure 4: Nura's productions of /f/ over time.....46
Figure 5: Nura's productions of /v/ over time.....47
Figure 6: Nura's /p/ and /b/ productions over time.....50
Figure 7: Nura's /k/ and /g/ productions over time.....51
Figure 8: Nura's /f/ productions over time.....52
Figure 9: Nura's productions of /pɹ/ and /bɹ/ over time.....54
Figure 10: Nura's productions of /tɹ/ and /dɹ/ over time.....55
Figure 11: Nura's productions of /kɹ/ and /gɹ/ over time.....56
Figure 12: Nura's productions of /fɹ/ over time.....57
Figure 13: Nura's productions of /θɹ/ over time.....58
Figure 14: Nura's productions of /kw/ over time.....61
Figure 15: Nura's productions of /tw/ over time.....62
Figure 16: Nura's productions of /kj/ over time.....63
Figure 17: Nura's productions of /sp/ clusters over time.....64
Figure 18: Nura's productions of /st/ clusters over time.....65
Figure 19: Nura's productions of /sk/ clusters over time.....66
Figure 20: Nura's productions of /sm/ clusters over time.....67
Figure 21: Nura's productions of /sn/ clusters over time.....68
Figure 22: Nura's productions of /sl/ clusters over time.....69
Figure 23: Nura's productions of /sv/ clusters over time.....70
Figure 24: Nura's productions of /sw/ clusters over time.....71
Figure 25: Nura's productions of /spl/ clusters over time.....72
Figure 26: Nura's productions of /spɹ/ clusters over time.....73
Figure 27: Nura's productions of /stɹ/ clusters over time.....74
Figure 28: Nura's productions of /skw/ clusters over time.....75

Chapter 1: Introduction

The relationship between a multilingual speaker's first and second languages (henceforth L1 and L2) has become a research focus starting around the 1950s. This was propelled by early questions in modern linguistic research about the origin of linguistic knowledge, and in light of obvious behavioural differences between child (L1) and adult (L2) learners. Several hypotheses have been put forth since, for example concerning language transfer effects as well as critical periods in language acquisition.

Language transfer, a topic specifically relevant to L2 acquisition research, provides a basis for the explanation of many phenomena that learners exhibit during the acquisition of their L2. However, not all aspects of transfer are understood, and three main questions continue to prevail, namely: What is transferred? What are the conditions for transfer? And when does transfer occur? Further, the literature on non-humans and humans provides evidence for biologically determined critical periods for aspects of development, including L1 and L2 development. While it is commonly observed that children are much more proficient than adults at language learning, debates remain about the theoretical notion of a critical period for language acquisition overall. Aside from this debate, and coming back to L1 versus L2 acquisition, it is also not clear whether child second language learners, namely children who are introduced to an L2 early in life, behave more like first or second language learners of that L2.

Despite the fact that such questions are central to a growing segment of our population, especially given the rise in immigration seen over the last few decades, empirical studies on the topic are limited in number and typically look at L1s and L2s from "European"

languages. In addition, very few of these studies follow a longitudinal design, which is central to the tracking of developmental patterns over time, and even fewer provide documentation of the earliest steps in L2 development. The current study offers a contribution in both of these respects.

In the chapters that follow, we discuss a new longitudinal case study of the L2 acquisition of English by an L1 child speaker of Kazakh named Nura. We focus primarily on the issue of transfer as observed in the phonological productions of this child. Specifically, we focus on Nura's L2 development of English consonants and consonant clusters in syllable onsets. As we will see, transfer effects manifest themselves from the very beginning of the period covered by the corpus period. As well, the rate of Nura's acquisition of consonant clusters suggests a positive effect of her still being within the critical period for first language acquisition.

The thesis is outlined as follows: In Chapter 2, we begin with a review of the four main trends in L2 acquisition research since the 1950s that have focused on the relationships between second language learners' L1s and L2s. As part of this survey, we discuss the notion of transfer in more detail, in particular the three main questions surrounding it mentioned above. Following this background, we introduce the current study in Chapter 3, including a summary description of the Kazakh language and of the similarities and differences between the Kazakh and English phonological systems, focusing on the subset of English consonants and consonant clusters that are at the centre of our analyses. In Chapter 4, we describe in detail Nura's development of English consonants and consonant clusters. Lastly, in Chapter 5, we discuss the main developmental trends

we observe in the data, as well as a number of implications for current models of L2 acquisition.

Chapter 2: Background

In this chapter, we summarize the literature relevant to the current study. The chapter begins with a historical survey of the main trends in L2 acquisition studies, starting around the middle of the 20th Century. It should be noted that it is difficult to pinpoint when L2 acquisition research emerged as its own field of study, due to the fact that it was considered interdisciplinary until the beginning of modern linguistics in the 1950s (Gass & Selinker 2008). Some researchers discuss L2 acquisition studies beginning later, around the 1970s (Braidi 1999). The following sections focus on three main frameworks: Contrastive Analysis, Error Analysis, and the Interlanguage approach. We then discuss how these frameworks formed the basis for the general approach used in contemporary studies, which embraces at its heart the notion of transfer. Next we turn our focus to the three questions about transfer that are central to debates in modern research on L2 acquisition. Finally, because of its general relevance to studies in L2 acquisition during childhood, we touch on the issue of critical periods for first and second language acquisition.

1 Trends in L2 acquisition: Historical survey

1.1 Contrastive Analysis

Linguistic analyses of the 1950s to 1970s were primarily influenced by structural linguistics and behavioural psychology. Structural linguistics was concerned with the description of patterns and related structures within language systems, with an emphasis on the identification of linguistic structures and their distributions (Braidi 1999). In the context of L2 acquisition studies, this gave rise to the Contrastive Analysis

framework (CA), which was used extensively during this period as a way to explain what language teachers were seeing within the second language teaching classroom (Major 2008). CA was based on the hypothesis that all errors produced by L2 learners were the result of transfer, also called *interference* (e.g. Lado 1957), from the learner's first language to their second (Major 2008). In their historical review of the field of Applied Linguistics, Els et al. (1984: 38) outline the three main objectives of CA:

- To provide insight into the similarities and differences between languages
- To explain and predict problems L2 learners may have given their L1
- To help develop teaching material for teachers of languages

Some well known examples of CA come from the early works of Fries (1945) and Lado (1957). For example, Fries (1945) explains, in his work on teaching and learning English:

> [...] the modern scientific study of language has within the last twenty years developed special techniques of descriptive analysis by which trained linguists can efficiently and accurately arrive at the fundamentally significant matters of structure and sound system amid the bewildering mass of details which constitute the actual rumble of speech ... [Contrastive Analysis] can provide a thorough and consistent check of language material itself and thus furnish the basis for the selection of the most efficient materials to guide the efforts of the learner. (Fries 1945: 5)

In spite of the advances CA enabled, this approach suffered from important shortcomings. Firstly, CA could not capture the fact that not all L2 learners make the same errors as those predicted by L1-L2 structural comparisons. Secondly, while CA could explain errors in a probabilistic sense, it could not predict what aspects of the

target language would be more or less difficult for learners to acquire (Major 2008). In a paper on learner errors, Corder (1967) states that the CA approach was too limited in that it merely confirmed what teachers already knew from being in the classroom, and that it focused on teaching rather than on actual learning. Finally, CA did not focus on other factors which may affect a L2 learner's performance such as communication strategies and overgeneralization errors (Khansir 2012). For example, Stockwell & Bowen (1965) list and explain all consonants and consonant sequences in English that can cause misunderstanding or may be of issue to a Spanish L2 learner of English. However, they are unable to state exactly what errors learners may make or in what proportion. In the same vein, Stockwell & Bowen state that one of the major problems in L2 learning is the interference from the learner's L1. They document examples of each type of transfer (positive, negative, and zero transfer). However their work only opens the door towards addressing the conditions needed for each type of transfer to occur.

More generally, researchers working within the CA framework also began to notice that learners with different first languages made similar errors during the acquisition of their L2, something that CA could not account for (Braidi 1999). As a result of the issues and limitations inherent to the CA approach, Braidi (1999) states:

> Learner's errors came to be viewed as an indication of the learning process rather than as evidence of bad language habits and thus became the new focus of L2-acquisition research. (Braidi 1999: 11)

L2 learners' errors eventually took centre stage, and Error Analysis was introduced as a new approach toward understanding L2 acquisition, as we discuss in the next section.

1.2 Error Analysis

Error Analysis (EA) was introduced in the 1960s and prevailed in the field of L2 acquisition research until the first half of the 1970s. As outlined by Schachter (1974), there were two main assumptions behind EA. The first was that every analysis should reveal what difficulties learners experience during the acquisition of their L2, as the difficulties in the target language must reveal themselves as errors in the L2 learner's productions. The second assumption was that the frequency of certain errors in the learner's productions should provide evidence of difficulty with particular areas of the target language.

To further understand L2 errors, researchers began to classify types of errors that learners made during the acquisition of their L2. Richards (1974) classified them into three types: interference errors, intralingual errors, and developmental errors. Interference errors are caused by the structure of the learner's native language; intralingual errors are caused by the structure of the target language; and developmental errors are caused by strategies that the learner uses in order to acquire the target language. In his contemporary review of EA, Richards (2013) further subdivides intralingual errors into two types: overgeneralizations (errors causes by extensions of the target language rules) and simplification (errors caused by the learner producing simpler linguistic rules than those in the target language).

One of the key findings from the EA literature is that learners from different L1 backgrounds often make similar errors if they are learning the same L2 (Braidi 1999: 11). For example, two L2 learners of English coming from different L1 backgrounds may both

overgeneralize and use the regular past tense marker in all cases that involve past tense, even on verb forms that do not take the regular past tense marker.

However, like CA, EA proved to be too limited to explain every type of error patterns. Among other issues, this approach made no provision for avoidance phenomena, which result from the learner's inability or unwillingness to use certain structures in the target language. There was also no recognition of an interlanguage within the EA framework, and so the interaction between the learner's L1 and L2 was not considered as a source of explanation (Braidi 1999; Khansir 2012). Because of issues such as this, Schachter & Celce-Murcia (1977) argued that it was not enough to solely analyze errors in isolation; a solution to this was to analyze all contexts where errors and correct forms were used by the learner. Doing so would allow the researcher to fully understand the unfolding knowledge of the L2 learner.

Despite their differences, both CA and EA shared one basic assumption for L2 acquisition, "[...] the view that the learner's developing system was in some way flawed because it did not conform with the rules of the target language" (Braidi 1999: 13). This assumption placed blame on the L2 learner's developmental systems for producing errors during acquisition. However, as can be seen through longitudinal studies, L2 learners improve over time as they continue to acquire aspects of the target language (e.g. Lennon 1990; Yamaguchi & Kawaguchi 2014). This resulted in questions about the nature of the L2 learner's developmental system over time, which ultimately led to the Interlanguage approach, to which we turn to next.

1.3 Interlanguage

The Interlanguage (IL) approach came about in the 1970s and gradually dislodged EA as the leading approach to L2 acquisition by the early 1980s. This new approach led scholars to examine how a learner's developing grammar functions as a separate system (Braidi 1999). Under the IL approach, learners build a system for themselves which is different from both their L1 and the target L2; the interlanguage is seen as a separate linguistic system which results from a partial learning of the target language (Khansir 2012). As stated by Selinker (1972), interlanguages are thus expected to exhibit five central processes: language transfer, transfer of training, strategies of L2 learning, strategies of L2 communication, and overgeneralization of target rules or structures.

Within this approach, the IL has always been considered to be a natural, grammatical language (Braidi 1999). Adjemian (1976) states that the IL is a natural language which is constrained by a system of linguistic rules, exhibiting internal consistency. However, these rules may change over time, as the learner makes progress towards the target language. As well, different researchers have since uncovered further properties of ILs (Khansir 2012). For example, Eckman (1991) argues that ILs are languages themselves and that linguistic universals are completely universal in that they apply to non-primary languages, such as ILs, in the same way as they apply to primary languages.

However, as discussed by Jie (2008), the IL approach also suffers from a number of shortcomings. The first criticism is that there does not appear to be a clear definition of IL in second language acquisition studies. This issue was also noted by Spolsky (1989), who highlights a tendency to confuse IL with basic models of linguistic competence.

Stemming from this is the more general issue that there are no clear research methods to study ILs, as analyses within this framework were done mainly through the comparison of target language norms, which sometimes obscured aspects of the IL (Jie 2008).

1.4 Current approach

Building on this background, and especially the advances in L2 acquisition research since the 1970s, the current approach to study the relationship between a learner's L1 and L2 generally consists of EA interpreted within the IL framework. In the 1980s, new questions arose concerning the relationship between L1 and L2, for example whether or to what extent one can compare L2 to L1 acquisition. This is particularly important given the IL approach, which embraces at its core the possibility that patterns in L2 acquisition reveal universal properties of language acquisition, in addition to language-specific conditioning factors (Braidi 1999). As a result of this development, an interlanguage can be defined as follows:

(1) An IL is a series of grammars independent yet related to L1 and L2, which exhibits internal consistency and grammatical steps which abide by universal linguistic properties (adapted from Braidi 1999: 13).

The IL approach thus incorporates every grammar that transfers between a learner's L1 and L2, with an emphasis on how the learner's L1 affects performance in their L2. How transfer effects should be analyzed is also subject to debate, however, as we discuss next.

2 Transfer

The research summarized above clearly suggests that there is a relationship between a learner's L1 and their L2. It is also uncontroversial that transfer drives particular aspects of this relationship. For instance, prosodic transfer can explain significant aspects of an L2 speaker's accentedness concerning stress patterns, to cite an obvious example. Whether transfer takes place at the level of grammatical competence or more superficial levels of linguistic performance, and in what areas of grammar or language production, is however subject to theoretical debate. We begin with a definition of transfer often cited:

(2) Transfer is the influence resulting from similarities and differences between the target language and any other language that has been previous acquired (Braidi 1999: 41, from Odlin 1989: 27).

There is evidence that transfer has an effect on a learner's L2 in the area of rule acquisition, in biasing the learner toward avoidance of given structures, because of basic use or influence of L1 characteristics (Braidi 1999). It has also been noted that some transfer effects are very salient while others can be very subtle and thus difficult to determine (Major 2008). However, there is still much to understand about transfer, since it can itself arise from so many different sources during the course of L2 acquisition.

As already mentioned, three key questions are at the centre of current debates: What is transferred? What are the conditions needed for transfer? And when does transfer occur? In the following subsections, we discuss these questions and the evidence that researchers put forth in an attempt to answer them. For sake of clarity, and in line with

the general orientation of this thesis, we restrict this discussion to phonological development only.

2.1 What is transferred?

Concerning the phonological and phonetic development of an L2, in terms of what is or can be transferred, we must first make a distinction between abstract-level versus surface-level phenomena. Abstract-level transfer typically refers to the deeper levels of grammatical learning, such as prosodic constituency and phonological features, and is concerned with the study of phonology (e.g. the types of syllable constituents allowed in the L1 versus the L2). Surface-level transfer refers to what can be directly observed on the surface (what the learner actually produces phonetically) and is concerned with the study of phonetics (Major 2008).

The debate on what can be transferred from one's L1 to their L2 falls on a continuum, one extreme position being that everything is transferred from the learner's L1 to their L2, a position made explicit in the Full Transfer, Full Access model of L2 acquisition (FT/FA; Schwartz & Sprouse 1996), which is discussed below in section 2.2, and the other extreme stating that only some aspects of a learner's L1 may be transferred, as is argued by the Weak Transfer Hypothesis (Eubank 1993) and the Minimal Trees Hypothesis (Vainikka & Young-Scholten 1994). For example, this latter hypothesis holds that the initial state of the L2 lacks functional categories and only consists of lexical categories, which are assumed to be transferred from the L1. In contrast to this, the Weak Transfer Hypothesis states that both functional and lexical categories are present

at the initial state of the L2, but the initial representations are missing fully specified feature values.

More generally, researchers in L2 acquisition typically view units that are considered to be transparent to the learner and structures that are similar from a learner's L1 to their L2 to be the most likely to be transferred (Braidi 1999). This captures the essence of the Speech Learning Model (SLM) by Flege (1987), which states that an L2 learner will modify L1 categories for similar phonemes found in their L2, whereas, if there are no similar categories between the L1 and L2, the learner will have to create a new category, a process which, in turn, is influenced by time and input factors from the L2. On the one hand, similar categories may be seen as aspects which are transferrable from the learner's L1 to their L2. On the other hand, new categories may be either the result of structures which the learner is unable to transfer from their L1, or arose from perceptual limitations on the learner's part, making them unable to distinguish possibly similar sounds across their L1 and L2. However, as noted earlier, it often remains difficult to predict exactly what can and cannot be transferred, as some transfer effects are more salient than others (Braidi 1999).

2.2 Conditions for transfer

Beyond the question as to what can be transferred, the conditions for transfer to take place appear shrouded in the most mystery. Understanding the conditions for transfer could result in many breakthroughs for language learning and help researchers understand how transfer actually operates (in the learner's mind). Many theories have been proposed to explain the conditions needed for transfer. For example, two opposing

hypotheses on conditions are the Transfer to Somewhere principle (Andersen 1983) and the Transfer to Nowhere principle (Kellerman 1995). The Transfer to Somewhere principle states that there has to be corresponding structures in the L1 and in the L2 in order for transfer to occur. This predicts that English speakers would not transfer over English sounds when they try to produce non-English sounds (Andersen 1983). In contrast to this, the Transfer to Nowhere principle predicts that English speakers may transfer English sounds when trying to produce non-English sounds (Kellerman 1995). Kellerman (1995) further explains that Andersen's principle would have to be modified to take into account the fact that any previously acquired language that can be used by the learner is a starting point for transfer, even in cases when the learner has not fully mastered that previous language. Finally, the Speech Learning Model (Flege 1987) embraces transfer at its core, at least for all sounds in the L2 that are considered similar to categories existing in the leaner's previously acquired phonological categories.

The issue of conditions needed for transfer also concerns the notion of Universal Grammar (UG; Chomsky 1957) and the initial state of the learner's L2. Some researchers argue that the initial state of the L2 is the end state of the L1 at the time when the learner engages in the acquisition of a new language (Eubank 1993; Vainikka & Young-Scholten 1994; Schwartz & Sprouse 1996), while others argue that the initial state of the L2 is UG and that L2 acquisition can occur without transfer (Epstein, Flynn & Martohardjono 1998; Hawkins & Chan 1997). In this latter case, the initial state for the L2 learner would be more closely similar to that of an L1 learner (Major 2008). Connected to these hypotheses is a consideration for access to UG (the way that L1 learners have access to it in theory) or whether the L2 learner must acquire their new

language based solely on transfer. Assuming the learner has access to UG, can this access affect transfer from the learner's L1 to their L2? If UG is accessible, then transfer may or may not operate. On the other hand, if UG is inaccessible, then it implies that transfer from the L1 would be the main factor governing the process of L2 acquisition (Major 2008). Different views on these possibilities range from full access, to partial access, no access, and indirect access. The FT/FA model, as previously mentioned, states that the learner transfers all aspects of their L1 which are compatible with their L2, and also has full access to UG, while Schachter (1988) argues for only partial access, claiming that adult L2 learners can access the parameters of all grammars but they cannot set or reset them. This last argument is evidenced through the Fundamental Difference Hypothesis (Bley-Vroman 1989), according to which L2 learners do not have direct access to UG and therefore must rely on their UG-derived L1 grammar in order to acquire their L2.

According to Major (2008), despite the sizeable amount of research on the relationship between transfer and the accessibility of UG, many questions remain. For example, White (2003) weighs in on this issue by noting that the effects of a learner's L1 are very seldom noticed outside of their speech accents, even in the early stages of acquisition. This latter observation also highlights that transfer might manifest itself in different ways across different aspects (e.g. phonological, morphological, syntactic) of the learner's L2. Therefore, the question of conditions for transfer is difficult to address in part because of issues related to the interpretation of the evidence available to the researcher.

2.3 When does transfer occur?

The question as to when transfer actually takes place depends, for the most part, on the different views of transfer summarized above. For example, according to the FT/FA model, transfer would be expected at the initial state of the L2 when the learner transfers all knowledge of their L1 to their L2 (Major 2008). The same holds true of other theories such as the Minimal Trees Hypothesis, the Weak Transfer Hypothesis, and the Speech Learning Model more generally. Some studies also suggest that linguistic transfer occurs at the same time as transfer from implicit to explicit phonological abilities (Janssen et al. 2017). In sum, all theories that build on transfer claim that the elements they allow to transfer are available at the beginning of the L2 acquisition process, and that transfer effects decline gradually until the learner becomes advanced or native-like in their L2. It should be noted, however, that the question as to when transfer occurs has not received as much attention compared to what can be transferred or the conditions for transfer to happen in the first place.

Finally, questions arise when we consider the age at which a learner begins to acquire a second language. Among other questions, if a person is exposed to their L2 during childhood, does this affect the process of transfer? And is access to UG more favourable at an earlier age? In the following section, we discuss critical periods and how age may factor into L2 acquisition.

3 Critical Period

3.1 L1 acquisition and the critical period

Research has shown that there are critical periods affecting both humans and non-humans for different aspects of cognitive and physiological development. For example, there is evidence for a critical period in cats concerning their perception of orientation specificity with horizontal and vertical stripes. In a study by Blakemore & Cooper (1970), researchers separated young kittens into two groups, those exposed to only vertical stripes and those exposed to only horizontal stripes. After the cats were allowed to roam free, Blakemore and Cooper found that the cats raised in the horizontal-striped environment were blind to the vertical stripes; they could see a chair and jump on it but could not see the legs of the chair and would run into them. The opposite was also true for the cats raised in the vertical-striped environment. Another example comes from songbirds. Songbirds have songs that are specific to their species, which they learn before they reach adulthood. However, if learning is compromised during the critical period, then the songbird will never fully acquire the song of its species (Mori & Wada 2015).

Turning the focus back to language acquisition, one well-known study for both linguists and psychologists is that of a girl named Genie, who was deprived of both language and social interactions until she was found at thirteen years of age. Despite efforts toward rehabilitation, Genie was never able to fully acquire a first language. However, other factors related to Genie's upbringing such as nutritional, cognitive, and social deprivation put into questioning whether or not her difficulties with learning a first language resulted

from the absence of early linguistic input or a combination of other non-linguistic factors (Johnson & Newport 1989).

Other studies by Newport (1984) and Newport & Supalla (1987) focused on congenitally deaf populations and their acquisition of American Sign Language (ASL). In these populations, for which aspects of social and cognitive development remain relatively constant, exposure to a first language may occur at varying ages. In Newport & Supalla's (1987) study, participants were grouped depending on the time of their first exposure to ASL. Those who had been exposed to ASL from birth by their deaf parents were named the native learners. Those who were exposed between 3 and 6 years were named early learners. Those who were exposed at 12 years or older were named late learners. Newport and Supalla found a linear decline in performance and comprehension of ASL verb morphology as age of first exposure increased. In other words, the native learners were better on performance and comprehension than the early learners, who were in turn better than the late learners. This study suggests that there is a critical period for gaining an L1, but that performance decreases gradually as the person's age increases; there is no indication of a "drop off" in performance at any given age, as previously argued by Lenneberg (1967).

In summary, studies of L1 acquisition suggest a critical period for learning an L1. However, as suggested by Johnson & Newport (1989), there is no obvious cut-off point for this time period; learning abilities decline over time as the learner matures. Johnson & Newport also suggest that while a person exposed to language for the first time at or after puberty only may still be able to gain some language skills, they will never reach

the same proficiency as a native learner, or possibly, even an early learner of that language.

3.2 L2 acquisition and the critical period

The proposal of there being a critical period for L2 acquisition is still a highly debated topic. Lenneberg (1967) was the first to propose a critical period for language acquisition, specifically for first language learners. If the critical periods were similar for L2 acquisition as they are for L1 acquisition, then, according to Lenneberg, there should be an abrupt cut-off point after which learners would no longer be able to attain a second language. According to Johnson & Newport (1989), this abrupt ending, which Lenneberg states would be at the onset of puberty, is not quite correct. As discussed above, Johnson & Newport proposed a different characterization of the critical period. They tested two hypotheses, the Exercise Hypothesis and the Maturational Hypothesis. The Exercise Hypothesis builds on a “use it or lose it” logic in that as long as a person exercises their language abilities they will always be able to learn a new language; under this hypothesis age is not a determining factor. The Maturational Hypothesis states that, over time, a person will lose their language learning abilities regardless of whether they exercise them or not. Johnson & Newport found in their study on 46 native Korean and Chinese learners of English as an L2 that the maturational hypothesis draws the most support from their data, consistent with other studies as well (e.g. Newport 1984). In this view, the critical period does not abruptly end; it is best described as a gradual decline, which Johnson & Newport (1989) suggest begins earlier than puberty. As well, while there is an overall decline in learning performance, it does not

mean that a late learner cannot acquire an additional language; rather it simply means that this learner may never attain native-like proficiency in this new language.

Studies of the critical period hypothesis have also supported the notion that the critical period affects formal properties (e.g. phonology, morpho-syntax) of language learning more than those associated with meaning (Newport, Bavelier & Neville 2001). There is also the suggestion that there are multiple critical periods since researchers in other disciplines have found evidence suggesting multiple critical periods in different aspects of development (e.g. in the human visual system, the development of acuity, orientation, stereopsis, and photopic vs scotopic vision; Harwerth et al. 1986). In the language acquisition literature, we also find suggestions about multiple critical periods (e.g. Flege, Yeni-Komshian & Liu 1999; Hurford 1991; Long 1990), namely different periods of time for a learner to fully acquire the phonology of the language versus its syntax, and so on. However, this research has been inconclusive about when these critical periods may end, or what exact aspects of the learner's grammar they may affect (Newport, Bavelier & Neville 2001). More generally, these empirical questions may be shrouded by the fact that there is variability between learners and that no two learners learn the same language in exactly the same way.

Finally, hypotheses about the critical period have ties to the issue of access to UG. Questions include whether access to UG is affected by the critical period, or whether the critical period affects access to UG as a whole or only parts of it, and when. As described earlier, many hypotheses have been proposed which fall along a wide ranging continuum. However, if the L2 learner is a young child, it may be assumed that they have access to UG (compared to an adult L2 whose access to UG is still largely

debated) since, depending on the age of onset of their L2, they may still be in the process of acquiring some aspects of their L1.

In summary, studies have evidenced effects of age on native-likeness in second language acquisition, with potential to attain native-like proficiency starting to decline before puberty. Researchers have thus come to conclude that while acquiring a second language is possible at any age, native-like abilities are most attainable for learners who begin learning their second language during childhood. In the chapter below, we investigate these general issues from the perspective of child L2 phonology development. However, as mentioned in the introduction, given the young age of the participant in my case study (described below), we do not directly address issues directly relevant to the critical period hypothesis, the study of which would ideally require comparisons with older learners. Rather we focus on potential transfer effects such as those summarized in section 2 above. In the next chapter, we outline the method proposed for the current research.

Chapter 3: Methodology for current study

The research outlined in this chapter builds on a case study of a young child named Nura, a native speaker of Kazakh who began learning English during her childhood. Nura was recorded during her acquisition of English for the first two years starting almost immediately after her arrival to an English-speaking community. For the current study, we analyze Nura's development of English phonological structures, more specifically, her acquisition of English consonants and consonant clusters which either do not belong to the Kazakh system or display a different distribution in Kazakh than in English.

1 Participant

Nura is from the Xinjiang Uyghur Autonomous Prefecture, a province in China which lies next to the border of Kazakhstan and is home to many Kazakh speakers. Nura moved to Canada when she was three years and eleven months (3;11) and almost immediately began recordings with the caregiver who is an adult native speaker of English with no knowledge of the Kazakh language. As Nura lived in a province of China, we assume she had exposure to the Chinese language, and thus may have had passive knowledge of Chinese at the time she moved to Canada. However, when she arrived to Canada, Nura was best described as a monolingual speaker of Kazakh.

2 Aspects of English phonology to be acquired by Nura

In order to set the acquisition challenge for Nura, we must first describe the sounds and sound combinations of English that fall outside of Nura's native phonological system. In

this section, we introduce the information relevant to both Nura's first and second languages, Kazakh and English, and focus specifically on consonants and consonant clusters of English which are not part of the Kazakh system.

2.1 Consonants in Kazakh and English

Kazakh is the official language of Kazakhstan, spoken by approximately nine million speakers. Kazakh is also a minority language in many countries including Uzbekistan, Kyrgyzstan, Mongolia, Russia, and China (Abuov 1994). Kazakh was not a written language until it adopted the Arabic orthography in the early 20th century, which was shortly after abandoned in favour of the Cyrillic system, after 1920 (Csató & Johanson 1998).

Kazakh is often described along two distinct dialects, the Western and the Eastern dialect. The Western dialect is considered to have 21 consonants, while the Eastern dialect arguably has 23 consonants. This discrepancy arises from the fact that Kazakh has integrated many loanwords from Arabic and, more recently, Russian and, as a result, imported a few phones into the consonant inventories of some of its regional dialects. In the table below, we provide the Kazakh consonant inventory, including the loan phones which occur in either or both the Western and Eastern dialects, underscored in Table 1 (Abuov 1994).

	Labial	Labio-dental	Alveolar	Post-alveolar	Palatal	Velar	Uvular	Glottal
Plosive	p, b		t, d			k, g	q	
Nasal	m		n			ŋ		
Fricative		f̲, v̲	s, z	ʃ̲, ʒ̲	ɕ̲	χ		h
Affricate			ʦ	(ʧ̲)[1], ʤ̲	ʨ̲			
Lateral			l					
Rhotic			r					
Glide	w				j			

Table 1: Kazakh consonant inventory (adapted from Abuov 1994: 40)

As we will see next, the Kazakh consonant inventory shares many similarities with that of English. However there are some differences, which form part of the basis for the current study. A basic comparison of the Kazakh consonant inventory with that of English reveals that, for example, English does not have the uvular stop [q] nor the alveolar trill [r] in its inventory; on the other hand Kazakh does not have the dental fricatives /θ, ð/ nor the rhotic approximant /ɹ/, while the status of the consonants underscored in Table 1 remains uncertain.

1 The status of [ʧ] is still a topic of debate in Kazakh. It has been classified as a Russian loan phone which researchers have stated has been reduced to [ʃ] (Vajda 1994). Other scholars include both [ʃ] and [ʨ] in the inventory of Kazakh (e.g. Dotton & Doyle Wagner 2018).

The English consonant inventory is illustrated in Table 2.

	Labial	Labio-dental	Dental	Alveolar	Retroflex	Post-alveolar	Palatal	Velar	Glottal
Plosive	p, b			t, d				k, g	
Nasal	m			n				ŋ	
Fricative		f, v	θ, ð	s, z		ʃ, ʒ			h
Affricate						ʧ, ʤ			
Lateral				l					
Rhotic					ɹ				
Glide	w						j		

Table 2: English consonant inventory (adapted from Jensen 1993: 28)

To further illustrate the differences between the English and Kazakh consonant inventories, we briefly discuss the consonants that occur in English but not in Kazakh, namely, the retroflex approximant /ɹ/, and the interdentals /θ, ð/. We also discuss the labial fricatives /f, v/, as they pertain to this study.

Firstly, both English and Kazakh display rhotics. However, while the rhotic of English is the retroflex approximant /ɹ/, the rhotic of Kazakh is the trill /r/, which is audiotorily and articulatorily different from /ɹ/, a coronal retroflex approximant that also comes with a certain degree of labiality. This labiality of /ɹ/ has been analyzed as an enhancement feature on the retroflex articulation (Ladefoged & Maddieson 1996; Keyser & Stevens 2006; Stevens & Keyser 2010). English /ɹ/ occurs in word-initial onsets and within consonant clusters in words like “right” and “bread”, while Kazakh /r/ rarely occurs in word-initial positions (Muhamedowa 2016). Secondly, the consonants /θ, ð/ are found in English onsets in words such as “thought” and “though” but they do not occur in the Kazakh language. However, /ð/ frequently occurs in function words such as “the” and

“this” and does not participate in onset clusters, whereas /θ/ does. For these reasons, we will be ignoring /ð/ in the current study.

Finally, as already mentioned, /f, v/ are not native Kazakh phones, as also indicated in Table 1. Beginning with /f/, this consonant is mostly found in loanwords from Russian and English, as well as Persian-Arabic words and names (Dotton & Doyle Wagner 2018). During the first decade of language contact, monolingual Kazakhs would substitute /p/ for /f/, whereas Russian dominant bilinguals retained /f/ in their speech. However, since then, bilingual Kazakhs have come to retain /f/ in their speech (Muhamedowa 2016). Moving on to /v/, this consonant it is also found in loanwords from Russian and can be an allophone of /p, b/ in intervocalic positions. Like /f/, bilingual Kazakhs retain /v/ in their speech (Dotton & Doyle Wagner 2018). Since /f, v/ are considered to be more recent loan phonemes from other languages, they are included in the current study. It should be noted, however, that Nura had no exposure to these phonemes from her dialect of Kazakh and, instead, was exposed only to /f/ through her passive knowledge of Chinese (/v/ is not a phoneme of Chinese and so we assume she did not have any exposure to this phoneme).

2.2 Consonant clusters in Kazakh and English

The Kazakh basic syllable is maximally CVC(C). The phonological system of Kazakh does not allow for clusters in word- or syllable-initial positions (Vajda 1994). The distribution of certain consonants is also restricted in word-initial onsets. For example the velar nasal /ŋ/ never occurs in word-initial position, and the liquids /l/ and /r/ occur word-initially only very rarely. In these cases, the word-initial liquid is often preceded by

an epenthetic vowel (Vajda 1994). Similarly, the absence of consonant clusters word-initially in Kazakh is such that if a consonant cluster is formed between two words (e.g. a word ending with a consonant followed by a word starting with another consonant), then an epenthetic vowel is generally produced between the consonants, for example, in the word *class,* a vowel is epenthesized between the first two consonants, класс |klas|→[kəlas] (Vajda 1994). While consonant clusters may be found in word-final position, these clusters are rare and typically arise from suffixation. Word-medially, hetero-syllabic clusters are attested. They are found mostly at morpheme boundaries and include a maximum of two consonants (Dotton & Doyle Wagner 2018). In order to control for these types of factors (i.e. potential occurrence of rare final clusters; the possibility of word-medial clusters), we restricted the current study to the word-initial context, for both individual consonants and consonant clusters.

In comparison to Kazakh, English displays a rich series of clusters word-initially (in addition to word-medial and word-final positions), including obstruent+approximant, s+consonant, as well as tri-consonant clusters. From these comparisons between the Kazakh and the English phonological systems, and focusing on the word-initial position, we arrive at a series of phonological contexts that Nura had to acquire in her second language. We summarize these in Table 3:

	Type	List
Individual phone	Labiodental	f, v
	Interdental	θ
	Retroflex rhotic	ɹ
Onset cluster	Obstruent + l	bl, pl, kl, gl, fl
	Obstruent + ɹ	bɹ, pɹ, tɹ, dɹ, kɹ, gɹ, fɹ, θɹ
	Obstruent + w	tw, dw, kw, gw
	sC($C_{Sonorant}$)	sm, sn, sl, sw, sp, st, sk, spl, skl, spɹ, stɹ, skɹ

Table 3: Individual phones and clusters (adapted from Goad 2011: 900)

In the analyses below, we focus primarily on Nura's acquisition of these phonological units, from the earliest recordings of her attempting word forms containing them in her L2 speech.

3 Research questions

Building on this background, our preliminary research questions are as follows:

(3) How did Nura acquire the individual English phones in word-initial onsets which are not part of the Kazakh inventory?

(4) How did Nura acquire the English onset clusters?

We address these questions through the longitudinal tracking of Nura's performance on the production of the phones and clusters listed in Table 3. In our interpretation of these results, we address questions concerning transfer previously mentioned in section 2, more specifically whether Nura transferred aspects of her L1 Kazakh to her L2 English; if so, what particular aspect(s) of her L1, and whether this yielded negative or positive

outcomes in her acquisition of English phonology. We provide more detail about data collection in the next section.

4 Data collection

The data consist of digital audio-video recordings. Nura began her interactions with a native English-speaking caregiver within 10 days after her arrival to Canada. This caregiver was Nura's main source of English-language interactions inside her home. Nura was first recorded within her home and, at a later stage, within a lab setting, for approximately two years and four months. During these recordings, there was little interruptions from other speakers (e.g. Nura's mother) and the caregiver would only speak to Nura using English while reading books and playing games. Early recordings consist mostly of the caregiver and Nura reading children's books (e.g. "Brown Bear, Brown Bear, What Do You See?") and Nura repeating single-word utterances and simple sentences produced by the caregiver (e.g. names of colours and shapes). Later recordings show increasingly more spontaneous speech by Nura with little prompting from the caregiver. Books and games were still used in the later recordings but Nura would be gently encouraged by the caregiver to narrate the books aloud by herself. The last recording of Nura's productions was taken when she was 6;03.

This research has received approval from the Interdisciplinary Committee on Ethics in Human Research at Memorial University as part of the project 20170104-AR "Factors influencing phonological development: A cross-linguistic, cross-learning context empirical study" directed by Dr. Yvan Rose.

5 Data editing

Once the recordings were completed, they were incorporated into a Phon database for editing (Rose et al. 2006; Rose & MacWhinney 2014), in which they were segmented and transcribed (orthographically and phonetically) by native speakers of English working in the Speech Sciences and Language Acquisition Laboratory at Memorial University. The corpus has been fully transcribed and edited. The final step in this process is for syllabification and alignment to be verified before data preparation is completed. Phon relies on specialized algorithms that assign annotations about the syllable position of each phone represented in the phonetic transcriptions, and also draw phone-by-phone alignments between the target and corresponding actual forms. This alignment between the target and actual forms occurs automatically through probabilistic analyses of the transcriptions. As a result, actual forms which do not reflect the target forms may be aligned incorrectly and require manual adjustment. Figure 1 below illustrates the interface to verify these syllabification and alignment annotations.

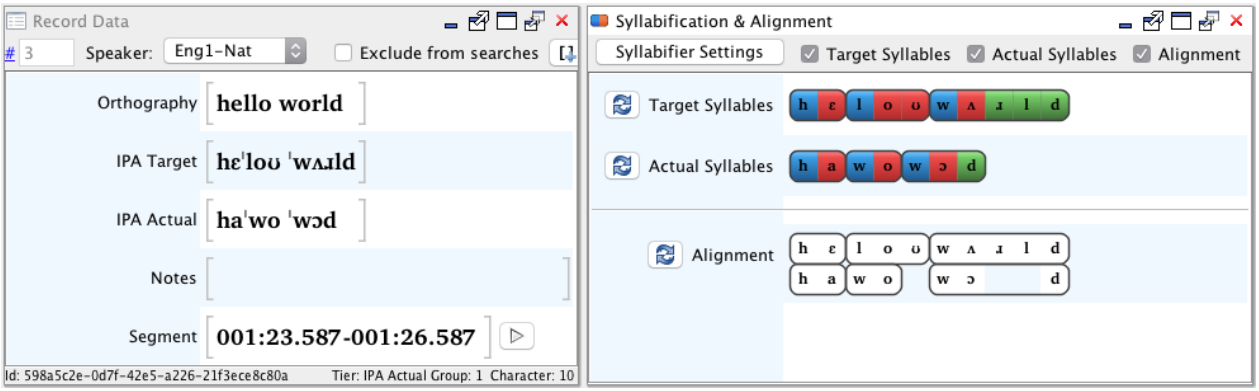


Figure 1: Syllabification and alignment in Phon (McAllister Byun & Rose 2016: 97)

6 Data analysis

Focusing first on Nura's development, in syllable onsets, of the English consonants which do not occur in Kazakh, as listed in Table 3, we determined whether Nura had all the "building blocks" available in her segmental language inventory to engage in cluster production. Building on this foundation, we then looked into Nura's production of consonant clusters in word-initial positions, also listed in Table 3.

We used the query and reporting functions in Phon in order to study each of the consonants and clusters. We then characterized these data through qualitative descriptions and descriptive statistics (e.g. overall accuracy; deletion or substitution patterns), from which we could create a detailed timeline of Nura's development over the documented period.

7 Significance of proposed research

The scientific literature on language acquisition, both in L1 and L2 contexts, focuses mainly on languages such as Dutch, French, German, Portuguese, Russian, Spanish, or Asian languages (e.g. Chinese, Japanese, Korean) as the learner's L1, and English as

their L2 (e.g. Genesee 1989; Barlow 2002; Ionin & Wexler 2002; Goad & White 2006; Demuth & McCullough 2009; see also contributions to Young-Scholten & Archibald 2000). Many theories of language acquisition have also been developed and tested through research based on these L1-L2 language pairs. On the other hand, Kazakh is a language with relatively limited documentation, especially concerning its potential effects as an L1 on L2 acquisition. It is also a language from the Turkic family, which is structurally rather different from European languages in many aspects (e.g. Kazakh is an agglutinative language, while languages such as those listed above are not). This research thus provides a step towards further understanding of how differences between languages of different families may interact during a child's phonological development of an L2. This research also offers a test for current theories of second language acquisition. In particular, given that recordings of Nura began almost immediately upon her arrival to Canada, we were able to observe the very early stages of development of her L2, something that most studies of L2 acquisition do not document. Finally, in connection to the various points above, is the fact that several hundred thousand people from different language backgrounds immigrate to Canada every year, including large numbers of families with young children. Being able to understand how these children transition into learning one of the official languages of Canada can help us to better the support and education we can provide to these young children and their families upon their entry into our country.

Chapter 4: Data description

1 Introduction

In this chapter, we describe phone and cluster development in Nura's English productions. We report on these data, extracted from the corpus via Phon queries, both qualitatively and quantitatively. For each phone and cluster type, we illustrate the longitudinal patterns using bar graphs, which show the proportion of target-like productions, substitutions, and deletion patterns for each recorded session throughout the documented period. Whenever relevant, we illustrate and compare Nura's production patterns using phonetically-transcribed examples.

We compiled the data from Nura's repeated and spontaneous speech separately, in order to verify whether there are any differences between these two contexts of production in Nura's speech. As we will see, no major differences arose between the two types of speech, which displayed qualitatively similar developmental patterns throughout the observation period.

In the following section, we begin with a description of Nura's repeated and spontaneous productions of |ɹ|, |θ|, |f|, and |v| in word-initial onsets.[2]

2 The development of consonants in singleton onsets

In this section, we describe the development of |ɹ|, |θ|, |f|, and |v| in word-initial onsets. As we will see, Nura's |ɹ| exhibited two stages of development. The first stage, mostly

2 For the purposes of this thesis, transcriptions between vertical bars represent adult-like, target forms. Arrows indicate correspondence between adult target forms and child productions (between phonetic brackets), but should not be taken to represent phonological derivations; this thesis is neutral with respect to the question of the child's lexical representations.

evidenced in repeated utterances, showed marked variability in her productions while the second stage shows Nura becoming more stable in her productions of |ɹ|, at around 4;01.09, also at a time when she began to produce spontaneous utterances in earnest.

Similar to her development of |ɹ|, Nura displayed two stages for |θ|: stage 1 showed a majority of substitutions to [s], while stage 2 showed Nura becoming more stable in her attempts at |θ|, which she mastered by 4;05.

Finally, concerning Nura's development of |f| and |v|, the data for |f| showed little to no variability, with only one stage of mastery evidenced from the earliest productions, at 3;11.11. |v| showed a similar pattern, with an early mastery stage at 3;11.11 despite the variability we observe towards the end of the recorded period, which resulted from a lexical exception.

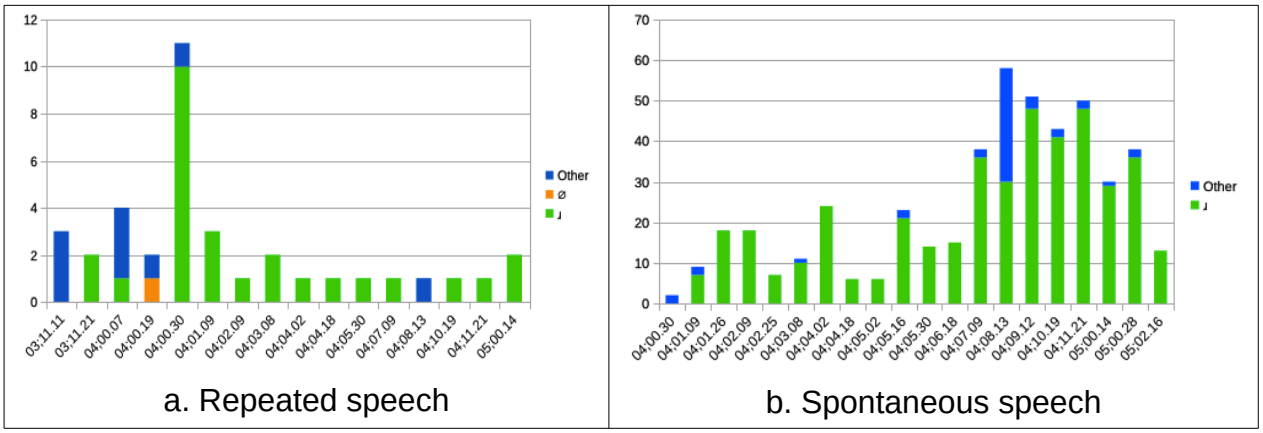
Throughout the subsections that follow, we describe these developmental patterns in more detail. While we only report on phones and clusters not found in the Kazakh inventory, we verified the overall data for phones found in both languages, to ensure Nura's ability to produce these without difficulty. For example, |l|, |w|, |j|, and |s| were all produced with a high degree of accuracy from the beginning of the recorded period.

2.1 |ɹ| in word initial onsets

Nura made a total of 511 attempts at |ɹ| in both her repeated and spontaneous speech during the documented period. As we can see in Figure 2,[3] she began attempting |ɹ| early in her repeated speech, at 3;11.11, but did not begin attempting words containing

3 All figures illustrating Nura's repeated and spontaneous speech display the number of tokens on the *y*-axis and the session, identified by age, on the *x*-axis.

|ɹ| in singleton onsets in her spontaneous speech until she was 4;00.30. As already mentioned, in Nura's repeated speech, we observe two main developmental stages. The first stage, ranges from 3;11.11 until 4;00.19. During this stage, Nura's productions were variable, with substitutions of |ɹ| for approximants [l] and [j] in words such as *raccoon* |ɹæˈkuːn|→[læˈkuːn] and *red* |ˈɹɛd|→[ˈjɛtʰ], for example. However, these substitutions were not systematic, and the data is too scarce to make further generalizations based on it.



a. Repeated speech

b. Spontaneous speech

Figure 2: Nura's |ɹ| productions over time

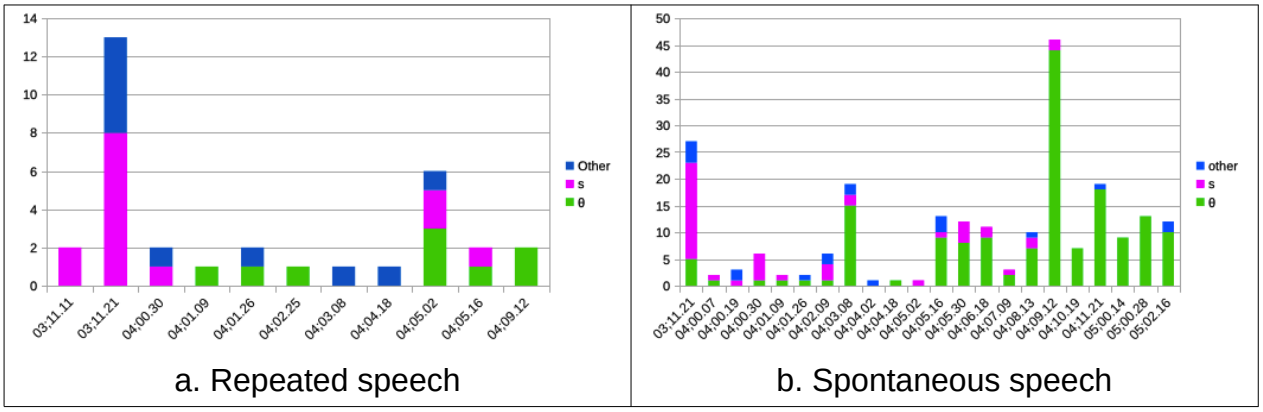
The second stage, which shows Nura becoming more accurate and reliable in her productions of |ɹ| in singleton onsets, ranges from age 4;00.30 until the end of the recorded period.

In Nura's spontaneous speech, only this second stage is evidenced in the dataset. From 4;01.09 onward, we see little to no variability in her attempts at |ɹ|, except at 4;08.13. The data from this particular session shows that, out of 58 attempts at |ɹ|, 30 were produced accurately, while the other 28 attempts showed non-systematic substitutions of phones such as [b], [v], [w], and [j]. In this session Nura repeated the word *really*

|ˈɹɪliː| → [ˈbiuwe], [ˈvɪwiː], [ˈwiliː], [ˈjɪwiː] multiple times within the same utterance (e.g. “I really really can’t see it”) as well as talking faster and producing much longer utterances while excitedly telling stories to the interviewer during the session, which may have resulted in her producing other consonants instead of |ɹ| as part of the repeated word sequences. In spite of this, Nura was clearly able to produce |ɹ| in onset position correctly during this session, in line with the remainder of the data for stage 2.

2.2 |θ| in word initial onsets

Nura began attempts at words containing |θ| in singleton onsets very early on, in both her repeated and spontaneous speech, with a total of 258 attempts over the documented period. However, Nura did not attempt |θ| in her repeated speech very often, with a total of only 33 attempts. Stage 1 shows a majority of substitutions to [s], from 3;11.11 until 4;05.02, while stage 2, from 4;05.16 onward, shows much more accurate productions for target |θ|, in spite of the occasional slip back into [s] production.



a. Repeated speech b. Spontaneous speech

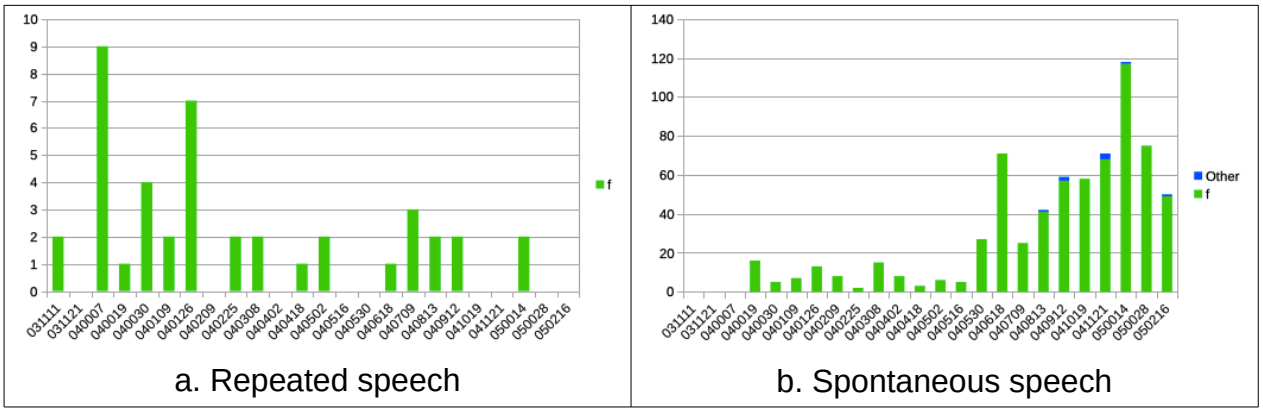
Figure 3: Nura’s |θ| productions over time

The majority of Nura’s substitutions of [s] for |θ| are seen between 3;11.11 and 4;00.30. For example, at 3;11.21, Nura frequently used the phrase *thank you* |ˈθæŋk ˈjuː|

→[ˈsæŋk ˈjuː], which accounts for most of the data in this session. Stage 2 displays much less variability in her attempts at |θ|, as the child was then able to produce |θ| more accurately and reliably.

2.3 |f| in word initial onsets

Nura began attempts at |f| very early on in her repeated speech, within which she made a total of 42 attempts at this consonant. As Figure 4 below illustrates, Nura produced |f| consistently from the very beginning of the documented period.



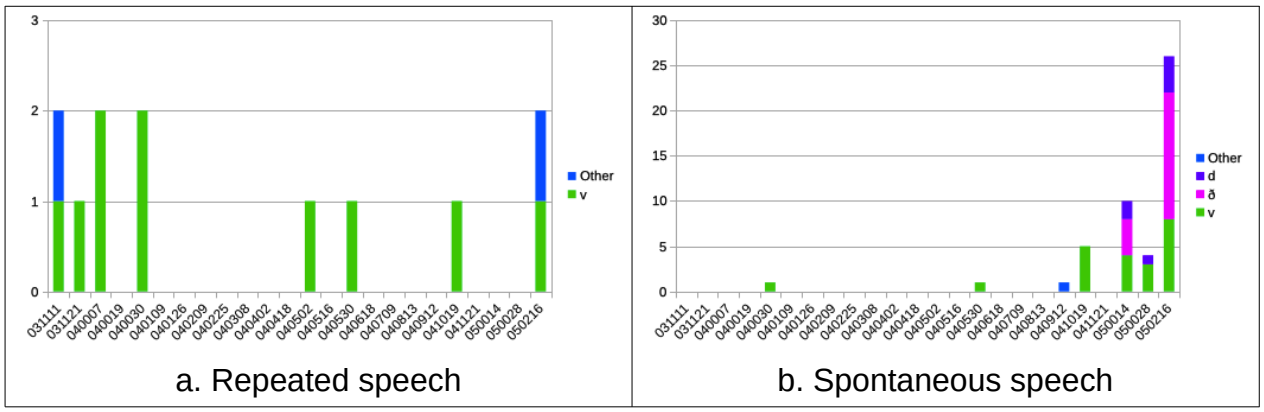
a. Repeated speech b. Spontaneous speech

Figure 4: Nura's productions of |f| over time

Nura's spontaneous speech shows the same pattern as in her repeated speech; she began attempts early on, at 4;00.19, and produced the target phone consistently from that moment on. We see some cases where Nura would substitute |f| for another phoneme, such as [b], [c], [d], [k], and [t], but these do not show any sort of pattern and only make up very little of the combined data. Overall, we can claim from these data that Nura had already mastered |f| in singleton onsets by 3;11.11.

2.4 |v| in word initial onsets

In comparison to |f|, Nura made few attempts at |v| in singleton onsets, with a total of only 60 attempts across both her repeated and spontaneous speech. In her repeated speech we see that Nura was relatively accurate in her productions of this phone; aside from 2 tokens where Nura produced something other than |v|, she accurately produced this consonant in the few tokens scattered through the observation period.



a. Repeated speech b. Spontaneous speech

Figure 5: Nura's productions of |v| over time

In Nura's spontaneous speech, we see very few early attempts at |v| until the latter part of the observation period. At 4;10.19, Nura made more attempts at |v|, which result in target productions. In the three sessions between 5;00.14 to 5;02.16, Nura continued to make more attempts at |v| with an overall prominent pattern of substitution, where she produced |v| as [d] and [ð] for the majority of her attempts. Note, however, that these substitutions occur only in the word *very* |ˈvɛɹiː|→[ˈdɛɹiː], [ˈðɛɹiː], which makes up for most of Nura's attempts at |v| in her spontaneous speech, with a total of 40 tokens of *very* out of the 60 attempts at |v| we observe in the data (other words that she attempted include *video*, *violin*, the letter *v*, and *vegetables*). All the substitutions that we observe in her spontaneous speech occur in the word *very,* while the other words beginning with |v|

are produced on target. In light of this, we can claim that Nura had acquired |v| from the beginning of the observation period.

2.5 Summary of development of consonants in singleton onsets

In summary, Nura's attempts at |ɹ|, |θ|, |f|, and |v| began early in her acquisition of English. |ɹ| and |θ| display two stages, a substitution stage and a mastery stage. On the other hand, Nura's |f| and |v| show only a mastery stage. The timeline in Table 4 summarizes Nura's developmental patterns during the documented period. While Nura mastered |ɹ| by 4;01.09, |θ| showed relatively stable substitution patterns to [s] from 3;11.11 until 4;05.02, when she mastered this consonant. The timeline also shows Nura's early mastery of |f| and |v| at 3;11.11.

	3;11.11	3;11.21	4;00.07	4;00.19	4;00.30	4;01.09	4;01.26	4;02.09	4;02.25	4;03.08	4;04.02	4;04.18	4;05.02	4;05.16	4;05.30	4;06.18	4;07.09	4;08.13	4;09.12	4;10.19	4;11.21	5;00.14	5;00.28	5;02.16
|ɹ|	A	A	A	A	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
|θ|	[s]	[s]	[s]	[s]	[s]	[s]	[s]	[s]	[s]	[s]	[s]	[s]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
|f|	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
|v|	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 4: Timeline of Nura's development of |ɹ|, |θ|, |f|, and |v| (A=Approximant)

This completes our description of Nura's development of English phones in singleton onsets over the documented period. In the next section we discuss Nura's development of clusters that occur in onset position in English words.

3 The development of clusters

In this section we discuss Nura's development of consonant clusters in English, as was listed in Table 3. We discuss her development of consonant+lateral (Cl) clusters, consonant+rhotic (Cɹ) clusters, consonant+glide (CG) clusters, s+consonant (sC) clusters, and finally, s+consonant+approximant (sCApp) clusters.

As we will see, Nura did not have marked difficulties acquiring Cl clusters, while she had some difficulty acquiring her Cɹ clusters. For the next three cluster types, we were only able to observe limited data, and from which we can claim that she acquired most of the relevant clusters, except |bj| and |sv|, by the end of the documented period.

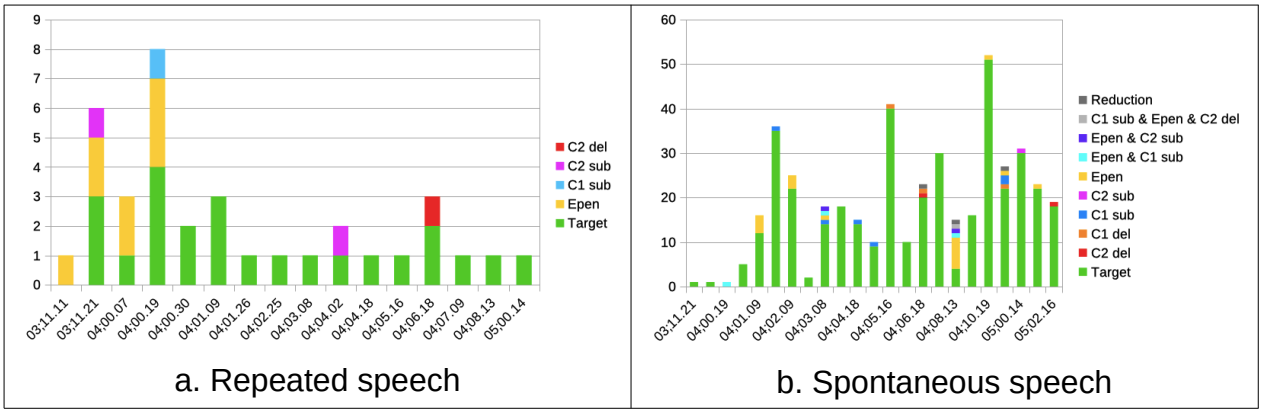
Keeping in line with the development of singletons in onset position, we compared Nura's repeated and spontaneous speech to verify if there were any differences between the two types of speech. Similar to singleton onsets, no real differences were found.

3.1 Consonant+lateral clusters

We begin with Nura's development of consonant+lateral (Cl) clusters in word-initial onsets. Nura made a total of 728 attempts at these clusters. As we will see, while she did not have much difficulty acquiring Cl clusters, for the most part, she did show difficulty with |fl| clusters.

3.1.1 |pl| and |bl|

We begin with |pl| and |bl| clusters, which Nura acquired quickly, as we can see in Figure 6. In both her repeated and spontaneous speech, Nura accurately produced |pl| and |bl| clusters by 4;00.30.



a. Repeated speech b. Spontaneous speech

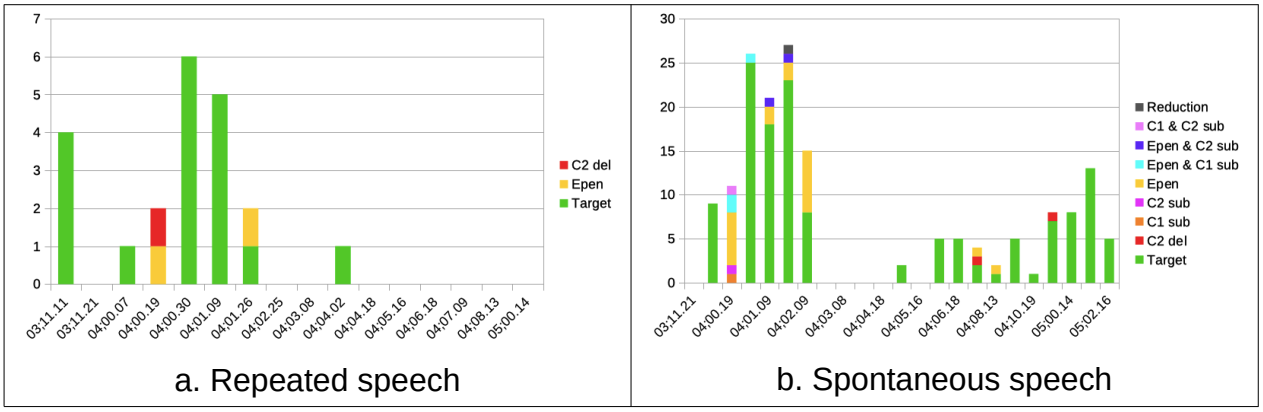
Figure 6: Nura's |pl| and |bl| productions over time

In Nura's repeated speech, the development of |pl| and |bl| takes place along two stages. Stage 1 shows some variability from 3;11.11 until 4;00.19. Most of this variability comes from an optional pattern of vowel epenthesis. For example, at 4;00.07, Nura produced the word *blocks* |ˈblɑks| as [ˈbʌlɑks]. By 4;00.30, Nura had mastered |pl| and |bl| clusters, as we see little to no variability in her productions until the end of the documented period. In Nura's spontaneous productions of |pl| and |bl|, because of data scarcity during the first few months of recording, we can only observe this second stage, during which we see little to no variation in the data, except at 4;08;13. In this session, we see an increase in her epenthesis pattern, with 10 of the 15 attempts resulting in epenthesis. These productions however come from two homophonic words, *blue* and *blew* [ˈbluː]→|bəˈluː|. Besides this, we can claim that Nura acquired |pl| and |bl| clusters at around age 4;00.30.

3.1.2 |kl| and |gl|

In Nura's speech, both repeated and spontaneous, we only see three attempts at |gl| clusters, while she attempted |kl| clusters 188 times. The data in Figure 7 below thus better reflects her attempts at |kl| clusters and will be discussed as such. As well, Nura's |kl| clusters only comes from 3 words, *close, clock,* and *clean*, and account for all non-target and target productions.

In Nura's repeated speech, we find 21 attempts at |kl|. Nura began producing this cluster early on in an accurate fashion, with little to no variability in her productions, as we can see in Figure 7a.



a. Repeated speech

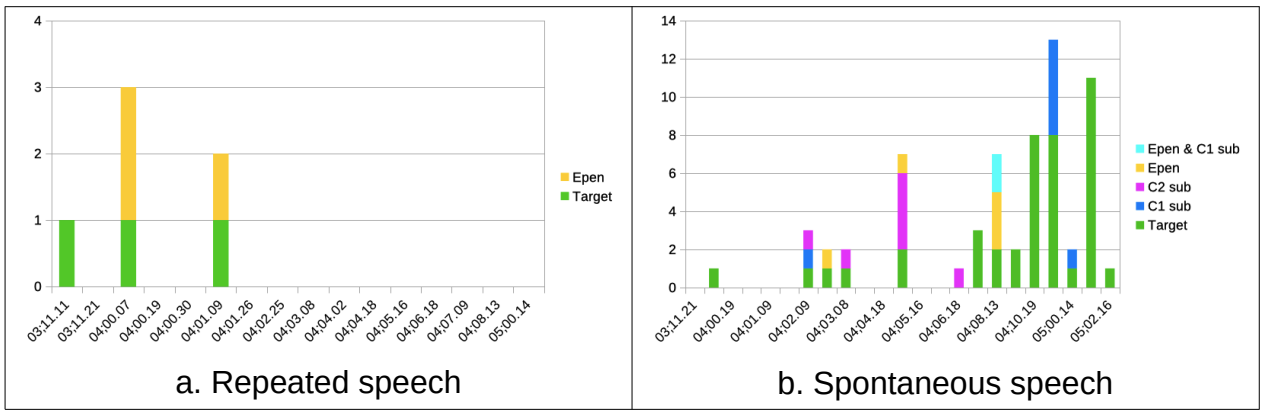
b. Spontaneous speech

Figure 7: Nura's |kl| and |gl| productions over time

Similarly, Nura made early successful attempts at |kl| in her spontaneous speech, with only minor variation in some sessions. For example, at 4;00.19, we see vowel epenthesis for the majority of her productions, with 8 of the 11 attempts resulting in epenthesis, for example in words such as *close* |ˈkloʊz|→[kʰəˈluwəz] and *clock* |ˈklɑk| →[gəˈlɑkʰ]. In spite of these exceptional occurrences, Nura was generally stable in her productions of |kl| with little to no variability from the earliest recordings.

3.1.3 |fl|

Concerning Nura's repeated attempts at words containing |fl| clusters, the corpus contains very little data, with a total of only 6 tokens. This data only appears in her earlier productions, as can been seen in Figure 8, where Nura's productions are variable, with the majority of her attempts resulting in vowel epenthesis.



a. Repeated speech b. Spontaneous speech

Figure 8: Nura's |fl| productions over time

Nura epenthesized a vowel for the majority of her attempts in words such as *flower* |ˈflaʊəɹ|→[ˈfʌlaʊəɹ]. However, because of the overall lack of data, we cannot say whether Nura had mastered |fl| clusters based solely on her repeated speech alone.

In contrast to this, Nura's spontaneous attempts at words beginning with |fl| provide discrete evidence for two distinct developmental stages. At stage 1, from 4;02.09 until 4;09.12, we observe variability in her productions. This variability comes mostly from C2 substitution, whereby Nura produces the [l] in the cluster as [ɹ]. This contrasts with her repeated speech where she epenthesized more frequently. As well, at 4;08.13, we witness an apparent regression from the previous session, recorded at 4;07.09, when Nura produced |fl| clusters in a target-appropriate fashion. At 4;08.13, she epenthesized a vowel for the majority of her attempts. However, this epenthesis only appears in two

words of the same lexeme, *fly* |ˈflaɪ|→[vəˈlaɪ] and *flying* |ˈflaɪɪŋ|→[fəˈlaɪdɪ], and as such can be attributed to a lexical effect. At stage 2, Nura became more stable in her productions, yet with some degree of variability, for example at 4;11.21, where she substituted [v] and [p] for |f| in the word *flower* |ˈflaʊəɹ|→[ˈvlaʊəɹ]. In spite of this, the overall data suggests that Nura had mastered the target cluster by 4;09.12.

3.1.4 Summary of Cl clusters

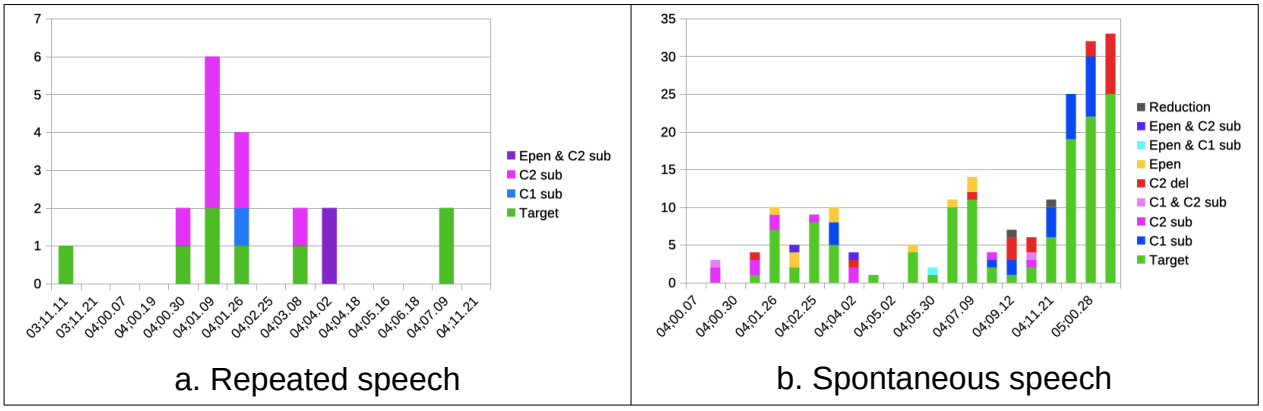
In summary, Nura mastered the majority of her Cl clusters without much difficulty by the end of the documented period, for all cluster types. In addition to an early stage characterized by vowel epenthesis which primarily affected labial+l clusters, she had more marked difficulties with |fl| clusters, which she acquired last. This completes our description of Nura's development of Cl clusters. In the next section we discuss Nura's development of consonant+rhotic (Cɹ) clusters in English.

3.2 Consonant+rhotic clusters

In contrast to her development of Cl clusters, we observed a lot more variation in Nura's consonant+rhotic clusters (Cɹ) clusters, as well as some degree of asymmetry between different clusters.

3.2.1 |pɹ| and |bɹ|

Over the documented period, Nura made a total of 215 attempts at |pɹ| and |bɹ| clusters. As we can see in Figure 9 below, there was some variability in her early attempts at the clusters. Beyond this early variability, Nura arguably mastered both clusters by 4;02.25.



a. Repeated speech

b. Spontaneous speech

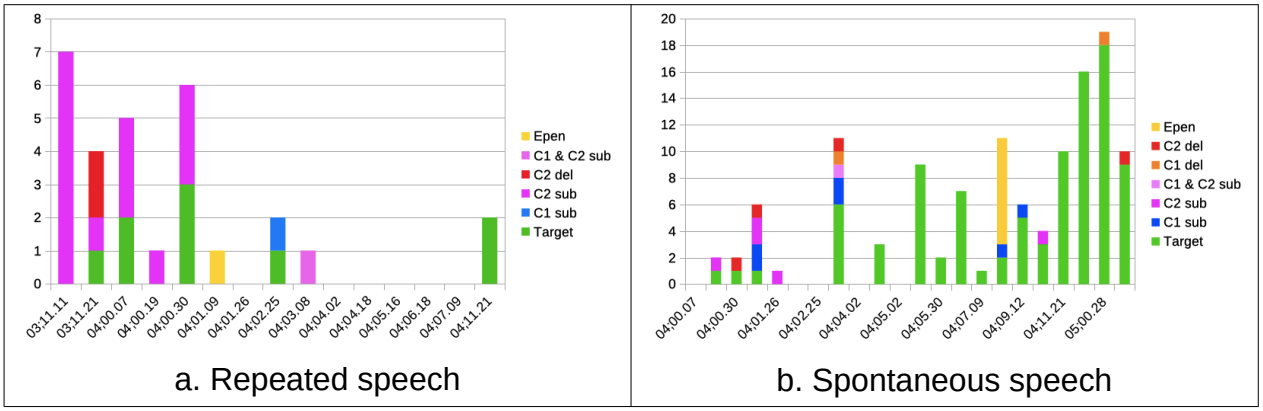
Figure 9: Nura's productions of |pɹ| and |bɹ| over time

In Nura's repeated speech, we see the majority of her attempts at the target clusters resulting in C2 substitution, until 4;03.08. In these sessions, all of Nura's productions of |ɹ| as [w] came from the word *princess* |ˈpɹɪnsɛs|→[ˈpwɪnsɛs], and all of her productions of |ɹ| as [l] came from the word *brown* |ˈbɹaʊn|→[ˈblaʊm]. However, Nura produced |bɹ| clusters accurately in other words such as *bruise* and *braids*. So these two observations may point at labial exceptions.

In Nura's spontaneous speech, we see early attempts at |pɹ| and |bɹ| clusters, which resulted in the same variability as in her repeated speech, especially until 4;01.26. Most of these early attempts come from |bɹ| clusters (14 tokens), rather than |pɹ| clusters (4 tokens), and most occur in the word *brown* (although she did produce |bɹ| as [bl] in one token of *brother*). After this, we still observe some variability, this time in the form of C1 substitution of [f] for |p| between 4;11.21 and 5;00.28. For example, at 4;11.21, this substitution occurred in the word *princess* |ˈpɹɪnsɛs|→[ˈfɹɪnsɛs], while, at 5;00.14, this pattern occurred in the words *present* |ˈpɹɛzənt|→[ˈfɹɛzənt] and *pretty* |ˈpɹɪɾiː|→[ˈfɹɪɾiː]. Aside from minor variations such as these, we can claim that Nura had mastered |pɹ| and |bɹ| clusters, by 4;02.25.

3.2.2 |tɹ| and |dɹ|

Over the documented period, Nura made a total of 149 attempts at |tɹ| and |dɹ| clusters. The variability we observe in her speech comes primarily from her C2 substitution of [w] for |ɹ|, which specifically affected her |tɹ| clusters, in line with her substitution pattern for |ɹ| in singleton onsets.



a. Repeated speech b. Spontaneous speech

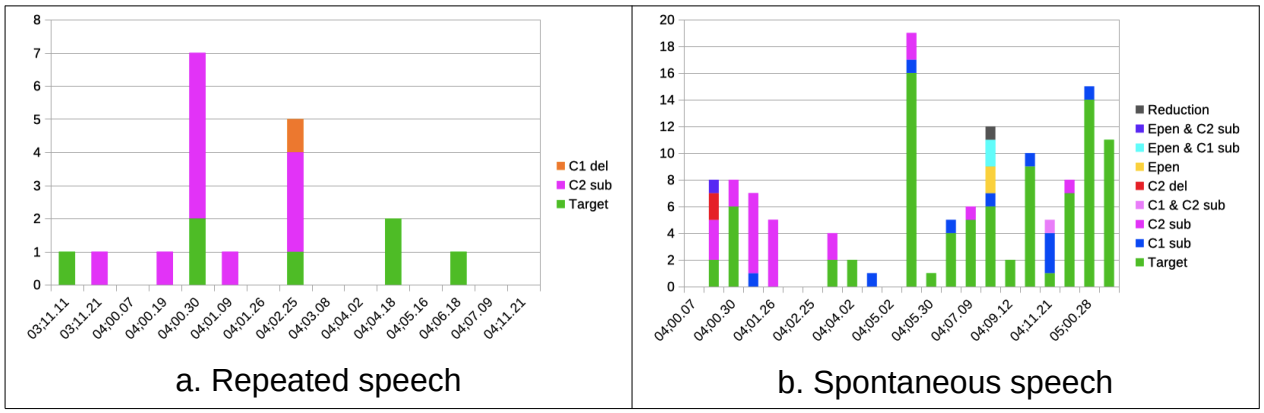
Figure 10: Nura's productions of |tɹ| and |dɹ| over time

In Nura's repeated speech, which contains the bulk of her early attempts at |tɹ| and |dɹ| clusters, we observe mainly C2 substitution of [w] for |ɹ|. For example, at 3;11.11 Nura produced [w] for |ɹ| in words such as *tree* |ˈtɹiː|→[ˈtwiː], *train* |ˈtɹeɪn|→[ˈtweɪn], and *triangle* |ˈtɹaɪˌæŋgəl|→[ˈtwaɪˌæŋgoʊ], the dominant pattern until 4;00.30.

An interesting pattern also emerges from the data when we compare attempts at |tɹ| versus |dɹ|. The production of |ɹ| as [w] exemplified above is much more prominent when |ɹ| is preceded by |t| than it is by |d|. Nura's attempts at |dɹ| resulted in more target-appropriate productions throughout the dataset, while her attempts of |tɹ| resulted in substitution early on, then progressed towards target-appropriate productions by 4;03.08, despite a few more variable productions afterwards.

3.2.3 |kɹ| and |gɹ|

Throughout the documented period, most of the variability we observe in Nura's 148 attempts at |kɹ| and |gɹ| clusters, in both her repeated and spontaneous speech, comes from C2 substitution of [w] for |ɹ|, still in line with her leading substitution pattern for |ɹ| in singleton onsets. In comparison to her |kl| and |gl| clusters, which were acquired very early, at 3;11.11, as we saw in section 3.1.2, Nura did not master her |kɹ| and |gɹ| clusters until later, at 4;05.16.



a. Repeated speech b. Spontaneous speech

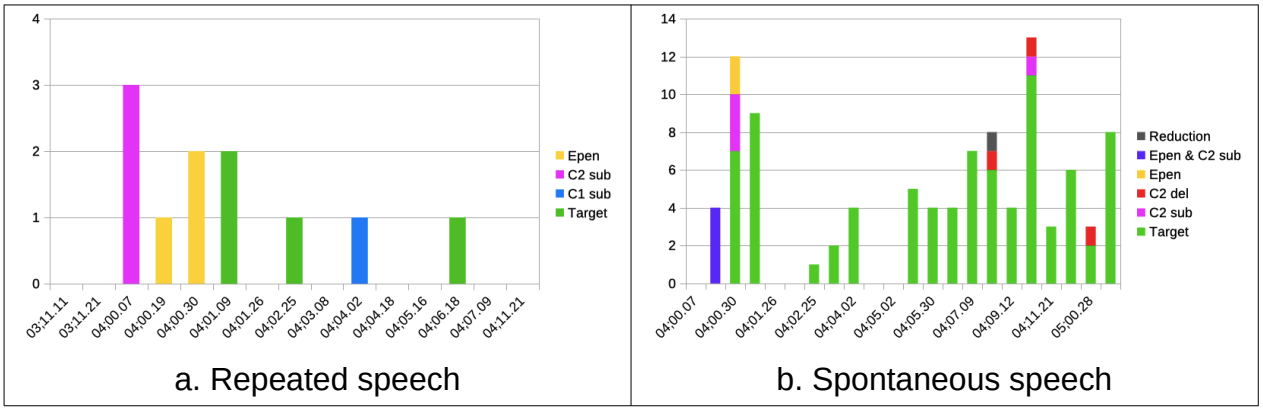
Figure 11: Nura's productions of |kɹ| and |gɹ| over time

For example, at 4;00.30, Nura substituted [w] for |ɹ| in her repetitions of the word *green* |ˈgɹiːn|→[ˈgwiːn], and showed the same pattern of substitution in her spontaneous speech (e.g. *green* |ˈgɹiːn|→[ˈgwiːn]) until 4;04.02. By 4;05.16, Nura had become much more stable in her target-like productions, in spite of some minor and unsystematic variation, especially at 4;08.13 and 4;11.21.

3.2.4 |fɹ|

Nura showed early mastery of |fɹ| clusters, by 4;01.09, in contrast to her acquisition of |fl| clusters reported in section 3.1.3. We observe some variation in her early attempts, in

the form of C2 substitution of [l] for |ɹ| or vowel epenthesis. However, this early variation is quickly overtaken by her target-like productions at 4;01.09, which she then maintained throughout the remainder of the documented period.



a. Repeated speech b. Spontaneous speech

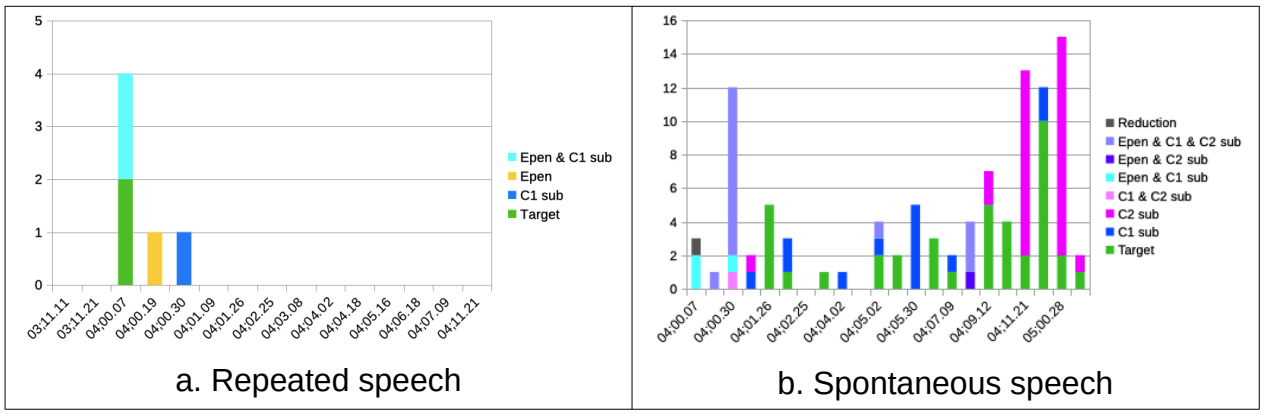
Figure 12: Nura's productions of |fɹ| over time

In Nura's repeated speech, we observe some early cases of C2 substitution and vowel epenthesis. For example, as mentioned above, Nura substituted [l] for |ɹ| in the word *frozen* |ˈfɹoʊzən|→[ˈfloʊzən] at 4;00.07. Between 4;00.19 and 4;00.30 she epenthesized a vowel in the words *frog* |ˈfɹɑg|→[fəˈɹɑkʰ] and *front* |ˈfɹʌnt|→[ˈfʌɹlʌnt]. After these sessions, by 4;01.09, we see Nura generally produced |fɹ| in a target-appropriate fashion.

The same can be said about Nura's spontaneous speech, where early cases of C2 substitution and vowel epenthesis occur in the words *frozen, front,* and *frog* (e.g. at 4;00.30, *frozen* |ˈfɹoʊzən|→[ˈfʌɹloʊzəːn], *front* |ˈfɹʌnt|→[ˈflɑnt], *frog* |ˈfɹɑg|→[ˈflɑk]). Despite this early variability, Nura had mastered |fɹ| clusters by 4;01.09.

3.2.5 |θɹ|

As mentioned at the beginning of this section, Nura showed a lot of variability in her development of |θɹ| clusters. Most of the data is a result of Nura attempting the word *three* in both her repeated and spontaneous speech. Nura produced a cluster for target |θɹ| by 4;01.26, although often not in a target-appropriate fashion from a segmental standpoint. Further, from her early repeated speech attempts, we are unable to identify any distinct or general pattern. In her spontaneous speech, we observe some target-like productions from 4;01.26 onwards (after the structure of the cluster was acquired). However, most of her attempts resulted in C1 and C2 substitution, the outcome of this substitution being [sl] for the majority of the documented period. This pattern of [s] substitution for |θ| falls in line with her |θ| in singleton onsets as we saw in section 2.2.



a. Repeated speech

b. Spontaneous speech

Figure 13: Nura's productions of |θɹ| over time

In her early attempts, Nura produced |θɹ| as [sl], with epenthesis also occurring within these [sl] clusters. For example, at 4;00.30, Nura produced |θɹ| clusters as |səl| in the word *three* |ˈθɹiː|→[ˈsəliː]. Nura then settled on the |θɹ|→[sl] pattern until 4;09.12. At this age, she began to produce the |θ| in the cluster, but still had trouble producing the following |ɹ|. However, we no longer observe her substituting [l] for |ɹ| as she instead

consistently produced a rhotic from that point onward (even though in most cases the rhotic is not the target |ɹ|). For example, at 4;10.19, Nura's only attempted |θɹ| clusters in the word *three,* which resulted in [ˈθriː], whereas at 5;00.14 she substituted |ɾ| for |ɹ| in the same word which she pronounced as [ˈθriː].

3.2.6 Summary of Cɹ clusters

In summary, Nura showed mastery of all of the target Cɹ clusters by the end of the documented period. We observed early asymmetries between |pɹ| and |bɹ| clusters as well as between |tɹ| and |dɹ| clusters. Between |pɹ| and |bɹ|, we observed two different patterns, where [pw] was substituted for |pɹ|, while [bl] was substituted for |bɹ|. This pattern persisted throughout the observation period, and at no point did Nura substitute [pl] for |pɹ| or [bw] for |bɹ|. Between her |tɹ| and |dɹ| clusters, for the first 4 months of the documented period, Nura substituted [tw] for |tɹ|, while she produced |dɹ| in a target-like manner fairly consistently. This completes our description of Nura's development of Cɹ clusters observed over the documented period. In the following section, we discuss Nura's development of consonant+glide (CG) clusters in English.

3.3 Consonant+glide clusters

This section focuses on Nura's consonant+glide (CG) clusters, specifically on consonant+w (Cw) and consonant+j (Cj) clusters. Nura did not make many attempts at these clusters, with a total of 69 attempts at Cw clusters and 30 attempts at Cj clusters over the documented period. Despite the limited productions, we observe mastery of her Cw clusters. However, she only mastered one of the two Cj clusters, |kj|, while we do not have sufficient data to describe her development of |bj|.

3.3.1 Consonant+w clusters

Throughout the documented period, Nura made a total of 69 attempts at consonant+w (Cw) clusters across both types of speech productions, all of which came from clusters whose initial consonant is voiceless: |kw| and |tw|.

3.3.1.1 |kw|

Nura's productions of |kw| are illustrated below in Figure 14. She made few attempts at this cluster during the documented period, with a total of only 38 tokens. In her early productions, most of her attempts at |kw| resulted in a reduced cluster to [g]. However, this reduction was only found in one word, *quack*, the onomatopoeia nature of which may not have been representative of other |kw| productions. We cannot verify this information based on the data available.

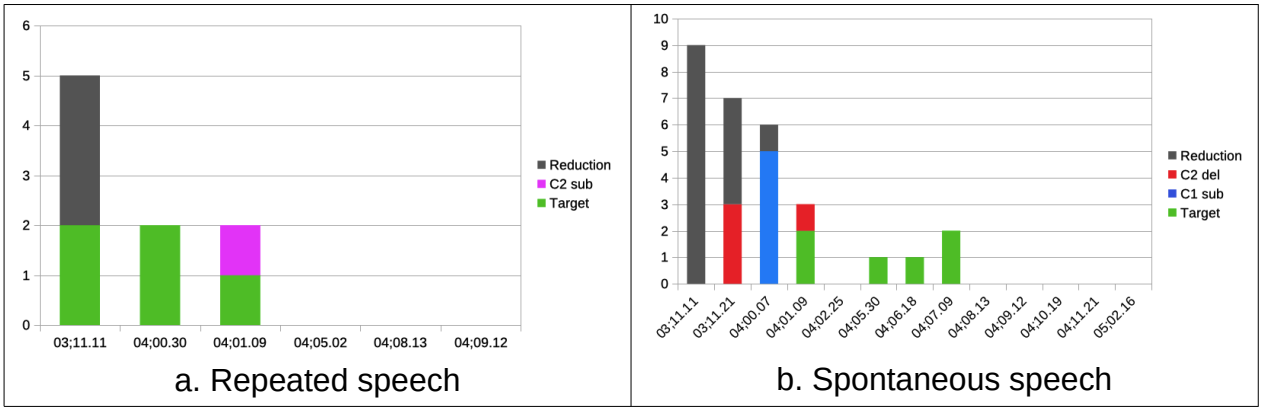
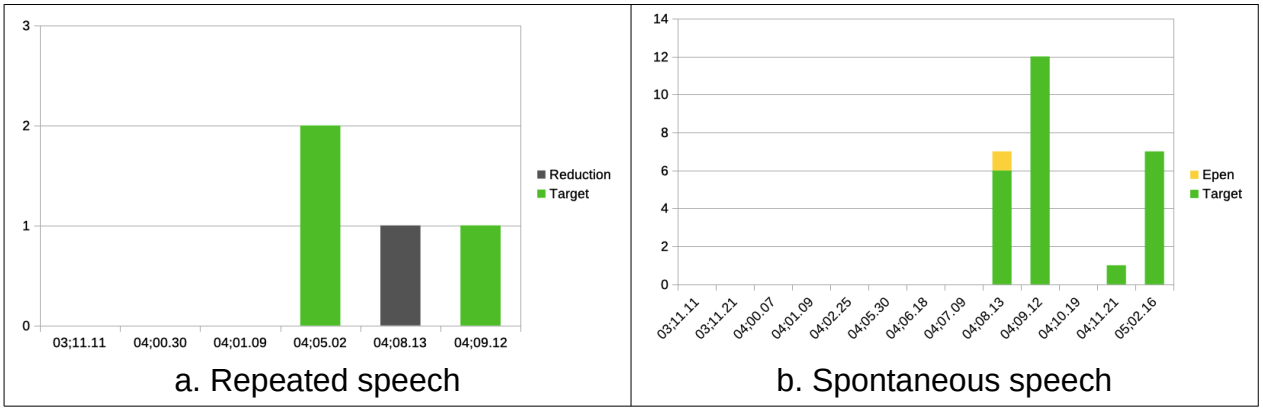


Figure 14: Nura's productions of |kw| over time

This same pattern of reduction is attested in her spontaneous speech as well. Starting at 4;01.09, however, the majority of her attempts at |kw| became successful, suggesting that Nura had mastered |kw| by 4;01.09.

3.3.1.2 |tw|

Nura's attempts at |tw| appear in the data at a much later time, in comparison to |kw|. Nura did not begin attempting |tw| until 4;05.02, when her attempts resulted in target-appropriate productions.



a. Repeated speech

b. Spontaneous speech

Figure 15: Nura's productions of |tw| over time

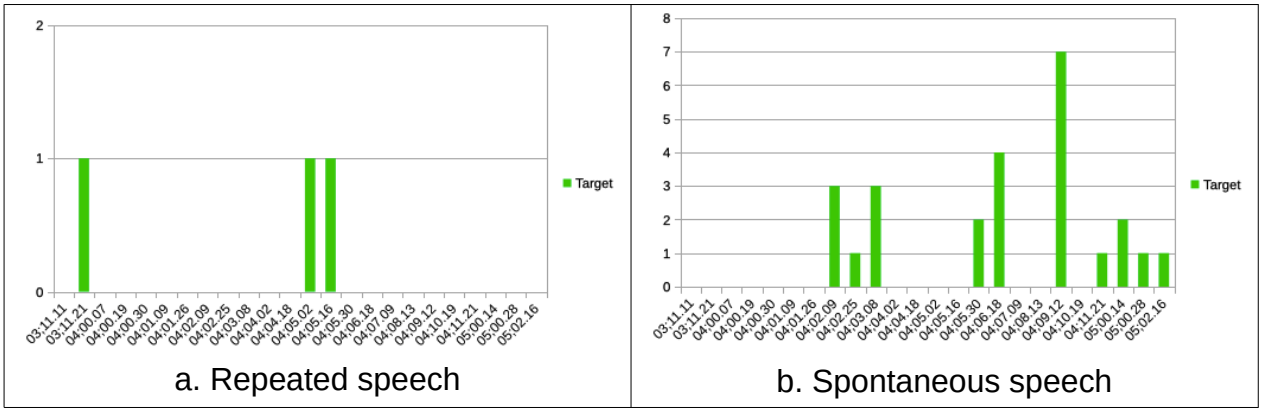
Based on these data, and in spite of a few exceptional productions recorded during later sessions, we can conclude that Nura had mastered her |tw| clusters by 4;05.02 or some time before.

3.3.2 Consonant+j clusters

Nura's consonant+j clusters (Cj) consist of the smallest sample of all the clusters we have observed so far, with a total of 30 tokens between two different clusters. From this small dataset, we are able to conclude that Nura mastered |kj| clusters, but are unable to come to a conclusion with her |bj| clusters, since she only made 2 attempts at the cluster.

3.3.2.1 |kj|

Over the recorded sessions, Nura made a total of 28 attempts at |kj| clusters. We see only 3 productions in her repeated speech, beginning at 3;11.21, all of which were accurate productions.



a. Repeated speech b. Spontaneous speech

Figure 16: Nura's productions of |kj| over time

We observe the same pattern in her spontaneous speech, where we see only target-like productions, beginning at 4;02.09. Based on this we can conclude that Nura had mastered |kj| clusters early on, by 3;11.21, at the very beginning of the documented period.

3.3.3 Summary of CG clusters

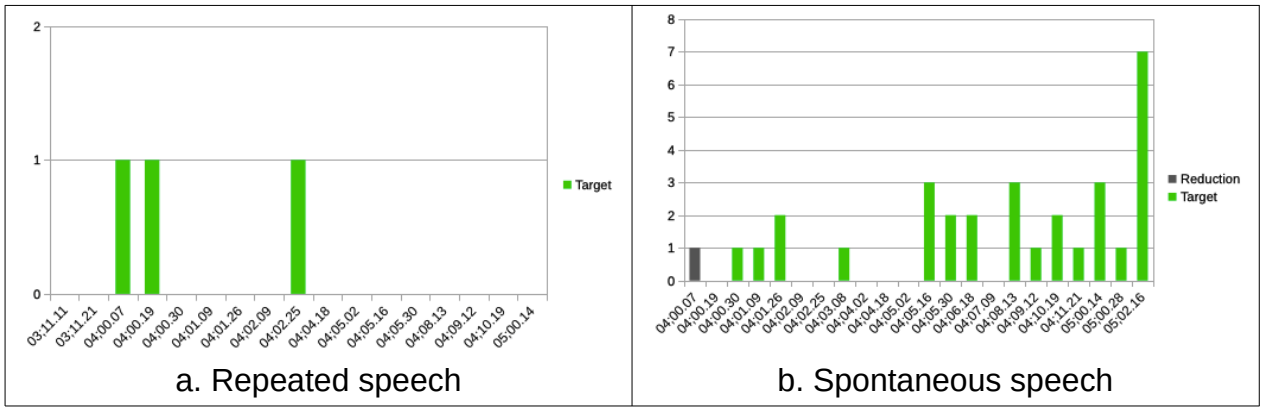
By the end of the documented period, Nura had mastered all of her CG clusters for which we have enough evidence to analyze. This completes our description of Nura's development of CG clusters. In the following section, we describe Nura's development of s+consonant (sC) clusters in English.

3.4 s+consonant clusters

Nura did not attempt many s+consonant (sC) clusters as part of her repeated speech (79 attempts total), as compared to her spontaneous speech (470 attempts total). Outside of this sampling difference between the two types of speech production, we see very little variability in the data: Nura mastered most of the sC clusters relatively early, yet failed to master |sv| by the end of the documented period.

3.4.1 |sp|

Starting with |sp| clusters, in Nura's repeated speech, we observe only three attempts in total. However, all of these attempts result in Nura accurately producing the cluster, as Figure 17a illustrates below.



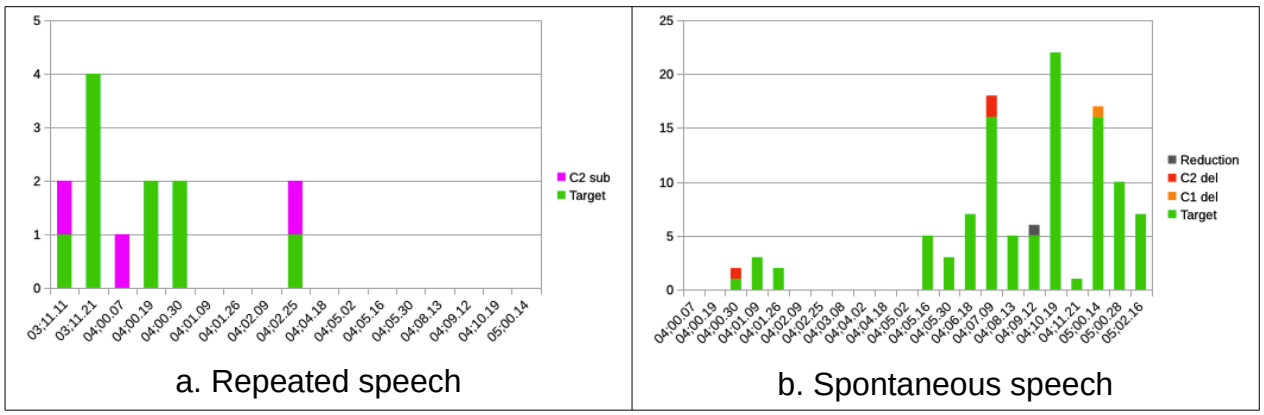
a. Repeated speech b. Spontaneous speech

Figure 17: Nura's productions of |sp| clusters over time

This same pattern appears in Nura's spontaneous speech, where we see that the vast majority of her attempts resulted in accurate |sp| productions, in spite of a single reduction (*spider* |ˈspaɪdəɹ|→[ˈbaɪdəɹ]) at 4;00.07. Given these data, we can claim that Nura had mastered |sp| by 4;00.07 or before.

3.4.2 |st|

Nura began attempts at |st| clusters early on, at 3;11.11. In her repeated speech we see a minor pattern of C2 voicing, resulting in [sd] cluster productions (e.g. *star* |ˈstɑɹ| →[ˈsdɑɹ]). On the other hand, the majority of her repeated attempts at this cluster are produced accurately.



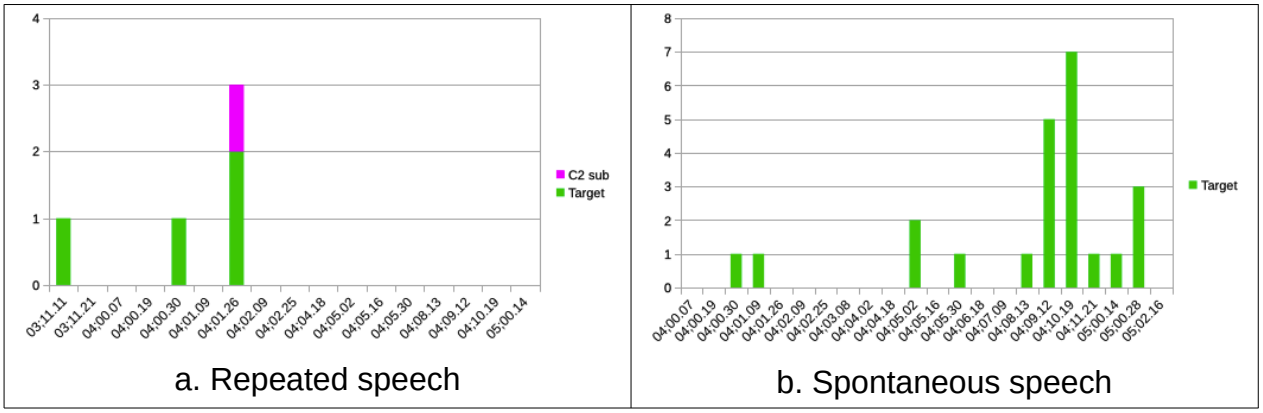
a. Repeated speech b. Spontaneous speech

Figure 18: Nura's productions of |st| clusters over time

The same holds true of her spontaneous speech, with attempts starting at 4;00.30, in spite of a lack of data between 4;02.09 and 4;05.16 and some random variation in the data at 4;07.09. Combining the observations from both types of speech production, we can claim that Nura had mastered |st| clusters by 3;11.21.

3.4.3 |sk|

In Nura's repeated speech, we observe only a few tokens of |sk| clusters, which show early target-appropriate productions beginning at 3;11.11. We see little variation, except for one occurrence at 4;01.25, where Nura attempted the word *scarecrow* and produced [g] for |k|: |ˈskæɹkɹoʊ|→[ˈsgæɹkɹoʊ].



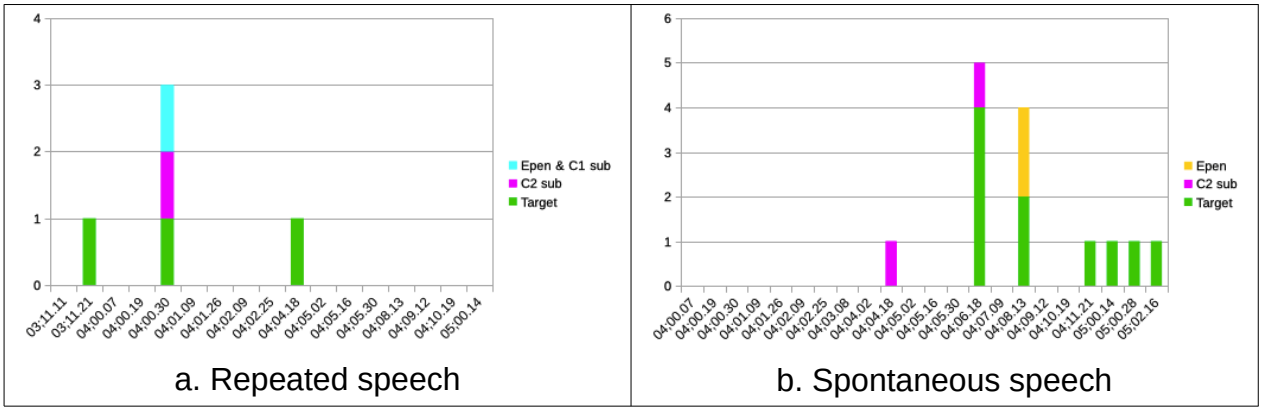
a. Repeated speech b. Spontaneous speech

Figure 19: Nura's productions of |sk| clusters over time

Again here, the same generalizations apply to Nura's spontaneous speech, also in an exceptionless fashion: Nura had thus mastered |sk| clusters very early on, by 3;11.11.

3.4.4 |sm|

Target |sm| clusters are also rather scarce across both types of speech, with this cluster occurring only in 4 words: *smell, small, smarty,* and *smooth.* In Nura's repeated speech, we see some minor variation of only two cases of C2 substitution and epenthesis and C1 substitution early in the data, at 4;00.30. However, the majority of her attempts resulted in accurate productions of |sm|.



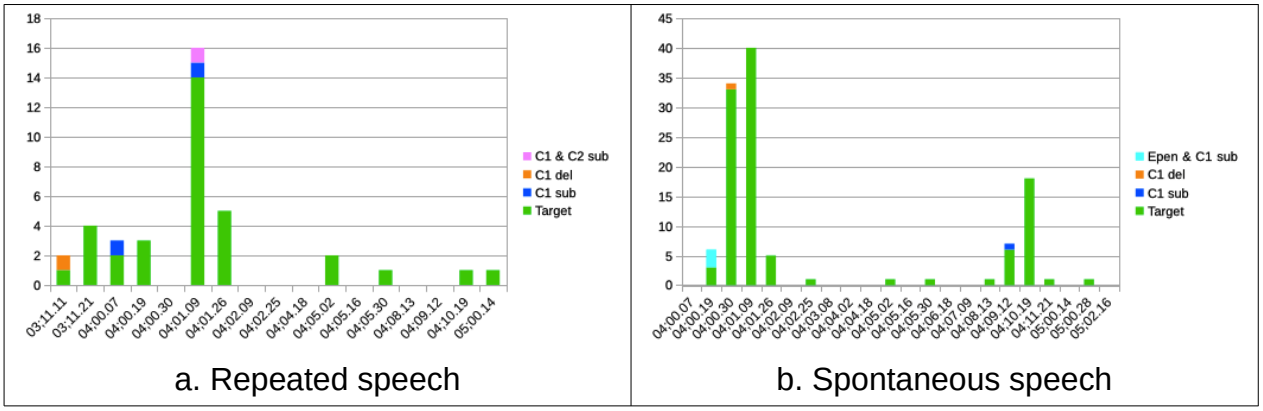
a. Repeated speech b. Spontaneous speech

Figure 20: Nura's productions of |sm| clusters over time

Nura did not begin attempts at |sm| in her spontaneous speech until 4;04.18, where we observe a few cases of C2 substitution and epenthesis. Despite this minor variability, Nura had arguably mastered |sm| clusters by 3;11.21.

3.4.5 |sn|

Moving on to Nura's development of |sn| clusters, in her repeated speech we observe early attempts beginning at 3;11.11. As we can see from Figure 21 below, Nura produced |sn| consistently throughout the documented period, in spite of minor and unsystematic variation.



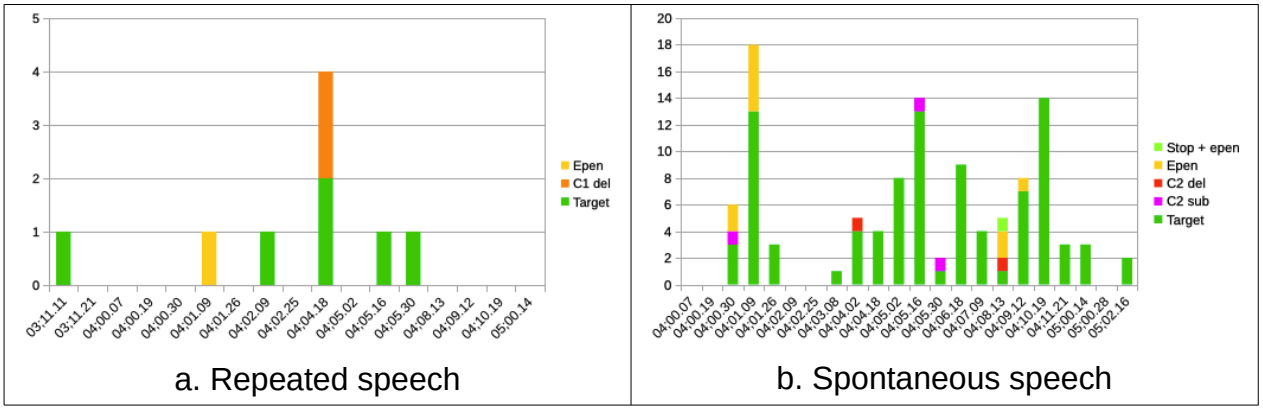
a. Repeated speech b. Spontaneous speech

Figure 21: Nura's productions of |sn| clusters over time

We see the same pattern in Nura's spontaneous speech, with early attempts at 4;00.19. Overall, Nura produced |sn| for the majority of the recorded sessions and had mastered this cluster by 3;11.11.

3.4.6 |sl|

Nura made early attempts at |sl| clusters in her repeated speech, beginning at 3;11.11. We see some variability, for example at 4;04.18, when Nura deleted her C1 in the word *slow* |ˈsloʊ| → [ˈloʊ]. Despite this, the majority of her attempts were on target.



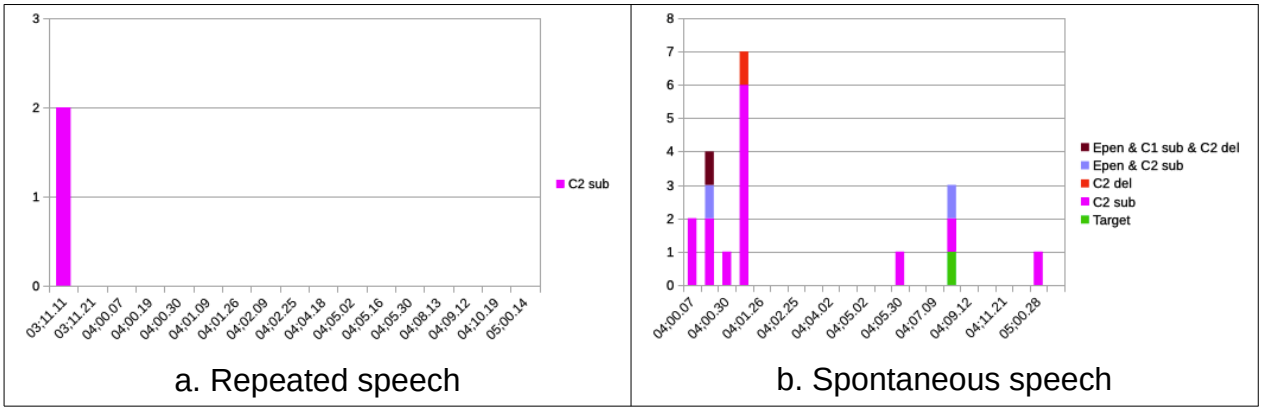
a. Repeated speech b. Spontaneous speech

Figure 22: Nura's productions of |sl| clusters over time

The same general observation applies to Nura's spontaneous speech, starting at 4;00.30, with all errors occurring in the word *sleep*. For example, at 4;01.09 we find a case of epenthesis in *sleep* |ˈsliːp|→[ˈsəliːp]. At 4;08.13 we also see epenthesis, in addition to Nura producing [t] for |s|: |ˈsliːp|→[tʰəˈliː], and C2 deletion, |ˈsliːp|→[ˈsiːp̚]. In spite of these few counter-examples, we can claim that Nura had mastered |sl| clusters early, as of 3;11.11, similar to all sC clusters discussed thus far.

3.4.7 |sv|

The corpus contains a limited set of examples for |sv|, with all of Nura's attempts from the name *Sven* (a total of 21 tokens across both types of speech). Nura's attempts at |sv| in her repeated speech is limited to 2 tokens, both of which resulted in C2 substitution of [w] for |v| (e.g. *Sven* |ˈsvɛn|→[ˈswɛn]), observed in the first recorded session.



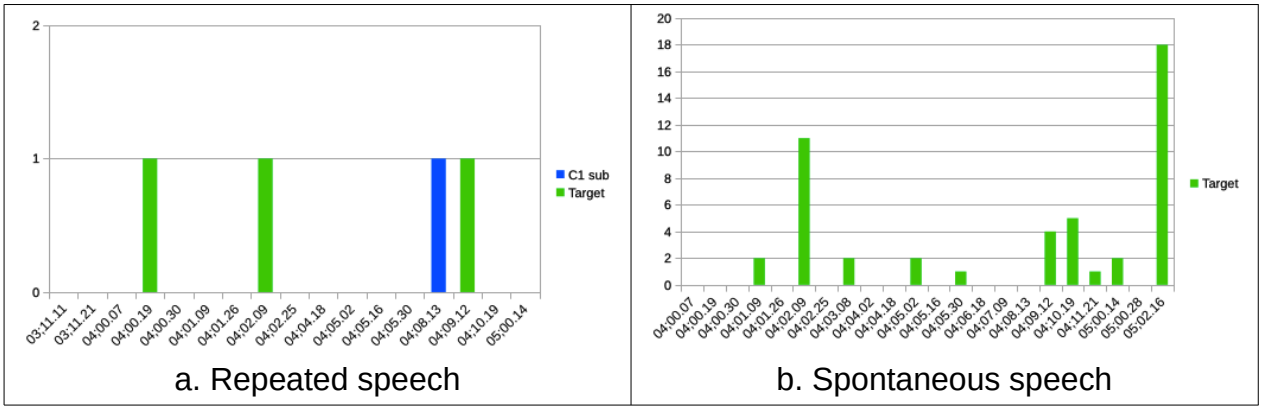
a. Repeated speech b. Spontaneous speech

Figure 23: Nura's productions of |sv| clusters over time

Nura also attempted |sv| early in her spontaneous speech, at 4;00.07. Focusing on the structure of the cluster, Nura acquired it very early on, by 3;11.11. However, segmentally, we observe C2 substitution of [w] for |v| throughout most of the documented period. Based on these data, we can claim that, segmentally, Nura did not master |sv| clusters by the end of the documented period.

3.4.8 |sw|

Finally, concerning |sw| clusters, we see a total of 4 tokens in Nura's repeated speech, of which the majority are produced accurately. We observe only one case of C1 substitution, which occurs in the cartoon character name S*wiper* |ˈswaɪpəɹ| → [ˈtʰwaɪb].



a. Repeated speech b. Spontaneous speech

Figure 24: Nura's productions of |sw| clusters over time

Similarly, in Nura's spontaneous speech, all of the productions of |sw| are target-like. We can thus conclude that Nura had mastered |sw| clusters early on, by 4;00.19 or before.

3.4.9 Summary of sC clusters

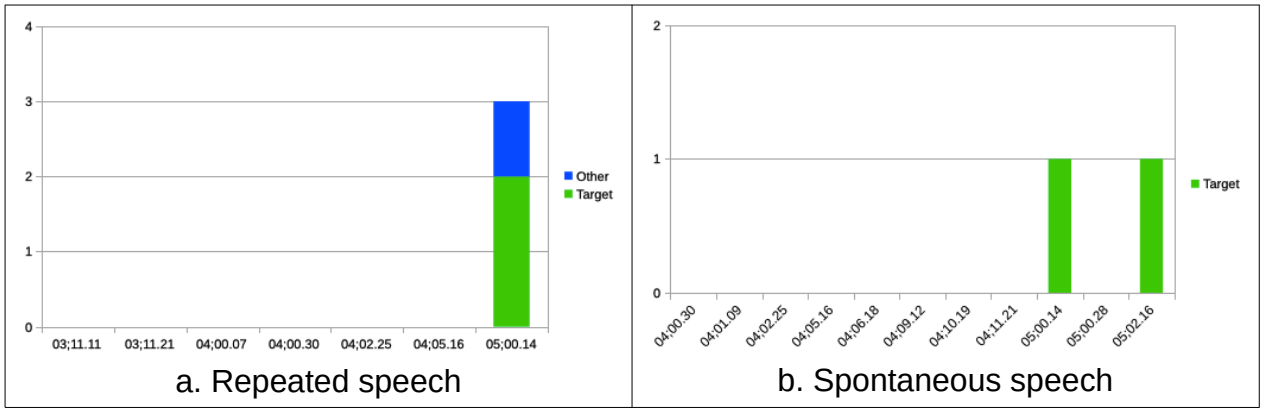
In summary, Nura mastered almost all target sC clusters early on, given our data sample. The only cluster she was unable to master was |sv|. This completes our description of Nura's development of sC clusters over the documented period. We now move to Nura's development of tri-consonant clusters, the s+consonant+approximant (sCApp) clusters of English.

3.5 s+consonant+approximant clusters

Over the documented period, Nura made few attempts at s+consonant+approximant (sCApp) clusters, with a total of 70 productions across her repeated and spontaneous speech. Of these, 50 are from |skw| clusters. Despite this, we are able to observe target-like productions, with some minor variations by way of epenthesis and approximant deletion. By the end of the recorded sessions, we can conclude that Nura had mastered all sCApp clusters.

3.5.1 |spl|

Nura only attempted 5 words containing |spl| clusters in total, as we observe in Figure 25, with the earliest attempts at 5;00.14. Of these attempts, 3 are of the word *splash,* while the remaining 2 productions are of the word *splat.*



a. Repeated speech

b. Spontaneous speech

Figure 25: Nura's productions of |spl| clusters over time

In spite of the few attempts made, she produce the target form a majority of the time. Thus, based on the data we do have, we can claim that Nura had mastered |spl| at 5;00.14, when productions began, if not before.

3.5.2 |spɹ|

As we see in Figure 26, Nura made only 3 attempts at |spɹ| over the documented period. These attempts, which only occur in her spontaneous speech, appear in three words of the same lexeme: *sprinkle*, *sprinkles,* and *sprinkly.*

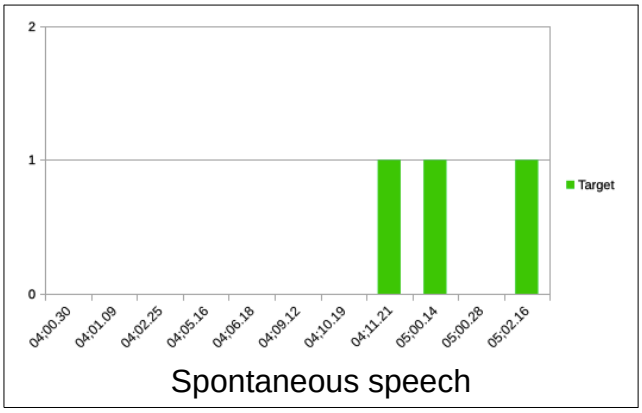
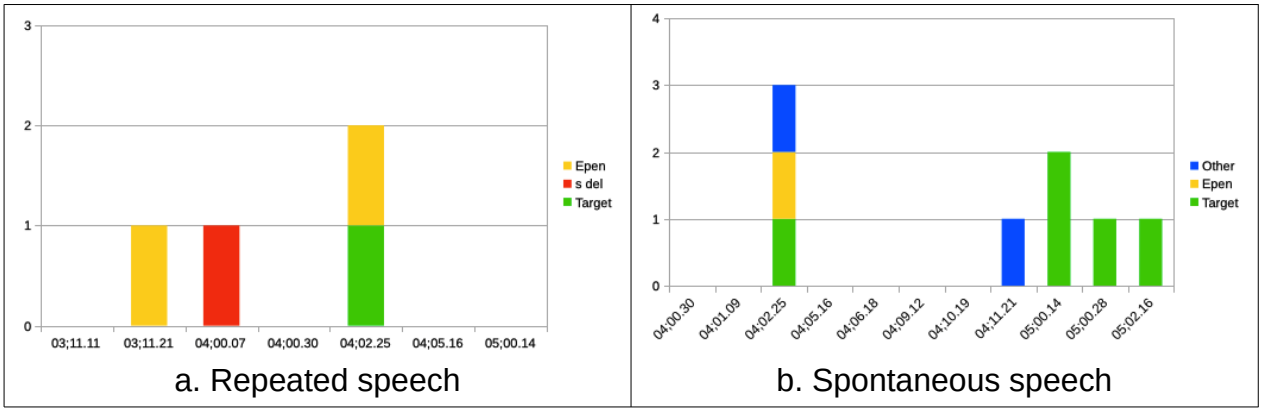


Figure 26: Nura's productions of |spɹ| clusters over time

The first attempt was recorded at 4;11.21 and was produced accurately, similar to her two later attempts. Based on this, we can claim that Nura had mastered |spɹ| at 4;11.21 or before.

3.5.3 |stɹ|

Over the documented period, Nura made only 12 attempts at |stɹ|, from which we observe some minor variability. Nura began attempts early, at 3;11.21, in her repeated speech. The variability that we observe in her productions mostly comes from epenthesis, with the majority of her productions coming from the word *strawberry* (9 out of 12 attempts). The variation that we observe comes only from this word. The other words she attempted towards the end of the documented period, *straw, stretching,* and *strong*, all display accurate productions.



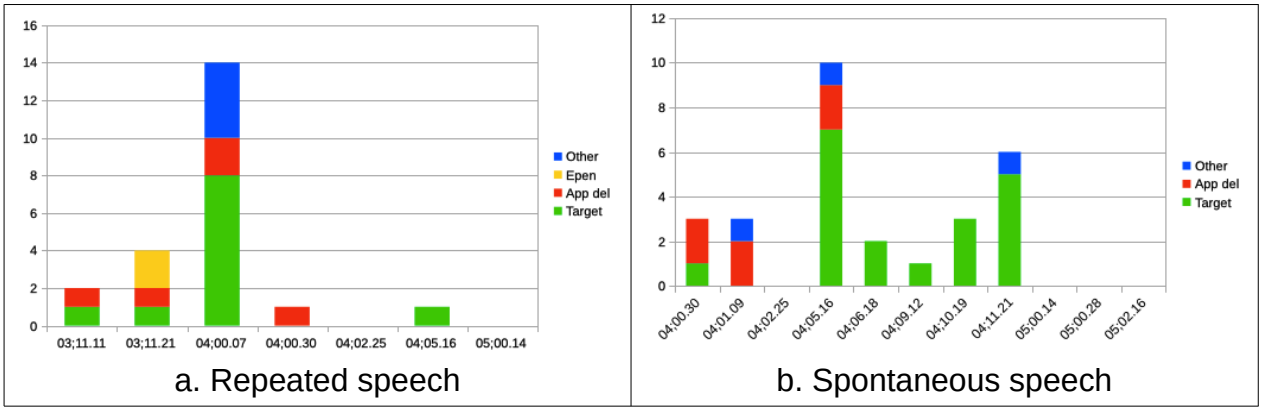
a. Repeated speech b. Spontaneous speech

Figure 27: Nura's productions of |stɹ| clusters over time

In Nura's repeated speech, the majority of her attempts at *strawberry* resulted in epenthesis (itself the result of vowel metathesis), for example, at 3;11.21, |ˈstɑˌbɛɹiː| →[ˈstɑɹˌbɛɹiː]. We also see one case of |s| deletion at 4;00.07, |ˈstɹɑˌbɛɹiː|→[ˈdɹɑˌbeɪbiː]. We observe this same pattern in her spontaneous speech at 4;02.25. After that, there is a gap in her productions until 4;11.21, after which she began to produce the target cluster consistently, beginning at 5;00.14. Based on the few tokens, we can conclude that Nura mastered |stɹ| at 5;00.14.

3.5.4 |skw|

Over the documented period, Nura made 50 attempts at |skw| clusters, most of them resulting in target-like productions. Very early on, we observe some variation by way of approximant deletion and epenthesis. Across both types of speech, the variability that we see only occurs in the word *square* in Nura's repeated speech. In her spontaneous speech, most of her attempts are also from the word *square* (21 tokens), with a few cases of the word *squish* (7 tokens).



a. Repeated speech

b. Spontaneous speech

Figure 28: Nura's productions of |skw| clusters over time

In her repeated speech, from 3;11.11 until 4;00.30, Nura either deleted the approximant |w| (e.g. at 3;11.11 *square* |ˈskwɛɹ|→[ˈskɛɹ]) or epenthesized a vowel (e.g. at 3;11.21 *square* |ˈskwɛɹ|→[ˈsʌgwɜɹ]). In her spontaneous speech, we see a similar pattern where Nura began attempts early on, at 4;00.30, and most of the variability comes from |w| deletion (e.g. at 4;00.30 *sqaure* |ˈskwɛɹ|→[ˈskɛɹ]). This pattern later resolved itself, and Nura mastered |skw| clusters by 4;05.16.

3.5.5 Summary of sCApp clusters

Over the documented period, Nura made relatively few attempts at sCApp clusters. Despite the limited data, the evidence suggests that Nura mastered all of her sCApp clusters between 4;05.16 and 5;00.14.

This concludes our description of Nura's development of clusters in English. In the following section we summarize her development of these clusters.

3.6 Summary of the development of onset clusters

By the end of the documented period, Nura had acquired almost all of the observed clusters, except for |sv|. Typically, clusters were acquired early on, with most mastered around 4;05, a generalization that may or may not include all of the clusters which Nura did not begin attempting until much later but were produced accurately at the time they were first attested. As such, we do not have on hand the type of evidence needed to properly assess Nura's developmental paths for all cluster types. In line with prior observations, we found no marked discrepancies between Nura's repeated and spontaneous speech; rather, production patterns observed in repeated and spontaneous speech largely overlapped until the child's productions were predominantly spontaneous.

Below is a legend for the timeline of Nura's cluster development which we obtained from the available data. In some cases, two developmental patterns were found at the same time, which often indicate differences between structural and segmental development. For example, Nura mastered the structure of most of her clusters early on, but did not segmentally master the production of the phones present in some of these clusters until later.

Legend	
E	Epenthesis of vowel between consonants
S	Substitution (of either consonant in cluster)
R	Cluster reduction (to a phone not present in cluster)
D	Deletion (of either consonant in cluster)
V	Variable productions (no clear pattern)
✓	Mastery of cluster
-	No productions

		3;11.11	3;11.21	4;00.07	4;00.19	4;00.30	4;01.09	4;01.26	4;02.09	4;02.25	4;03.08	4;04.02	4;04.18	4;05.02	4;05.16	4;05.30	4;06.18	4;07.09	4;08.13	4;09.12	4;10.19	4;11.21	5;00.14	5;00.28	5;02.16
C+lateral	pl bl	E/✓	E/✓	E/✓	E/✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	kl gl	✓	-	✓	E/✓	✓	✓	E/✓	E/✓	-	-	✓	-	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	fl	E/✓	-	E/✓	-	-	E/✓	-	E/✓	E/✓	S/✓	-	-	S/✓	-	-	S/✓	S/✓	S/✓	✓	✓	✓	✓	✓	✓
C+rhotic	pɹ bɹ	S/✓	-	-	S/✓	S/✓	S/✓	S/✓	S/✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	tɹ dɹ	S/✓	S/✓	S/✓	S/✓	S/✓	S/✓	S/✓	S/✓	S/✓	✓	-	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	kɹ gɹ	S/✓	S/✓	-	S/✓	S/✓	S/✓	S/✓	-	-	S/✓	S/✓	S/✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	fɹ	-	-	E	E	E	✓	-	-	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	θɹ	-	-	E	E	E	E	S/✓	S/✓	-	S/✓	S/✓	-	S/✓	S/✓	S/✓	S/✓	S/✓	S/✓	✓	✓	✓	✓	✓	✓
C+glide	kw	R/✓	R/✓	R/✓	R/✓	R/✓	✓	-	-	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-	-
	tw	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	✓	✓	-	✓	-	-	✓
	kj	-	✓	-	-	-	-	-	✓	✓	✓	-	-	✓	✓	✓	✓	-	-	✓	-	✓	✓	✓	✓
s+C	sp	-	-	✓	✓	✓	✓	✓	-	-	✓	✓	-	-	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓
	st	-	✓	✓	✓	✓	✓	✓	-	✓	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	sk	✓	-	-	-	✓	✓	✓	-	-	-	-	-	✓	-	✓	-	-	✓	✓	✓	✓	✓	✓	-
	sm	-	✓	-	-	✓	-	-	-	-	-	-	✓	-	-	-	✓	-	✓	-	-	✓	✓	✓	✓
	sn	✓	✓	✓	✓	✓	✓	✓	-	✓	-	-	-	✓	-	✓	-	-	✓	✓	✓	✓	-	✓	-
	sl	✓	-	-	-	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓
	sv	S/✓	S/✓	S/✓	S/✓	S/✓	S/✓	-	-	-	-	-	-	-	-	S/✓	-	-	S/✓	-	-	-	-	S/✓	-
	sw	-	-	-	✓	-	✓	-	✓	-	✓	-	-	✓	-	✓	-	-	✓	✓	✓	✓	✓	-	✓
s+C+App	spl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓
	spɹ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓	✓	-	✓
	stɹ	-	E	E	-	-	-	-	-	E	-	-	-	-	-	-	-	-	-	-	-	V/✓	✓	✓	✓
	skw	D/✓	D/✓	D/✓	D/✓	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-	✓	✓	✓	-	-	-

Table 5: Timeline of Nura’s development of onset clusters

Starting with Cl clusters, we first notice that Nura could produce velar+l onsets from the earliest recordings, in spite of marginal cases of epenthesis found at 4;00.19. She, however, displayed a much more prominent pattern of vowel epenthesis in labial+l clusters. While this pattern was resolved early for |pl| and |bl| clusters, it extended for a longer period of time in the context of |fl| clusters, only to give way to a substitution pattern affecting these clusters specifically between 4;03.08 and 4;08.13.

Concerning Cɹ clusters, two main observations emerge from the data. First, we observe across-the-board substitutions affecting stop+ɹ clusters, which was resolved between 4;02.25 and 4;05.16. In contrast to this, fricative+ɹ clusters first underwent a stage of epenthesis, which was resolved early for |fɹ|, but was followed by a stage of segmental substitution in the case of |θɹ|.

Moving on to Nura's CG clusters, we observe more limited data with some cluster types attempted only later on (for example, the earliest attempt at |tw| was recorded at 4;05.02). While we are able to report on her k+glide clusters, which were acquired early, the limited data for |tw| leaves little to discuss, as we are unable to observe any early developmental patterns. Because of this, |tw| will not be discussed any further.

Similarly, Nura mastered sC clusters very early on, both structurally and segmentally. The only cluster which she did not master was |sv|, which was never acquired segmentally by the end of the documented period.

Lastly, there is very limited data for Nura's sCApp clusters. Because of this, and also given that the |skw| cluster, for which we have most of our observations, comes from only two words, we are unable to draw firm generalizations; these clusters will not be discussed any further.

This concludes the data descriptions of Nura's development of onset clusters. In the following section we present a general summary of both her singletons and clusters in onset position, as they relate to each other over the documented period.

4 General summary: singletons and onset clusters

In this section we summarize all of the findings described throughout this chapter. As we can see in Table 6, Nura mastered most of her singleton onsets and onset clusters early on during the developmental period. As mentioned in section 2, Nura already had mastery of the English consonants that are present in the Kazakh inventory (|l|, |w|, |j|, and |s|) from the beginning of the documented period. In Table 6 below, “acquired from the beginning” is mastery from the earliest observations; “acquired early” accounts for the singletons and clusters mastered between 3;11.21 and 4;05.16, whereas “acquired later” corresponds to mastery after 4;05.16.

		Acquired from beginning	Acquired early	Acquired later	Not acquired
Singletons	|ɹ|		✓		
	|θ|		✓		
	|f|	✓			
	|v|	✓			
C+l	Lab stop+l		✓		
	Vel stop+l	✓			
	|fl|			✓	
C+ɹ	Stop+ɹ		✓		
	|fɹ|		✓		
	|θɹ|			✓	
C+glide	k+glide		✓		
s+C	s+stop		✓		
	|sv|				✓
	|sl|	✓			
	|sw|		✓		

Table 6: Development of singletons and clusters in onset position

As summarized in Table 6, Nura mastered almost all of the singletons in onset position. She had mastered |f| and |v| from the beginning, while both |ɹ| and |θ| were acquired early.

Moving on to onset clusters in word-initial position, Nura mastered the bulk of her clusters relatively early. Both velar stop+l and |sl| were acquired from the beginning. These were followed by k+glide, |sw|, |fɹ|, and clusters that included stops (s+stop, labial stop+l, and stop+ɹ). In contrast to these, Nura did not acquire |fl| and |θɹ| until later and lastly, did not acquire |sv| clusters by the end of the documented period.

The concludes our description of the development of Nura's singletons and clusters in onset position. In the next chapter, we discuss some of the implications of these observations in light of the background literature summarized in Chapter 3.

Chapter 5: Discussion

In this chapter we provide a summary discussion of the main developmental trends we observed in Nura's L2 acquisition of English consonants and consonant clusters. As we will see, the patterns we find for both singleton onsets and onset clusters follow an expected developmental logic, especially if we consider the phones categories which Nura could transfer from her prior phonological knowledge. This supports models of L2 phonological development which allow for the early transfer of phonological categories into the L2 in addition to mechanisms for the development of novel phonological categories.

1 Singletons in onset position

As previously discussed, Nura acquired English |ɹ| and |θ| early on. We observed expected substitutions of [w] for |ɹ| and [s] for |θ| during the earliest period of Nura's development. In contrast to this, Nura had already mastered |f| and |v| by the time of the first recording. As discussed in section 2.3, while |f| and |v| are not native sounds in Kazakh, they are attested in the consonant inventory as loan phonemes (illustrated in Table 1) as well as in some dialects of the language (e.g. Abuov 1994; Vajda 1994; Dotton & Doyle Wagner 2018). The dialect which Nura acquired did not have |f| or |v| present in its inventory. However, |f| is found in the Chinese language, which Nura had some passive knowledge of, given that she spent almost the first four years of her life in China. This, combined with the fact that |v| is similar to |f| in all respects but voicing, and also given that voicing contrasts are present in the phonology of Kazakh, all point to Nura's ability to piece together this new sound from her prior linguistic knowledge.

2 Onset clusters

We now turn to Nura's development of onset clusters. As a reminder, the tri-consonant (sCApp) and the |tw| clusters will not be discussed in this section, as we were unable to draw generalizations about their development for lack of sufficient evidence in our dataset.

2.1 Consonant+lateral

As we observed in the data, Nura mastered almost all of her Cl clusters early on, except for |fl|. We also witnessed a pattern of vowel epenthesis, found almost exclusively in her Cl clusters. This epenthesis was found to be most prominent in her |fl| clusters, followed by her |pl|/|bl| clusters, in addition to marginal attestations in |kl|/|gl| clusters.

Focusing on phonological aspects of each cluster type, it appears that Nura had difficulty transitioning from the initial consonant to the lateral, especially if that initial consonant was labial. The more noticeable difficulty with |f| adds support to our hypothesis that while Nura originally had passive knowledge of Chinese |f|, she did not master the production of this consonant to the extent she did for the other consonants available from her native Kazakh, something that reflected itself in onset clusters. As we will see below, it appears that the continuant nature of |f| is what yielded the most difficulties.

2.2 Consonant+rhotic

Cɹ clusters differed from Cl in that the second consonant of Cɹ cluster, the retroflex approximant |ɹ|, had no phonetic correspondence in Nura's phonological knowledge prior to her learning English. In light of this, it is not surprising that Nura did not acquire

any of her Cɹ clusters until after she had mastered |ɹ| in singleton onsets, at 4;01.09. Compared to her Cl clusters, she had less difficulty with labiality, even if we still observed a number of cases of vowel epenthesis in her early productions of Cɹ clusters. As well, in ways similar to the extended pattern of epenthesis for |fl|, vowel insertion to break up the target cluster only occurred when the rhotic was preceded by a fricative, in |fɹ| and |θɹ| clusters. In contrast to this, clusters which begin with a stop (|pɹ|/|bɹ|, |tɹ|/|dɹ|, and |kɹ|/|gɹ|), did not follow a pattern of epenthesis, but instead one of substitution in the earliest recorded sessions, which fell in line with Nura's patterning of |ɹ| in singleton onsets.

Focusing on |fɹ|, we notice an earlier articulatory mastery as compared to |fl|. This is likely due to the fact that |ɹ| involves a labial articulatory component which, as mentioned in section 2.1 of Chapter 3, may be analyzed as an enhancement feature to the retroflection or bunching of the tongue (Ladefoged & Maddieson 1996; Keyser & Stevens 2006; Stevens & Keyser 2010). We can thus speculate that the sharing of this labiality in labial+ɹ clusters, as compared to labial+l, provided Nura with an easier transition between the two consonants. As well, it is possible that Nura's earlier acquisition of |fɹ| was facilitated by her markedly frequent usage of the words *frozen* and *frog* very early on. While our data does not allow us to determine which of articulatory place sharing within the cluster, or frequency, governed this development, we note in the next paragraph that place sharing also appears to have played a role in clusters that begin with a coronal fricative

Lastly, Nura's |θɹ| clusters were only mastered by 4;09.12, a full eight months after the mastery of |ɹ| in singletons. |θɹ| also is the only cluster which includes two foreign

sounds, neither of which is available through her Kazakh inventory or her passive knowledge of Chinese. This likely made |θɹ| more difficult to acquire compared to the other onset clusters. After an early period of vowel epenthesis, already discussed above, Nura moved to a stage during which she substituted [s] for |θ| and [l] for |ɹ|. This pattern of substitution is in line with what we observed in her singletons, where she substituted [s] for |θ| until mastery. The substitution of [l] for |ɹ| in this cluster also brings an element of alveolar place sharing between the two consonants in a way similar to what we discussed above for |fɹ|. More generally the combination of a fricative and a liquid in a cluster seems to have involved marked difficulties, as Nura continued to display difficulties with producing |ɹ| within this particular cluster until the end of the documented period.

2.3 Consonant+glide

Nura mastered her CG clusters early on, in spite of a lengthy pattern of variation which is essentially the result of a lexical exception, *quack,* as discussed in section 3.3.1.1 of Chapter 4. Nura's early mastery of CG clusters was likely the result of the relevant sounds being already available in her Kazakh inventory.

2.4 s+Consonant

Similar to her CG clusters, Nura mastered sC clusters very early on, except for |sv|. All of the other sC clusters contained sounds already present in Nura's Kazakh inventory, which we can relate to early mastery.

2.5 Interim summary

In sum, in Nura's development of singletons and onset clusters, we saw what appears to be a gradience of difficulties when one or more of the following three conditions arose: when an English consonant was not available from her native Kazakh inventory or passive knowledge of Chinese; when there was any co-articulation issues between sounds (in clusters); and when the first consonant in the cluster was a fricative other than |s|.

3 Implications for theories of second language acquisition

In the following subsections, we discuss the implications of the data and how it relates to the background literature as previously summarized in Chapter 2. In this discussion we focus primarily on transfer effects, as predicted by the Speech Learning Model and the Full Transfer, Full Access theory of L2 acquisition, also in relation to the Critical Period Hypothesis.

As previously discussed in section 2.1 of Chapter 2, the Speech Learning Model (SLM) by Flege (1987) states that an L2 learner will modify L1 categories for similar phonemes found in their L2 but that, in cases where there is an L2 category which does not find a similar correspondent in the L1, the learner will have to create a new category. The creation of this new category is predicted to take time and be influenced by properties of the input from the L2.

Concerning Nura's development of |ɹ|, Kazakh and English have similar categories in that they both display a rhotic in their inventories, although, as described in section 2.1

of Chapter 3, these rhotics differ articulatorily. Thus, Nura had to modify her L1 rhotic category, the approximant trill |r|, to match her L2 rhotic category, the retroflex approximant |ɹ|, something which she achieved early on, by 4;01.26. In ways that are, in part, similar to her acquisition of |ɹ|, Nura was also able to use the features of [s] as a stepping stone for her acquisition of |θ|. [s] is an alveolar fricative, which is very close to dental |θ| in place of articulation, also with the same manner of articulation. In sum, Nura's relatively rapid development of English |ɹ| and |θ| appears to be the result of partial transfer from her native system.

As mentioned in section 2.1 of Chapter 2, the predictions of the SLM are in practice similar to that of the Full Transfer, Full Access (FT/FA) model of second language acquisition, even though these two models are based on different theoretical assumptions about the nature of the human language faculty. (This topic transcends the scope of this thesis.) More generally, the data supports the notion that Nura truly behaved like an L2 learner, more so than an L1 learner, during her development. As discussed, Nura had little to no difficulty in acquiring most of her singletons and onset clusters, except when they involved phone categories that were not already available, if only in part, through her language background.

Returning to the question concerning the conditions needed for transfer, introduced in section 2.2 of Chapter 2, the data suggests that access, through transfer, of corresponding structures between the L1 and the L2 is key to the rapid acquisition of foreign sounds (see, also, Brown & Matthews 1993). Our data also supports that there *must* be corresponding structures in order for transfer to occur (as argued by Andersen 1983 and Brown & Matthews 1993), given that it is the phones of English which have at

least some correspondence to those of Kazakh (e.g. |ɹ|, |θ|) that were mastered early. Finally, concerning *when* transfer actually occurs, it appears from the developmental patterns observed that transfer is virtually immediate given the child's rapid mastery of all the transferable categories from Kazakh to English.

More generally, since Nura was very young when she first began acquiring English (only a few days before recordings began, at 3;11.11), she can be considered to have been within the critical period for L1 acquisition, as stated in 3.2 of Chapter 2. This notion is further supported by Nura's ability to quickly acquire most of the singletons and onset clusters of English early on, with little to no difficulty, even if the phonotactics of Kazakh proscribe initial clusters. This leaves open the question as to whether there is a link between rate of transfer and the critical period, something we could only study in a meaningful way based on additional learners who would be older than Nura, but otherwise share her linguistic background.

4 Limitations of study

In spite of the findings highlighted above, this study is not without limitations. For one, this is a case study which cannot be readily generalized to all L2 learners, irrespective of any language learning situation. As well, the observed dataset consists of recordings which are approximately one month apart. Thus it is possible that we were not able to observe all of the developmental facts that may have taken place between the recordings. In relation to this is the absence of statistical treatment of our data. Finally, while a formal analysis of the patterns discussed above transcends the scope of this thesis, the lack of such analysis prevents us from making strong claims to support

theoretical hypotheses. Nonetheless, this study offers one further step toward our understanding of child L2 acquisition, and adds to the pool of limited longitudinal studies in L2 development during childhood.

5 Conclusion

To conclude, while this study is presented with limitations, it provides a starting point for future studies concerning both the L2 acquisition of English by Kazakh speakers and, more generally, L2 acquisition during childhood. This study also provides a starting point to better understand how we can provide support and education to immigrant children and their families upon their arrival to Canada as they begin their transition into their new linguistic community.

References

Abuov, Zhoumaghaly. 1994. The Phonetics of Kazakh and the Theory of Synharmonism. *University of California Working Papers in Phonetics* 88. 39–53.

Adjemian, Christian. 1976. On the Nature of Interlanguage Systems. *Language Learning* 26(2). 297–320. https://doi.org/10.1111/j.1467-1770.1976.tb00279.x.

Andersen, Roger. 1983. Transfer to Somewhere. In *Language Transfer in Language Learning*, 177–201. Rowley, MA: Newbury House.

Barlow, Jessica A. 2002. Error Patterns and Transfer in Spanish-English Bilingual Phonological Development. *Proceedings of the Annual Boston University Conference on Language Development* 26(1). 60–71.

Blakemore, Colin & Grahame F. Cooper. 1970. Development of the Brain Depends on the Visual Environment. *Nature* 228(5270). 477–478. https://doi.org/10.1038/228477a0.

Bley-Vroman, Robert. 1989. What Is the Logical Problem of Foreign Language Learning? In *Linguistic Perspectives on Second Language Acquisition*, 41–68. Cambridge University Press.

Braidi, Susan M. 1999. *The Acquisition of Second Language Syntax*. New York: Oxford University Press.

Brown, Cynthia A. & John Matthews. 1993. The Acquisition of Segmental Structure. *McGill Working Papers in Linguistics* 9. 46–76.

Chomsky, Noam. 1957. *Syntactic Structures*. The Hague: Mouton.

Corder, S. P. 1967. The Significance of Learner's Errors. *IRAL - International Review of Applied Linguistics in Language Teaching* 5(1–4). 161–170. https://doi.org/10.1515/iral.1967.5.1-4.161.

Csató, Éva Ágnes & Lars Johanson (eds.). 1998. *The Turkic Languages*. London: Routledge.

Demuth, Katherine & Elizabeth McCullough. 2009. The Longitudinal Development of Clusters in French. *Journal of Child Language* 36(02). 425. https://doi.org/10.1017/S0305000908008994.

Dotton, Zura & John Doyle Wagner. 2018. *A Grammar of Kazakh*. Duke University Slavic and East European Language Resource Center.

Eckman, Fred R. 1991. The Structural Conformity Hypothesis and the Acquisition of Consonant Clusters in the Interlanguage of ESL Learners. *Studies in Second Language Acquisition* 13(1). 23–41. https://doi.org/10.1017/S0272263100009700.

Els, Theo van, Theo Bongaerts, Guus Extra, Charles van Os & Anne-Mieke Janessen-van Dieten. 1984. *Applied Linguistics and the Learning and Teaching of Foreign Languages*. London: Edward Arnold.

Epstein, Samuel D., Suzanne Flynn & Gita Martohardjono. 1998. The Strong Continuity Hypothesis: Some Evidence Concerning Functional Categories in Adult L2 Acquisition. In Suzanne Flynn, Gita Martohardjono & Wayne A. O'Neil (eds.), *The Generative Study of Second Language Acquisition*, 61–71. Mahwah, N.J.: Lawrence Erlbaum Associates.

Eubank, Lynn. 1993. On the Transfer of Parametric Values in L2 Development. *Language Acquisition* 3(3). 183–208. https://doi.org/10.1207/s15327817la0303_1.

Flege, James E. 1987. The Production of 'New' and 'Similar' Phones in a Foreign Language: Evidence for the Effect of Equivalence Classification. *Journal of Phonetics* 15. 47–65.

Flege, James Emil, Grace H. Yeni-Komshian & Serena Liu. 1999. Age Constraints on Second-Language Acquisition. *Journal of Memory and Language* 41(1). 78–104. https://doi.org/10.1006/jmla.1999.2638.

Fries, Charles C. 1945. *Teaching & Learning English as a Foreign Language*. Ann Arbor: University of Michigan Press.

Gass, Susan M. & Larry Selinker. 2008. *Second language acquisition: an introductory course*. 3rd ed. New York: Routledge/Taylor and Francis Group.

Genesee, Fred. 1989. Early Bilingual Development: One Language or Two? *Journal of Child Language* 16(01). 161–179.

Goad, Heather. 2011. The Representation of sC Clusters. In Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume & Keren Rice (eds.), *The Blackwell Companion to Phonology*, 898–923. Oxford, UK: John Wiley & Sons, Ltd. https://doi.org/10.1002/9781444335262.wbctp0038.

Goad, Heather & Lydia White. 2006. Ultimate Attainment in Interlanguage Grammars: A Prosodic Approach. *Second Language Research* 22(3). 243–268.

Harwerth, Ronald S., Earl L. Smith, Gary C. Duncan, M. L. J. Crawford & Gunter K. Von Noorden. 1986. Multiple Sensitive Periods in the Development of the Primate Visual System. *Science* 232(4747). 235–238.

Hawkins, Roger & Cecilia Yuet-hung Chan. 1997. The Partial Availability of Universal Grammar in Second Language Acquisition: The 'Failed Functional Features Hypothesis.' *Second Language Research* 13(3). 187–226. https://doi.org/10.1191/026765897671476153.

Hurford, James R. 1991. The Evolution of the Critical Period for Language Acquisition. *Cognition* 40(3). 159–201. https://doi.org/10.1016/0010-0277(91)90024-X.

Ionin, Tania & Kenneth Wexler. 2002. Why is "is" easier than "-s"?: acquisition of tense/agreement morphology by child second language learners of English. *Second Language Research; London* 18(2). 95–136. http://dx.doi.org.qe2a-proxy.mun.ca/10.1191/0267658302sr195oa.

Janssen, Caressa, Eliane Segers, James M. McQueen & Ludo Verhoeven. 2017. Transfer from Implicit to Explicit Phonological Abilities in First and Second Language Learners. *Bilingualism* 20(4). 795–812. http://dx.doi.org.qe2a-proxy.mun.ca/10.1017/S1366728916000523.

Jensen, John T. 1993. *English Phonology*. Amsterdam, The Netherlands: John Benjamins Publishing Company.

Jie, Xu. 2008. Error Theories and Second Language Acquisition. *US-China Foreign Language* 6. 35–42.

Johnson, Jacqueline S & Elissa L. Newport. 1989. Critical Period Effects in Second Language Learning: The Influence of Maturational State on the Acquisition of English as a Second Language. *Cognitive Psychology* 21(1). 60–99. https://doi.org/10.1016/0010-0285(89)90003-0.

Kellerman, Eric. 1995. Crosslinguistic Influence: Transfer to Nowhere? *Annual Review of Applied Linguistics* 15. 125–150. https://doi.org/10.1017/S0267190500002658.

Keyser, Samuel Jay & Kenneth N. Stevens. 2006. Enhancement and Overlap in the Speech Chain. *Language* 82(1). 33–63. https://doi.org/10.1353/lan.2006.0051.

Khansir, Ali Akbar. 2012. Error Analysis and Second Language Acquisition. *Theory and Practice in Language Studies* 2(5). 1027–1032.

Ladefoged, Peter & Ian Maddieson. 1996. *The Sounds of the World's Languages*. Cambridge, MA: Blackwell.

Lado, Robert. 1957. *Linguistics Across Cultures*. Ann Arbor, Michigan: University of Michigan Press.

Lenneberg, Eric H. 1967. *Biological Foundations of Language*. New York: Wiley.

Lennon, Paul. 1990. The Advanced Learner at Large in the L2 Community: Developments in Spoken Performance. *International Review of Applied Linguistics in Language Teaching* 28(4). 309–324.

Long, Michael H. 1990. Maturational Constraints on Language Development. *Studies in Second Language Acquisition* 12(3). 251–285. https://doi.org/10.1017/S0272263100009165.

Major, Roy C. 2008. Transfer in Second Language Phonology. In *Phonology and Second Language Acquisition*, 63–94. John Benjamins Publishing Company.

McAllister Byun, Tara & Yvan Rose. 2016. Analyzing Clinical Phonological Data Using Phon. *Seminars in Speech and Language* 37(2). 85–105.

Mori, Chihiro & Kazuhiro Wada. 2015. Songbird: A Unique Animal Model for Studying the Molecular Basis of Disorders of Vocal Development and Communication. *Experimental Animals* 64(3). 221–230. https://doi.org/10.1538/expanim.15-0008.

Muhamedowa, Raihan. 2016. *Kazakh: A Comprehensive Grammar*. Routledge.

Newport, Elissa L. 1984. Constraints on Learning: Studies in the Acquisition of American Sign Language. *Papers and Reports on Child Language Development* 23. 1–22.

Newport, Elissa L., Daphne Bavelier & Helen J. Neville. 2001. Critical Thinking about Critical Periods: Perspectives on a Critical Period for Language Acquisition. 24.

Newport, Elissa L. & Ted Supalla. 1987. A Critical Period Effect in the Acquisition of a Primary Language. University of Illinois, ms.

Odlin, Terence. 1989. *Language Transfer: Cross-Linguistic Influence in Language Learning* (Cambridge Applied Linguistics Series). Cambridge: Cambridge University Press.

Richards, Jack C. 1974. *Error Analysis: Perspectives on Second Language Acquisition* (Applied Linguistics and Language Study). London: Longman.

Richards, Jack C. 2013. *Longman Dictionary of Language Teaching and Applied Linguistics*. 4th edn. Routledge. https://doi.org/10.4324/9781315833835.

Rose, Yvan & Brian MacWhinney. 2014. The PhonBank Project. *The Oxford Handbook of Corpus Phonology*. https://doi.org/10.1093/oxfordhb/9780199571932.013.023.

Rose, Yvan, Brian MacWhinney, Rodrigue Byrne, Gregory Hedlund, Keith Maddocks, Philip O'Brien & Todd Wareham. 2006. Introducing Phon: A Software Solution for the Study of Phonological Acquisition. In David Bamman, Tatiana Magnitskaia & Colleen Zaller (eds.), *Proceedings of the 30th Annual Boston University Conference on Language Development*, 489–500. Somerville, MA: Cascadilla Press.

Schachter, Jacquelyn. 1974. An Error in Error Analysis 1. *Language Learning* 24(2). 205–214. https://doi.org/10.1111/j.1467-1770.1974.tb00502.x.

Schachter, Jacquelyn. 1988. Second Language Acquisition and Its Relationship to Universal Grammar. *Applied Linguistics* 9(3). 219–235. https://doi.org/10.1093/applin/9.3.219.

Schachter, Jacquelyn & Marianne Celce-Murcia. 1977. Some Reservations Concerning Error Analysis. *TESOL Quarterly* 11(4). 441–451. https://doi.org/10.2307/3585740.

Schwartz, Bonnie D. & Rex A. Sprouse. 1996. L2 Cognitive States and the Full Transfer/ Full Access Model. *Second Language Research* 12(1). 40–72. https://doi.org/10.1177/026765839601200103.

Selinker, Larry. 1972. Interlanguage. *International Review of Applied Linguistics* 10. 209–231.

Spolsky, Bernard. 1989. *Conditions for Second Language Learning: Introduction to a General Theory*. Oxford: Oxford University Press.

Stevens, Kenneth N. & Samuel J. Keyser. 2010. Quantal Theory, Enhancement and Overlap. *Journal of Phonetics* 38(1). 10–19.

Stockwell, Robert P. & J. Donald Bowen. 1965. *The Sounds of English and Spanish* (Contrastive Structure Series). Chicago: University of Chicago Press.

Vainikka, Anne & Martha Young-Scholten. 1994. Direct Access to X'-Theory. In *Language Acquisition Studies in Generative Grammar*, 265–316. Amsterdam, The Netherlands: John Benjamins Publishing Company.

Vajda, Edward J. 1994. Kazakh Phonology. *Opsucula Altaica: Essays Presented in Honor of Henry Schwarz; Western Washington University* 603–650.

White, Lydia. 2003. *Second Language Acquisition and Universal Grammar* (Cambridge Textbooks in Linguistics). Cambridge: Cambridge University Press.

Yamaguchi, Yumiko & Satomi Kawaguchi. 2014. Acquisition of English Morphology by a Japanese School-Aged Child: A Longitudinal Study. *Asian EFL Journal* 16(1).

Young-Scholten, Martha & John Archibald. 2000. Second Language Syllable Structure. In John Archibald (ed.), *Second Language Acquisition and Linguistic Theory*, 64–101. Malden, MA: Blackwell.