Phonological development of consonants in Vietnamese children

by
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To my grandfather and my children

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Chapter 1: Introduction

Speech patterns in Vietnamese phonological development have been the subject of a number of research works. However, the topic has not been investigated from a longitudinal perspective. This current research proposes a first step in this direction, through:

- Description of two longitudinal case studies on the first language development of Vietnamese
- Identification of a number of issues both concerning the data and their analysis
- Publication of the entire dataset to a public database to potentiate more research the issues observed and beyond

As we will see, although differences were detected in the acquisition of consonants by the two children participating in this research, in general, both of them showed similarities in terms of the stages and order of consonantal development. In particular, both children were better at acquiring coda consonants than onset consonants. They also shared similar patterns in the development of their consonantal inventories in terms of early versus late acquired consonants as well as the phonological processes relating to the acquisition of these consonants.

Building on these observations, I then focus on the intriguing pattern of palatalization observed in the speech of both children recorded for the present study, in addition to being attested in the past literature on Vietnamese development. As we will see, I attribute this process to a pattern of palatalization present in the speech of adult Vietnamese speakers addressing young children (child-directed speech).

Beyond these descriptions and analyses, this study offers further practical potential, which comes from its empirical coverage, especially from the longitudinal research design, which may provide preliminary bases for understanding how children come to develop erroneous speech production patterns or, during later stages, resolve these patterns toward more target-appropriate productions. This work would in turn offer an extended basis toward the diagnosis and treatment of phonological disorders in Vietnamese children. In a related fashion, the proposed study also offers potential for more effective ways to address problems related to the acquisition of Vietnamese by children in bilingual environments or by foreign people learning Vietnamese as a second language.

Chapter 2: Background

1. Vietnamese: an overview

Vietnamese is a Mon-Khmer language, member of the Austroasiatic language family. There are three main mutually intelligible regional dialects: the Northern, Central, and Southern varieties. The current study mostly involves the Northern dialect of Vietnamese, in particular the "standard" variety of Hanoi (the capital city) and nearby region. Particular aspects of the phonological system of other dialects will be described when relevant.

Vietnamese can be considered a typical isolating, non-inflectional language with lexical tones. The basic word order is Subject-Verb-Object (SVO). Verbs have no tense or person/number agreement markings. Nouns also do not have morphological inflections for case, gender, person, or number. Other typical characteristics of Vietnamese are serial verbs, in-situ *wh*- words, pro-dropping, and a classifier system (Aikhenvald, 2007; Edmondson, 2006).

Western linguists have long considered Vietnamese as having a monosyllabic word structure. However, not all Vietnamese words consist of only one syllable or one morpheme. Vietnamese words can be monosyllabic, disyllabic, and at times even longer. In fact, 80% of the Vietnamese lexicon is disyllabic (D. H. Nguyen, 1997). Polysyllabic words are formed via compounding and/or reduplication, and the syllables of a word are not written together or with hyphens, but separately with a space between them. This is one of the main reasons why most foreign scholars have considered Vietnamese a monosyllabic language. Another reason comes from the fact that all morphemes that are native to Vietnamese are monosyllabic. Morphemes that are disyllabic originate in foreign loanwords and words with obscure etymology. For examples, *cù lao* "island", *măng cụt* "mangosteen", *sầu riêng* "durian" are borrowed form Malay, while *xà phòng/xà bông*

“soap bar”, *cà rốt* “carrot”, *sơ mi* “shirt”, *ca vát* “tie” come from original French words (D. H. Nguyen, 1997).

When we consider the phonology and phonetics of Vietnamese, it is necessary to notice the differences between “literary Vietnamese” and the colloquial language that is used on a daily basis. In the literary language, the pronunciation of the initial consonants is based on orthography. Literary Vietnamese involves clear distinctions between 'l' and 'n', 's' /ʂ/ and 'x' /s/, 'tr' /ʈ/ and 'ch' /c or tɕ/, and 'r' is pronounced as [r] (for loanwords) and [ʐ] (for native words). Below are some examples:

(1) Words are pronounced differently in “literary Vietnamese”

Words	**Gloss**
så – xả	lemongrass – exhaust
tra – cha	check, look up – father
lên – nên	up – should

Children going to kindergartens and elementary schools are taught to read/pronounce words in a “standard” way which follows the literary rules. This is considered the “formal” or “educated” style. However, in the spoken colloquial language, those different sound pairs are merged together, especially in the Northern dialect. For example, in this dialect, /l/ and /n/ are freely interchangeable; /ʂ/ is pronounced as [s], /ʈ/ as /c/ or /tɕ/, while /r/ or /ʐ/ are both pronounced as /z/. For the purposes of my study, the colloquial language is used as the target to the child’s phonology, except for cases where the literary pronunciation is employed and emphasized by the caregivers and the participants.

1.1 Vietnamese phonology

1.1.1 Syllable structure

The syllable structure of Vietnamese is schematized as follows:

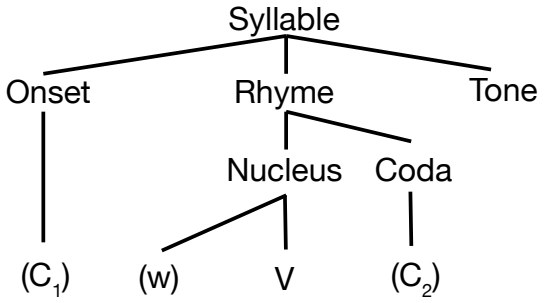


Figure 1: Vietnamese syllable structure

This representation is, for the most part, uncontroversial. However, two issues remain under debate to this day. They relate to the domain of tone assignment and to the status of the glide [-w-], as to whether Vietnamese allows for consonantal clusters in the onset of syllables. I address these issues in turn below, as part of my description of each syllable position.

The onset position (C_1) can host any of the consonants of the Vietnamese inventory, discussed in the next section. As just mentioned, the status of [w] within what phonetically can be described as onset clusters, remains controversial. Traditionally, [-w-] is named "medial" and is considered an optional part of the rhyme, independent from the vowel and the final consonant (Đoàn, 1977; Hoàng & Vương, 1994). In this scenario, there is absolutely no initial consonantal clusters in Vietnamese. This position has however been challenged by Pham (2003, 2009), who argues that /w/ should be identified as a part of the onset, with Cw clusters (where C stands for any consonant) forming the only type of tautosyllabic consonantal clusters in the language. Adopting yet a different approach, Kirby (2011) transcribes /w/ as an initial consonant when there is no

other consonant in the onset of a syllable, and as a secondary labial articulation accompanying other initial consonants (C^w). As this issue transcends the goal of this thesis, I will follow Đoàn (1977) and assume that [w] within Cw syllable-initial sequences is syllabified as the first member of the nucleus.

Vowels (V) and tones are the two obligatory components of a Vietnamese syllable. The coda (C_2) can be a glide, a nasal or a stop, which belong to the final consonant inventory (also discussed in the section below). In the coda position, the approximant /j/ never follows a nucleus containing a front vowel, and the approximant /w/ never follows a nucleus containing a rounded vowel. C_1, C_2 and [-w-] are optional elements in a syllable. The domain of tones is argued to be the whole syllable (Đoàn, 1977; Hoàng & Vương, 1994) or the rhyme – including both vowel and final consonant (Pham, 2003). I describe each phonological unit of the Vietnamese syllables in sections 1.1.2 and 1.1.3 below.

1.1.2 Segmentals

1.1.2.1 Consonants

I introduce the syllable-initial consonant inventory assumed in the context of this study in Table 1 below. As we can see, the consonant inventory of Vietnamese syllable onsets consists of oral and nasal plosives, fricatives, approximants, one rhotic and one affricate. In the paragraphs that follow, I discuss aspects of this inventory which may prove relevant to either empirical aspects of the current study or theoretical assumptions relevant to the analyses discussed throughout this thesis. These controversial aspects of the inventory are indicated through grey shadings in the table below.

	Labial	Labio-dental	Alveolar	Palatal	Velar	Glottal
Plosive	p b(ɓ)		t t^h d (ɗ)	(c)	k	
Fricative		f v	s z		x ɣ	h
Affricate				tɕ		
Nasal	m		n	ɲ	ŋ	
Approximant	w					
Lateral approximant			l			
Rhotics			r			

Table 1: Northern Vietnamese initial consonant inventory (Hoàng & Vương, 1994)

Thompson (1965) and Kirby (2011) both describe /b/ and /d/ as implosive (/ɓ/ and /ɗ/). However other authors just use the symbols /b/ and /d/ for these consonants. Đoàn (1977), Hoàng & Vương (1994) and Pham (2009) consider /t, t^h, n, l/ as part of the alveolar group, but Thompson (1965) and Kirby (2011) both consider them as dental consonants. The orthographic “ch” is traditionally described as a voiceless palatal stop /c/. However, Kirby (2011) reports it as a voiceless palatal affricate /tɕ/ based on modern Vietnamese speech samples. I attest to this matching my intuition as a native speaker of Vietnamese and, accordingly, I adopt this transcription for the target forms described in this thesis.

Another ongoing debate about Vietnamese phonology regarding whether the glottal stop /ʔ/ is a phoneme of the initial consonant system. Đoàn (1977), Kirby (2011), Pham (2009) and Thompson (1965) argue, based on evidence from language games and reduplication, that /ʔ/ is encoded as part of phonemic representations. However, the distribution of this consonant is fully predictable (at the beginning of otherwise onsetless syllables) and thus can be considered epenthetic (similar to English and many other languages). In line with these observations, I do not consider /ʔ/ to be encoded in lexical representations.

As mentioned in section 1, /l/ and /n/ are freely interchangeable in the Northern dialect. From a normative perspective, this phenomenon is usually associated to “non-standard” or “mistaken”. Beyond normative considerations, this phenomenon also implies that learners of Vietnamese may be exposed to variable pronunciations for certain lexical entries. As discussed further in Chapter 4, my study will offer additional insight on how free phonetic variation may influence children’s lexical and related phonological development.

Finally, I include /p/ and /r/ within the inventory because they do occur in a number of loan words. This completes the description of the consonants which occur in syllable initial position in Vietnamese. I now turn to the consonants which occur in syllable codas. The syllable-final consonant inventory is shown in Table 2 below. As we can see, this inventory primarily consists of stops (oral and nasal) and glides.

	Labial	Alveolar	Palatal	Velar	Velar-labial
Voiceless stop	p	t	[c]	k	[k͡p]
Nasal	m	n	[ɲ]	ŋ	[ŋ͡m]
Glide	w		j		

Table 2: Northern Vietnamese final consonant inventory (Pham, 2003; Kirby, 2011)

All the final oral stops are voiceless, phonetically realized as unreleased. Further, the velars /k/ and /ŋ/ have three allophones each. These consonants are phonetically fronted to [c] and [ɲ] when they follow front vowels (/i, e, ɛ/), doubly-articulated as [k͡p, ŋ͡m] when they follow back rounded vowels (/u, o, ɔ/), and realized as [k] and [ŋ] in all other contexts. Each of these observations is relevant to the current study, as any child learning Vietnamese must make generalizations about these distributional aspects of their target language.

This completes my discussion of the Vietnamese consonantal system. I continue in the next section with a description of the vocalic system of the language.

1.1.2.2 Vowels

Following Kirby (2011), I employ a system of nine vowel qualities.

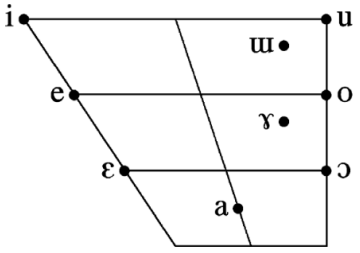


Figure 2: Vietnamese vowel system (Kirby, 2011)

This system, shown in Figure 2, consists of three front vowels, one central vowel, and five back vowels (two of which are unrounded and the other three are rounded).

In Vietnamese, vowel length is contrastive for some vowel qualities. Specifically, long /a/ and short /ă/ are two phonemes, as well as long /ɤ/ and short /ɤ̆/, as shown in (2). Đoàn (1977) and Hoàng & Vương (1994) include /ɛ̆/ and /ɔ̆/ to make a 13-monophthong vowel inventory. Their evidence for this consists of pairs of words such as those in (3).

(2) Minimal pairs for /a – ă/ and /ɤ – ɤ̆/

Words	lan – lăn	sơn - sân
Gloss	spread – roll	paint - yard
IPA	[lan¹] - [lăn¹][1]	[sɤn¹] - [sɤ̆n¹]

1 The numbers represent tones, which are described in section 1.1.3.1

(3) Minimal pairs for /ɛ – ɛ̆/ and /ɔ – ɔ̆/

Words	cảnh – kẻng	bong - boong
Gloss	scene – gong	come off - deck
IPA 1	[kɛ̆ŋ^{4}] - [kɛŋ^{4}]	[bɔ̆ŋ^{1}] - [bɔŋ^{1}]
IPA 2	[kɛŋ^{4}] - [kɛŋ^{4}]	[bɔŋ͡m^{1}] - [bɔŋ^{1}]

Whether or not to consider [ɛ̆] and [ɔ̆] as two vowel phonemes in the inventory is still under debate and not relevant to my study, whose focus is solely on the acquisition of the Vietnamese consonantal system.

Beside the above-mentioned monophthongs, the vocalic system of Vietnamese also contains vowel clusters, diphthongs and triphthongs. Thompson (1965) and Emerich (2012) distinguish vowel clusters and diphthongs in Vietnamese. The three vowel clusters are /ie, uɵ, ɯɤ/. Diphthongs are combinations of the high monophthongs with one of the four semivowels (or glides) /j, u̯, w, ə/. The semivowels /w/ can either precede or follow main vowels while other semivowels can only follow the main vowels. Triphthongs are combinations of either a vowel cluster with a following glide or a preceding glide with a vowel cluster or a monophthong with a preceding glide and a following glide. Other authors only report three diphthongs which are either /ie, uo, ɯɤ/ (Đoàn, 1977; Hoàng & Vương, 1994) or /iə, uə, ɯə/ (Kirby, 2011; Pham, 2009). However, due to the fact that both vowel clusters and diphthongs are tautosyllabic (i.e. they form the only nucleus of the only syllable that they belong to, without any syllable boundary crossing) they can be considered of the same type. In this study, I do not differentiate vowel clusters and diphthongs, instead I use /iə, uə, ɯə/ as three falling diphthongs. And because I consider /-w-/ as a part of the nucleus instead of the onset, /-w-/ together with a single vowel form a rising diphthong, and /-w-/ together with /iə/ form a triphthong. In the next section, I turn

to describe the suprasegmental components of Vietnamese syllables which include tones, stress, and intonation.

1.1.3 Suprasegmentals

1.1.3.1 Tones

Most researchers agree that Vietnamese has a system of 6 tones, which is numerically coded in the current study as follows:

Tone 1 ("ngang") has a high-mid pitch level according to Thompson (1965), but is a mid tone according to Brunelle (2003) and is a high tone according to Đoàn (1977), Hoàng & Vương (1994) and Pham (2003). Thompson describes this tone with a trailing-falling contour and a lax feature. However it is a level tone according to other authors. Pham (2003) states that this tone is characterized by a modal voice.

Tone 2 ("huyền") is a low tone in Đoàn (1977), Hoàng & Vương (1994), Pham (2003) and Thompson (1965) but a mid-low tone in Brunelle (2003). It is described as a trailing tone with laxness and breathiness in Thompson (1965), a falling tone in Brunelle (2003) and Kirby (2011) and a level tone in Đoàn (1977) and Pham (2003). Brunelle (2003) notes that the slope of this tone is never very steep, and Pham (2003) also claims that breathy voice is a feature of this tone.

Tone 3 ("ngã") is described in Thompson (1965) as a high rising tone while it is a mid tone in Brunelle (2003) and a low tone in Pham (2003). Its other features are the curve or broken contour and strong glottalization or creakiness.

Tone 4 ("hỏi") is a mid-low tone in Thompson (1965), a mid tone in Brunelle (2003) and a low tone in other studies. Thompson mentions that this is a tense dropping tone, and according to

Kirby it is a falling tone, while Brunelle, Pham, and other authors describe it as curve, broken or falling for the first half of the vowel and rising at the end. This tone is accompanied by creaky voicing (Brunelle, 2003) or a breathy voice (Pham, 2003).

Tone 5 ("sắc") is a high rising tone, non-broken (Đoàn, 1977), tense (Thompson, 1965), with modal voice (Pham, 2003). Brunelle (2003) mentions that it starts at the mid-low point and rises to the upper end of the pitch range.

Tone 6 ("nặng") is a low tone (Đoàn, 1977; Kirby, 2011; Pham, 2003; Thompson, 1965) but a mid tone according to Brunelle (2003). This tone is described as tense, glottalized and dropping in Thompson (1965), "falls rapidly", "shorter" and "ends in a glottal stop" (Brunelle, 2003, p.2), falling and accompanied by creakiness (Pham, 2003).

Pham (2003) and Kirby (2011), following other scholars, argue for two additional tones ("checked" tones; Kirby, 2011) which are tone 5 and tone 6 in marked syllables with voiceless stop codas. For the data coding of this study, I follow the six-tone system.

1.1.3.2 Stress

Vietnamese does not have lexical stress (or word stress). Instead, the language has prosodic stress (phrasal stress and sentence stress). As Thompson (1965) states: "In ordinary speech the majority of syllables are accompanied by medium stress. In sequences of several such syllables alternate ones are slightly louder, but this is not a distinctive matter. Each pause group has at least one heavy stress. Weak stresses are fairly frequent in rapid passages, rather in careful speech" (p.41). However, Nguyen & Ingram (2007), in an experimental study, show that there is no evidence of contrastive stress patterns that are used by native speakers to distinguish compounds and noun phrases in Vietnamese.

1.1.3.3 Intonation

Thompson (1965) defines intonations as the patterns of "fading syllabic stress" (p.42). He states that decreasing stress contour which "involves a gradual diminishing of force from the beginning of the syllable" (p.42) is a feature of the vast majority of syllables. Final syllables in pause groups can be accompanied by fading intonation, sustaining intonation or increasing intonation. These types of intonations correlate with the tones of such syllables. Specifically, tones are somewhat lower with fading intonation, somewhat higher with sustaining intonation, and cover more of the voice range with increasing intonation.

Brunelle, Ha, & Grice (2012) however find that the use of intonation strategies to mark communicative functions varies a lot among speakers, some of whom do not even use intonations at all. They conclude that intonations are not grammaticalized in Vietnamese, due to the extensive use of sentence-final particles. The lexical tones also limit the role of intonations.

In summary, all the studies cited above show that even though stress and intonations may exist in Vietnamese, they are not as prominent as tones and, in many cases, it is hard to verify their actual properties. Therefore, in this study, I only focus on the development of tones in Vietnamese children, and do not aim at any analysis of the stress and intonation system.

In the following sections, I turn my focus to the process of acquiring Vietnamese by monolingual children, beginning with a summary of the previous studies about this topic.

2. Previous research on the acquisition of Vietnamese by children[2]

As already mentioned in the introduction, not many studies on the acquisition of Vietnamese by children currently exist, and only a few of them are currently available through the scientific literature. Of these, only two studies were published in English. The first is an article about phonological development in monolingual Vietnamese children with language disorders. The second is a thesis about the acquisition of the Vietnamese classifier system by children, which will not be relevant to my study.

Also compounding this documentation issue is the fact that most of those available studies are cross-sectional. While these studies provide us with a general picture of what phenomena might be observed in Vietnamese-learning children, alongside age ranges and other relevant developmental detail (see further below), these studies often fail to provide empirical observations about how individual learners come to display these phenomena and how these phenomena interact within an individual system.

In the next subsections, I describe the most central studies on Vietnamese phonological development.

2.1 Luru (1996)

The first study is by Luru (1996), who focuses on the Northern dialect of Vietnamese. This study includes 2 children observed longitudinally, and 150 children observed cross-sectionally. However the author only reports on the cross-sectional data, and only presents a few examples from the longitudinal data, limiting herself to observations about the development of lexical items.

2 This review does not include two additional cross-sectional studies, by Nguyễn (2011) and Phạm & McLeod (2019).

Lưu (1996) describes Vietnamese language development from three main perspectives: phonetic/phonemic, lexical, and syntactic. Most relevant to the current study are her findings about phonetic/phonemic development. However, the descriptions from this perspective are generally brief throughout the thesis, with no quantitative data reported.

The author illustrates the phonetic/phonemic development of the children over three age periods. Children between one and two years old, after the babbling period, have their very first words and they are able to produce CVC syllables. During the period between two and three years of age, there is a significant development in the children's vocabulary and phonemic inventories. Of the initial consonants, /b, m, p/ are well acquired from early on. Among these sounds, /b/ and /m/ are highly accurate. Sounds that occur more frequently in the children's speech are /b, m, d, t, n, k/. Sounds that occur less frequently in the children's speech are /g (ɣ), f, p, r, s/. The medial /-w-/ is dropped in all cases. The vowels /a/ and /ɯ/ are produced accurately. Children of this age attempt to produce all six final consonants. However, /n/ is more frequent, and /k, p/ are less frequent. The author does not mention whether final glides and consonants are pronounced correctly or not. Examples (4), (5), (6) illustrate some errors attested in the children's production of the segmental units. Regarding tones, tones 3 (ngã) and 4 (hỏi) are not stable. Tone 3 is produced as tone 5 (sắc), and tone 4 is produced as tone 6 (nặng), as given in (7) below. Other tones are produced accurately.

(4) Initial consonant substitutions (adapted from Lưu, 1996)

Errors	IPA Target	IPA Actual	Gloss
k → t	kwa^{5}	tuə^{5}	very
d → t	dɔŋ^{5}	tɔŋ^{5}	close
ɣ → h	ɣa^{2}	ha^{2}	chicken
l → n	lam^{2}	nam^{2}	work, do
x → h	xoŋ^{1}	hoŋ^{1}	no, not
ɲ → z	ɲɯ^{1}	zɯ^{1}	as
p → b	pin^{1}	bin^{1}	battery
tʰ → s	tʰɯ^{4}	sɯ^{4}	try
tʰ → c	tʰɤ̆t^{6}	cɤ̆t^{6}	real
c → t	caw^{2}	taw^{2}	greeting
s → tʰ	saŋ^{5}	tʰaŋ^{5}	morning
ŋ → ɲ	ŋu^{4}	ɲu^{4}	sleep

(5) Deletion of /-w-/ (adapted from Lưu, 1996)

IPA Target	IPA Actual	Gloss
hwa^{1}	ha^{1}	flower
kwa^{4}	ka^{4}	fruit
swăn^{1}	săn^{1}	curly
hwɛ^{2}	hɛ^{2}	Japanese pagoda tree

(6) Vowel substitutions (adapted from Lưu, 1996)

Error	IPA Target	IPA Actual	Gloss
e → ɤ̆	ec^{5}	ɤ̆k^{5}	frog
ɤ̆ → ɯ	tɕɤ̆n^{1}	tɕɯn^{1}	feet
ă → ɤ̆	kăp^{6}	kɤ̆p^{6}	bag
ɔ → ă	sɔŋ^{1}	săŋ^{1}	done
i → iə	but^{5} tɕi^{2}	but^{5} tɕiə^{2}	pencil
ɯə → iə*	hɯəw^{1}	hiəw^{1}	giraffe

*This should be considered as dialectal characteristic other than error made by the children.

(7) Tone substitutions (adapted from Luru, 1996)

Error	IPA Target	IPA Actual	Gloss
Tone 3 → Tone 5	mɤ^{3}	mɤ^{5}	fat
Tone 4 → Tone 6	kɯə^{4}	kɯə^{6}	door

Children between 4 and 6 years old show relatively stable productions of the initial consonants, medial /-w-/, vowels, final consonants and tones. However, variation remains notable among members of this age group.

Regarding the lexicon, the author reports that between 12 months and 18 months there are very few words produced. At 18 months the average number of words per child is 11; only one child has a vocabulary of 45 words, and some other children do not produce any word at all. Between 19 months and 21 months, the number of words increases quickly. At 21 months, the average number of words per child is 220. Between 21 months and 24 months, the number of words increases at a slower rate. At 24 months, the average words per child is 234. At 30 months, this number increases to 434, and it is 486 at 36 months. By 6 years old, the children in this study have an average of 1033 words. Monosyllabic words are acquired first, then polysyllabic words. Nouns and verbs are acquired before adjectives and pronouns.

Regarding syntax, at 13 months, the children only produce one-word sentences. At 17 and 18 months, they can produce one-phrase sentences, mostly a noun and a particle. At 22 months, they are able to create sentences that contain one noun and one verb. At 3 years old, they can form several sentence structures, such as Noun + Verb + Particle; Noun phrase + Verb phrase; Noun + Verb + Object.

2.2 Vũ et al. (2006)

The second study is by Vũ et al. (2006), who report on the acquisition of the Northern dialect as well. This is a cross-sectional study about the development of initial consonants and the average utterance length produced by children from 12 months old to 6 years old. All the children are typically developing.

30 children are selected for each group of age (6 months difference: 12-18 months, 19-24 months, etc.). In total the study includes 210 children. According to the results of this study, children in the age group between 12 months and 18 months are able to articulate the initial consonants /m/ and /b/ fairly accurately (98.8% and 82.3% target-like, respectively). 26 out of 30 children in this group use initial consonants /c/ and /k/ while 50% of them use /z, h, ɣ, s/, and these sounds are produced with more than 70% accuracy. The least accurate sounds produced are /tʰ/, /ɲ/, and /x/ (61.54%, 68.9%, and 26.9% respectively). From 19 to 24 months, /p, b, k, h/ are the most accurate sounds. Between 25 and 30 months, /ɲ/ is then produced with 85% accuracy. Children aged 31 to 36 months add /z, c, d, v/ to the acquired norm, while the consonants /t, ɣ, k, f, ŋ, s/ are acquired between 37 and 48 months. From 49 months to 60 months, /tʰ, n, x, l/ become parts of their phonemic inventories, and most children between 60 and 72 months have acquired all the initial consonants.

The authors state that /tʰ/ and /x/ are the most difficult sounds for all the children. /n/ is produced fairly accurately with 73% target-like forms at 24-30 months, however when /l/ is acquired at 31-48 months, these two consonants become “mistaken” for one another. The authors also mention the correlation between the frequency of the sounds used by the children and the rate of accuracy of the production. For examples, at the age of 49-60 months, /k, c, b, d/ occur the most frequently

and are produced more accurately (99.56%, 100%, 99.2%, and 98.9% target-like, respectively), while /x/ only occurs in 3.83% of the utterances and is produced less accurately (88.4%).

2.3 Tang & Barlow (2006)

The third study is by Tang & Barlow (2006) which is a cross-sectional description of the Southern dialect of Vietnamese. This study investigates four children in total, two of them are at the age of 4;4, the other two are 5;5. All four children are reported with language disorder (slower development compared to other children of the same age). The authors use a picture-naming task to elicit the words from those children.

The results of this study show that all tones produced by the children are adult-like, and there are very few errors in their pronunciations of vowels. All children are able to produce the initial plosives /b, d, t, k/, nasals /m, n/, glides /w, j/, the glottal fricative /h/, and the final consonants /p, k, m, ŋ/. Three out of four children can pronounce /ɲ/ in syllable-initial position. However, only one child has /tʰ/ and /ʈ/ in his/her phonemic inventory.

The article lists seven phonological processes that are shared by at least two children, including gliding, fronting, glottal replacement, backing, velar assimilation, stopping, and final consonant deletion. These findings are explained in light of markedness and functional load theories. Particularly, more marked sounds are replaced with less marked sounds, for examples:

(8) Phone substitutions (adapted from Tang & Barlow, 2006)
- a) /tʰ, f, x/ → [h]
- b) /s/ → [t]
- c) /z, l/ → [w, j]

However, the authors state that although some sounds are more marked, they still emerge in the children' actual speech, as shown in (9), because they are in line with the dialectal patterns.

(9) Final consonant neutralization (adapted from Tang & Barlow, 2006)
/n, t/ → [ŋ, k]

According to the authors, the high occurrence of velar sounds in both syllable-initial position (/k, ŋ, x, ɣ/) and syllable-final position (/k, ŋ/) and the dialectal feature of backing /n, t/ to [ŋ, k] have an influence on the children's productions.

2.4 Nguyễn & Phạm (2014)

The fourth study is by Nguyễn & Phạm (2014), which is also a cross-sectional report of the acquisition of the Southern dialect. In total, 725 children participated in this study, including 102 children aged 2;0-2;5, 105 children aged 2;6-2;11, 134 children aged 3;0-3;5, 132 children aged 3;6-3;11, 129 children aged 4;0-4;5, and 123 children aged 4;6-4;11. All children were typically developing.

According to the report, in general, of the five components of the Vietnamese syllable structure (i.e. tone, initial consonant, medial /-w-/, vowel, and final consonant), tones are the most accurately produced. The next are vowels, final consonants and initial consonants. The medial /-w-/ is the most problematic element with a high rate of errors in children of all ages, even those at 4;6-4;11.

Regarding tones, tone 6 (nặng) is the most accurately produced, without any errors. At 2 years of age, children have more errors with tones 2 (huyền) and 3 (ngã). Specifically, tone 2 is produced as tone 1 (ngang), and tone 3 is produced as tone 2. At 5 years of age, tone 3 (ngã) and tone 4 (hỏi) are more mistaken, with tone 4 produced as tone 3. This could be the effect of dialectal features. However, because this is a cross-sectional study, it is not clear whether those 5 year-old children had troubles with tone 3 and tone 4 earlier or only at the age of 5.

Final consonants are also better acquired than initial consonants and /-w-/. /ŋ/ has the highest rate of inaccuracy. 11% of the children at the age of 5 still make errors regarding this final sound. This finding is questionable though, because in Southern dialect, /n/ is backed to /ŋ/ so /ŋ/ should be acquired from early on.

/w/ has the second highest rate of inaccuracy: 0.8% of the five-year-old children make errors with this final glide. /p/ also has 0.5% rate of errors in children at 5 years old. /t/ and /n/ are acquired early on. The paper did not mention whether this is a pattern specifically belonged to the dialect under investigation.

Concerning initial consonants, children acquire /b, ɲ, n, z, v, m/ early on, while the later consonants to emerge are /t^h, x, ʂ, t, ŋ, ɣ/. At the age of 4;6-4;11, 28% of the children make errors with /t^h/ and 16.8% of the children make errors with /x/. While the authors did not provide much detail about the phonological processes affecting the consonants before they were acquired, a review of the few examples they provided suggests that the process of palatalization (C- → [c]/[ɲ]) can apply to virtually all initial consonants, while devoicing / voicing occurs in some cases (/f/ → [v], /d/ → [t], /ŋ/ → [k]).

The medial /-w-/ is the most problematic. 50.2% of the children at the age of 2;0-2;5 and 32.7% of the children at the age of 4;6-4;11 drop this element in their speech productions.

2.5 Interim summary

The research discussed above provides descriptions of phonological development in Vietnamese children mainly based on cross-sectional data. Although both the Southern and the Northern dialects have been investigated, the authors have obtained many common observations.

Firstly, the acquisition of tones and vowels takes place during early stages. Of the six tones, tone 3 (ngã) and tone 4 (hỏi) show the most errors. Secondly, children are better at pronouncing final consonants compared to initial consonants, and the medial /-w-/ is omitted in many of the cases reported. Thirdly, regarding the initial consonants, /m b k h/ are produced accurately from the beginning. In contrast, /tʰ/ and /x/ have been reported in all four documents as latest initial consonants to be acquired by the children. Fourthly, the authors also describe some dialectal phenomena such as the confusion between the two initial consonants /l, n/ in the Northern dialect, and the backing process of the final consonants /n, t/ to /ŋ, k/ in the Southern dialect.

3. Rationale, focus, and research questions

In this section, I present my research questions. These questions address theoretical, empirical and methodological aspects of the acquisition of Vietnamese phonology by children.

3.1 General questions about phonology and phonological development

In phonological development, two central questions concern 1) the nature of units in phonology; and 2) how they are acquired. For example, do children start with words, or syllables, and break them down into phones and features? Or vice versa; do children start with features and build up the larger elements from them?

Other questions relate how general the acquisition process is, and to what extent it is influenced by the properties of the target language. Specifically, what are the relationships, if any, between phonological processes observed in child language data and phonetic/phonological properties of the adult language?

3.2 Empirical questions

Within the scope of this thesis, my focus is to examine the development of initial and final consonants by the two children.

Although the acquisition of Vietnamese consonants has been investigated in several cross-sectional studies, questions remain regarding the order of development of consonantal sounds in terms of natural class effects or position within the word or syllable.

As we will see in Chapter 4, additional questions also emerge from observations about the types of production patterns attested in the corpus built for the purpose of this study. These questions focus in particular on late-acquired consonant such as /f, x, tʰ/, on a general pattern of palatalization as well as on the quality of the release of aspirated and affricate consonants /tʰ, tɕ/. As noted above, in addressing these observations, I will keep focusing on the question of variability and the factors that may drive it.

3.3 Methodological issues

All previous studies reported above use cross-sectional methods. Cross-sectional data only provide snapshots of degrees of development in separate individuals. While these types of data can provide useful information about population groups, they do not offer much detail about individual, systemic development (Rose & Inkelas, 2011). Another methodological issue involves dialectal variation. Of the four reports discussed above, two are about the Northern dialect of Vietnamese, and the other two are about the Southern dialect. Whether children speaking the two dialects share any patterns in phonological development and whether there are any typical patterns for each dialect still remain questions. Moreover, the study conducted by Tang & Barlow

(2006) raises up the question as to whether the phonological processes they detected are typical in Vietnamese children or they are signs of delayed development in language acquisition.

Now that I have finished presenting about previous literature of phonological development in Vietnamese children and laying out my research questions, I move to a description of the study that I conduct, beginning with details of the methodology in Chapter 3 and following by the description of data from the two corpora (Chapter 4).

Chapter 3: Methodology

1. Ethics approval

This study was granted ethical approval in April 2010. The ICEHR reference number is 2009/10-088-AR.

2. Participants

I recruited one participant from Vietnam, Hìu. Later, in 2014, a second participant, Mun, who is currently living in St. John's, joined in my study. Both children are reported by their parents to be typically developing.

2.1 Hìu

Participant 1 is a boy who was 1;5.24 (1 year 5 months and 24 days) on the first session of recording. He was born to a family in which the father is from Ha Noi and the mother is from Hai Phong, the two biggest cities in the North of Vietnam. The family is living in Hai Phong. All family members are from Hai Phong, and people in the neighbourhood are also from Northern Vietnam.

The child was staying at home with his grandmother during daytime over the period covering the first year and a half of the data collection. He then began to attend kindergarten. His mother, who also participated in some of the recording sessions, could only stay at home and play with him during evenings.

2.2 Mun

Participant 2 is a girl who was 1;7.8 on the first recording day. She was born to a family in which the father is from Ha Tinh, a province in the North-Central region, and the mother is from Hai Duong, a province in between Ha Noi and Hai Phong, in the Northern region of the country. Both parents moved to St. John's NL in 2011. Although they live in an English environment, the language used in their house is Vietnamese. The child was staying at home most of the time with her grandmother, who is also from Hai Duong and does not know English.

3. Recordings

Hìu and Mun were recorded using different means. Hìu was audio-recorded and Mun was videotaped.

3.1 Equipment

For the audio-recording, I used a Sony PCM-M10 audio recorder with built-in electret condenser microphones. I chose this audio recorder because it is portable, yet gives high quality recordings. The output sound file format is wav and the audio resolution is 48kHz sampling rate with 16 bit-depth. For the video recording, I used a Sony DCR-HC20 digital video camera recorder for 3 of the first 4 sessions, a Sony Alpha NEX-3 for the second session, and a Sony HVR-A1U digital HD video camera recorder for all other sessions with participant 2. An external microphone Sony ECM-MS907 was used in all videotaped sessions with the exception of the second session.

3.2 Process

3.2.1 Schedule

For Hìu, pilot recording sessions occurred in April and May 2010. Data collecting started in June 2010. Most of the recording sessions were conducted by his grandfather, at the boy's parents' house. The recording sessions were scheduled on a regular, fortnight basis. However, his grandfather could not keep that regularity due to intervening circumstances such as vacations or sickness. The recording of this first participant was completed in May 2013.

For Mun, I conducted all the recording sessions myself, in the child's parents' house. The recordings took place weekly during the first year of recording and after that once a month until the child's third birthday. However, there were some missing weeks also because the child was sick. The recording of this second participant is was completed in March 2016.

3.2.2 Length

For Hìu, length of the recording sessions varies from 5 minutes to 1 hour and 30 minutes, due to several reasons. The first reason is that for the first few sessions, the child was not used to sitting still in front of the recorder. He started to cry and ran away after only a few minutes. The second reason is that for some sessions, even though the length of the recordings were 30 minutes to one hour, there was so much background noise occurring toward the end of the sessions that the child's speech could not be captured clearly enough. I address this in more detail in section 3.3. In total, only 25 recordings were usable for my research.

For Mun, each recording session was set for one hour. However there are a few exceptions: session 4 was 50 minutes long, session 12 was 44 minutes long, session 19 and 22 were 34 minutes long. The reason for these exceptions is mainly that the child did not want to sit still in

front of the camera at the beginning of the sessions, therefore the recording started late and stopped before reaching the one hour duration, due to lunch or nap time. In total, there are 40 recordings.

3.2.3 Elicitation

The current study follows the tradition of naturalistic studies. The purpose was to record the children's speech in the most natural way possible, while they were playing with toys and/or looking at picture books. All the recording sessions were conducted in the form of natural conversations between the children and/or the caregivers (either mother or grandmother/grandfather) and the investigator. At the beginning, when the children did not know many words, the conversation mostly consisted of an informal naming task, i.e. the children were shown with toys and pictures – either on flash cards or in picture books – and were asked what the names of the toys or things/animals in the pictures were. When the children did not know the words, the adults would say the words and the children repeated. Later, when the children had learnt more words and could produce longer phrases and sentences, more story telling and spontaneous speech was involved.

3.3 Scenarios and quality of the recordings

3.3.1 Hìu

As mentioned above, all the recordings of Hìu took place in Hai Phong, Vietnam. It is nearly impossible to find a quiet room in a quiet house in a busy neighbourhood in one of the biggest cities in Vietnam. Even though all the recordings of Hìu were conducted in a closed room, there were still a lot of noises from the surrounding neighbourhood. Hìu's grandfather made every effort to keep the recorder as close to the child as possible, ideally at a distance of 20 to 30 centimetres, however, the lack of a high-quality external microphone and the fact that the child

from time to time moved away from the recorder or he spoke very quietly did affect the quality of a portion of the recordings. Particularly, of the total 28 sessions recorded, three sessions were rejected because of excessive levels of background noise. In other sessions, from time to time the child's speech was also unintelligible due to background noises.

3.3.2 Mun

The child was recorded in a house located in a quiet neighbourhood in St. John's, NL. The level of background noise was very low. During all recording sessions, the microphone was put on a pillow and mostly kept at a distance of 30 centimetres from the child. Except for the second session, which was recorded with a digital camera with only a built-in microphone, and except for some portions of some recordings in which the child moved away from the microphone, in general, the quality of the recordings is good enough for acoustic analysis.

3.3.3 Summary of recordings

Code-name	**Age**	**Length of recordings** (HH:MM:SS)	**Number of child utterances**[3]	**Code-name**	**Age**	**Length of recordings** (HH:MM:SS)	**Number of child utterances**
Hìu	1;05.24	00:04:16	22	Mun	1;07.08	01:00:04	82
	1;07.10	00:06:44	121		1;07.21	01:02:35	175
	1;07.14	00:30:25	210		1;07.28	00:49:31	186
	1;07.24	00:29:20	269		1;08.04	01:03:06	400
	1;08.22	00:30:10	169		1;08.11	00:59:40	285
	1;09.07	00:24:05	27		1;08.25	00:57:13	412
	1;09.23	00:25:50	402		1;09.02	01:02:40	457
	1;10.15	00:59:34	91		1;09.09	01:02:32	372
	1;10.30	00:22:44	144		1;09.16	01:00:14	317
	1;11.19	00:17:23	146		1;09.23	00:59:28	166
	2;02.01	00:24:09	95		1;09.30	00:43:28	267
	2;02.21	00:22:41	108		1;10.06	00:59:02	334
	2;03.11	00:36:07	185		1;10.20	01:02:20	330
	2;05.20	00:32:36	134		1;11.10	00:59:39	203

3 For both children, only intelligible utterances that were clear enough to be transcribed were counted here.

	2;06.09	00:46:14	80		2;00.02	00:33:12	156
	2;06.27	00:27:22	253		2;00.22	00:56:53	274
	2;07.12	00:57:46	438		2;01.13	00:58:58	278
	2;10.17	00:32:20	355		2;02.05	01:02:26	224
	2;11.06	00:50:17	506		2;02.25	01:02:12	342
	3;00.01	00:43:51	320		2;03.15	00:11:37	49
	3;00.19	01:29:01	840		2;03.22	01:03:02	351
	3;02.06	00:55:15	453		2;04.13	00:59:48	257
	3;02.28	00:49:27	410		2;05.03	01:01:48	308
	3;03.21	00:58:59	597		2;05.17	00:34:27	105
	3;04.29	01:03:43	518		2;06.00	01:02:34	242
					2;07.26	00:58:26	310
					2;11.07	00:28:47	212

Table 3: Summary of recordings

4. Data analysis

Data were transcribed and analyzed with Phon, a specialized software program for the building and analysis of phonological corpora (https://www.phon.ca/; Rose et al., 2006, Rose & MacWhinney, 2014).

4.1 Data transcription

Data from both corpora were transcribed by the author of the current study – a native speaker of Vietnamese and a person who had training in phonetic transcription in both Vietnamese and English. Only the portions of the child's speech that are intelligible were transcribed. Only 27 out of 37 recordings from Mun's corpus were transcribed to match Hìu's intervals of three weeks between recording sessions. Due to lack of other trained transcribers who are native speakers of Vietnamese, the transcription could be somewhat subjective. However I have double-checked every example that prove to be crucial for my data description and analysis.

4.2 Syllabification and alignment

All data from Hìu and Mun were annotated for syllabification information, with target (model/adult) and actual (child) forms aligned on a phone-by-phone basis. Note that these annotations (both syllabification and alignment) are driven by automatic algorithms in Phon, the outcomes of which may at times be problematic. In such cases, the user can modify them using the graphical user interface. Figure 3 and Figure 4 below show an example of how automatic syllabification annotations can be adjusted to fit the analysis of the language discussed in Chapter 2: section 1.1.1. Two separate issues are illustrated in these figures. The first relates to the glide /j/, which was at first syllabified (by Phon) as part of the syllable nucleus of the second syllable (Figure 3). In the revised form, in Figure 4, this glide is instead assigned a coda position. The second issue concerns the glide /w/ in the third syllable, which was automatically syllabified as part of the onset (Figure 3); it was then assigned a nucleus position (Figure 4). Finally, the three symbols /w/, /i/, /ə/ of this syllable were grouped to form a triphthong nucleus (Figure 4).

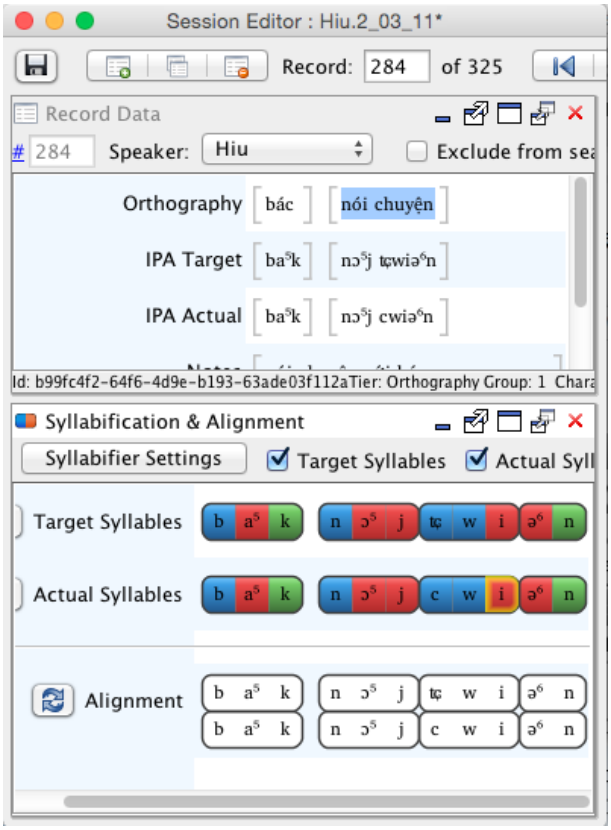


Figure 3: Example of groups before syllabification

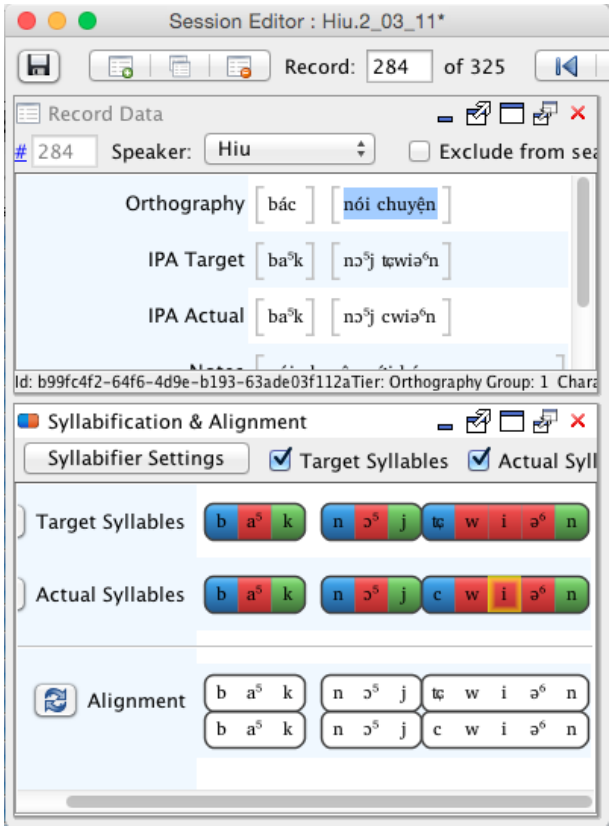


Figure 4: Example of groups after syllabification

Figure 5 and Figure 6 are examples of groups of segments before and after alignment verification. In Figure 5, /w/ was aligned automatically by Phon with /j/ based on their similarities as glides. In Figure 6, /w/ is re-aligned with /b/ based on the feature [labial].

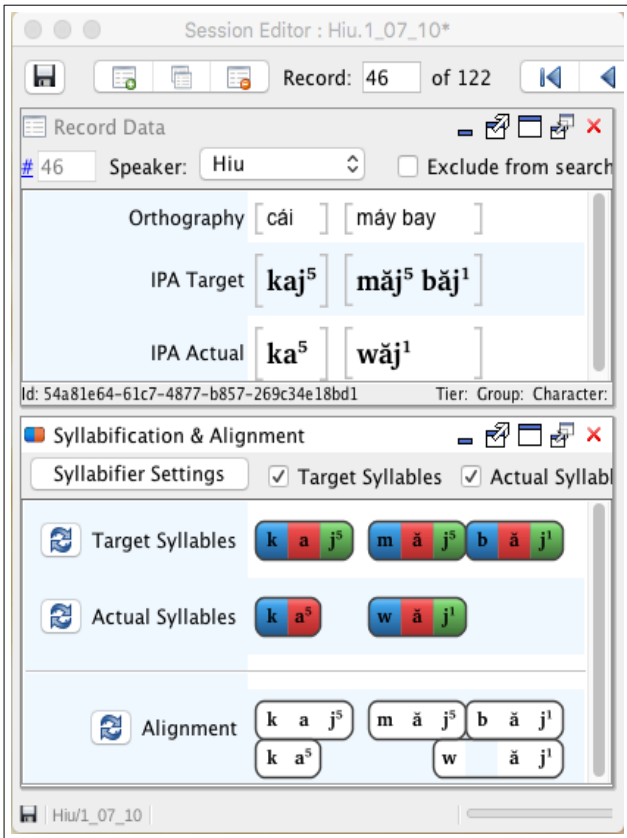


Figure 5: Example of groups before alignment

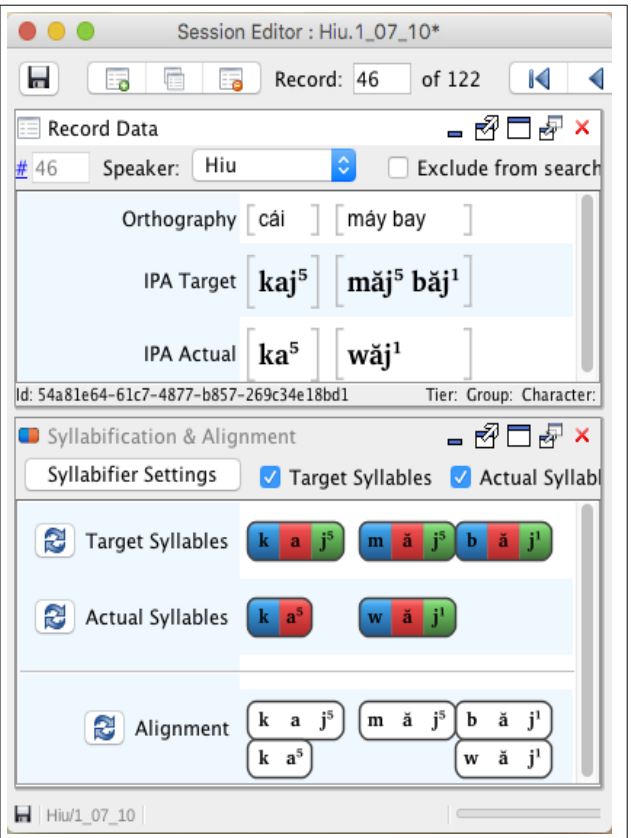


Figure 6: Example of groups after alignment

4.3 Data compilation

Once syllabification and alignment were done, I compiled the data using Phon's query system and reported them with spreadsheets to study in detail the children's phone inventories that developed over time, the emergence of phones in different positions in syllables, and the prominent phonological processes involved.

4.4 Result summaries and reports

As we will see in tables from Table 32 to Table 35 and from Table 44 to Table 47, a consonant is considered successfully acquired in a session (presented with a green checkmark) if the majority (i.e. more than 50%) of the child's productions of that consonant are target-like. Otherwise, the session is marked with the most prominent error pattern observed during the session.

Chapter 4: Consonantal development

1. Introduction

In this chapter, I describe the development of consonants in the productions of Hìu and Mun, respectively. As these two children display similar patterns in their development of the Vietnamese system, I describe their data in conjunction and provide a comparison between them whenever differences are worth noting. In order to organize the description in a way that corresponds to properties of the Vietnamese phonological structure, I describe the development of syllable onsets and syllable codas separately, starting with onsets. For each of these syllable positions, I organize the descriptions first by place of articulation, and then by manner of articulation.

2. The development of syllable onsets

In this section, I describe Hìu's and Mun's development of segments in syllable onset position. I start with places of articulation (PoA – labial, alveolar, palatal, velar, and laryngeal), and follow with manners of articulation (MoA – plosive, fricative, affricate, nasal, and liquid). Sub-section 2.3 provides a summary of the two children's syllable onset development. As we will see, in terms of place of articulation, alveolars and velars display more difficulties than labials and laryngeals. Especially, palatalization is a significant pattern for alveolars, and the voiceless velar |x|[4] is the most challenging consonant. Regarding manner of articulation, fricatives, affricates, and liquids are acquired later than plosives and nasals. Particularly, stopping is common among

4 Throughout this thesis, following Rose & Inkelas, (2011), I represent target phones between |pipes| in order to set them apart from actual phonemes (represented between /slash bars/) and actual phonetic realizations of phones (between [square brackets]).

fricatives, the affricate |tɕ| is not successfully acquired at all, and the liquid |l| is pronounced as [n] at the beginning stage for Hìu and throughout Mun's corpus.

2.1 Place of articulation

2.1.1 Labial

Recall from Chapter 1 section 1.1.2.1 that Vietnamese allows for the following labial consonants in syllable onsets: /p, b (ɓ), f, v, m/. However, /p/ only appears in a limited number of words, especially in loanwords. In both corpora, |p| appears 47 times, but only in three words: 'pằng' (imitate a sound), 'pin' (battery), and 'pờ' (letter P).

In this section, I start with the description of |p| and |f| then follow with |b|, |v| and |m| due to the similarities in the development of these three consonants. In general, both children acquired the labial place of articulation relatively early. For all labial onsets, there was only one stage of development: the acquisition stage.

As can be seen in Table 4 below, in spite of its rarity, in terms of place of articulation, |p| was realized as target-like from the first time it was attempted by the children (at 1;10.15 for Hìu and at 1;08.25 for Mun). Hìu made no errors at all, while Mun palatalized |p| two times.

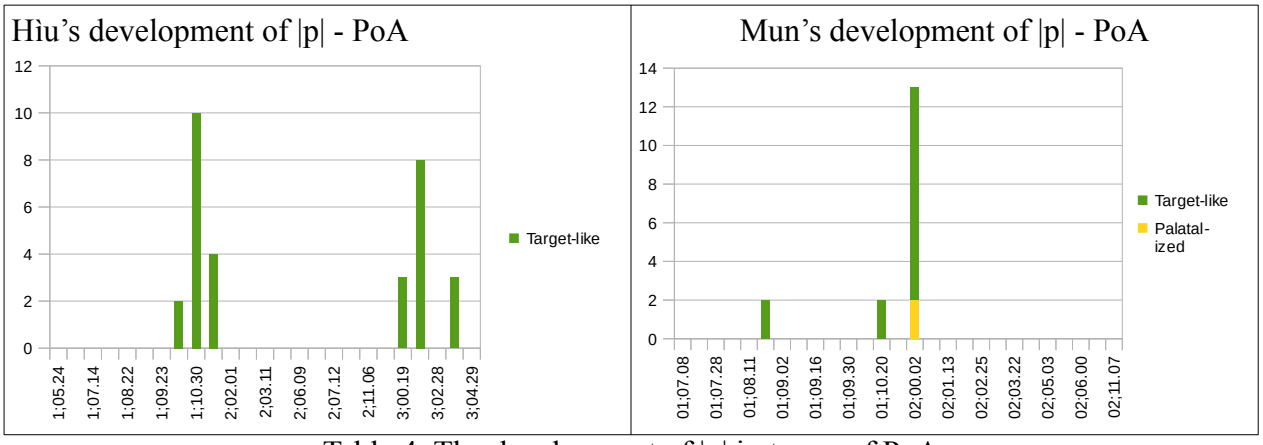


Table 4: The development of |p| in terms of PoA

The development of |f| showed some difference between the two children. Hìu did not attempt words containing onset |f| until age 1;09.23 but the place of articulation of this sound was correct since the first attempt and throughout the course of recordings, except one particular case where |f| was substituted with [t], possibly due to the presence of another alveolar consonant in the compound word '*phiêu lưu'* |***f***iew1 luw1| -> [***t***iew1 dwi1] *(adventure).*

Mun, however, attempted words containing |f| slightly earlier than Hìu, at 1;07.08. Although most of her productions are target-like in term of PoA, there were a few cases of deletion and palatalization. Especially, between age 2;04.13 and 2;06.00, most of her attempts at |f| were substituted with [k]. Yet all these substituted instances related to only one lexical item, the French loanword *'phô mai'* |***f***o1 maj1| *(cheese*) which she produced as *[**k**o1 maj1]*. Table 5 illustrates the difference between the two children regarding the development of the PoA of |f|.

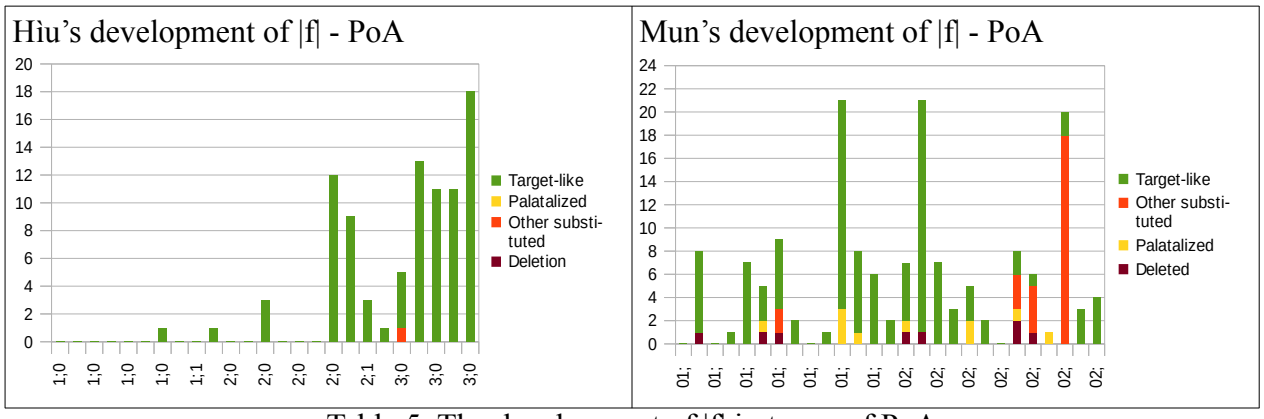
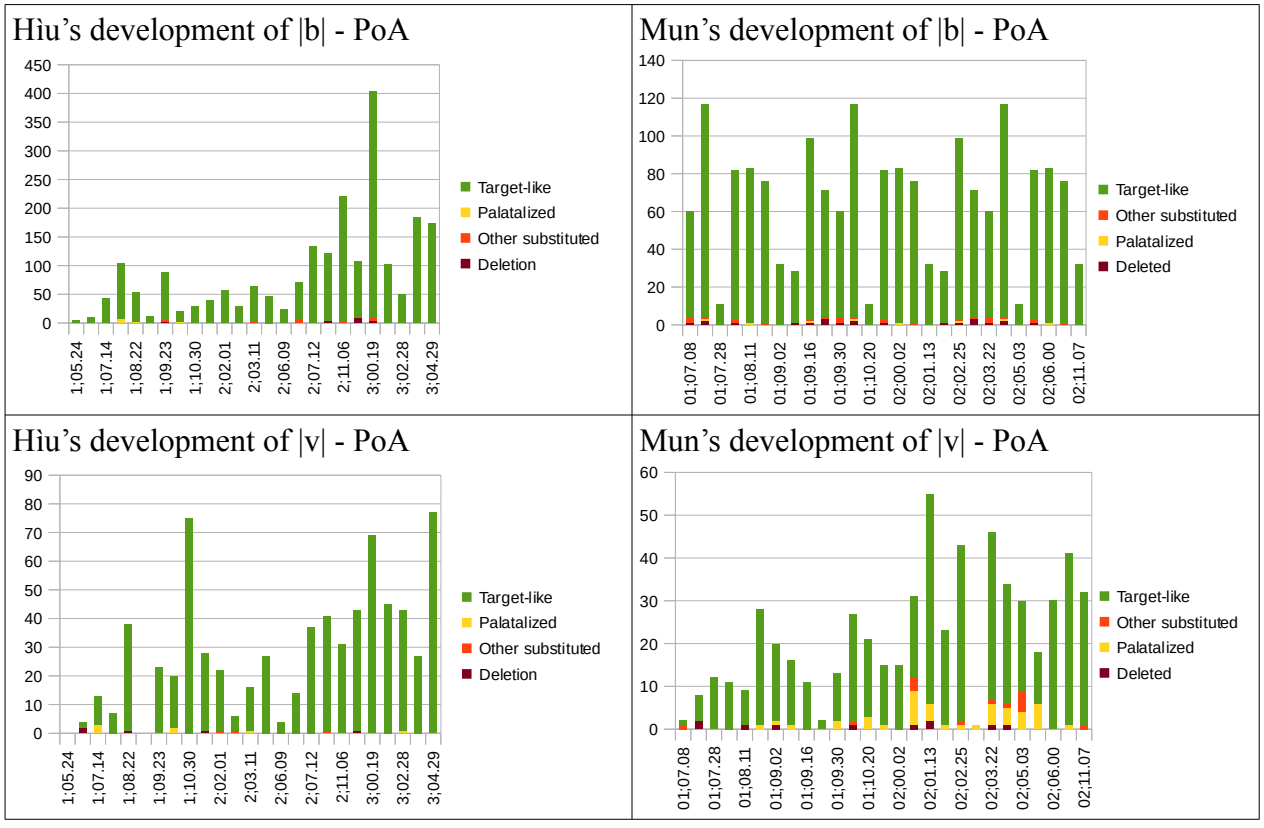


Table 5: The development of |f| in terms of PoA

|b|, |v|, and |m| are also successfully acquired early on and produced reliably throughout the corpus with a high ratio of target-like forms out of the total of attempts by both children. The percentage of target-like forms of |b| is 97.5% (n=2137 out of 2192 total attempts) for Hìu and

96.9% (n=1724 out of 1779 total attempts) for Mun. The percentage of target-like forms of |v| is 97.9% (n=695 out of 710 total attempts) for Hìu. This rate of accuracy is slightly lower for Mun, at only 88.5% (n=526 out of 594 total attempts). The percentage of target-like forms of |m| is 96.7% (n=1843 out of 1906 total attempts) for Hìu, and 89.6% (n=1015 out of 1133 total attempts) for Mun. As shown in Table 6, Mun had more substitution of |v| (9.76%, n=58 out of 594 attempts) and |m| (6.18%, n=70 out of 1133 attempts) compared to Hìu (only at 1.4% for |v| and 1.05% for |m|). Mun also deleted |m| more than Hìu, at a rate of 4.23% (n=48 out of 1133 attempts) compared to Hìu's 2.25% (n=43 out of 1906 attempts).



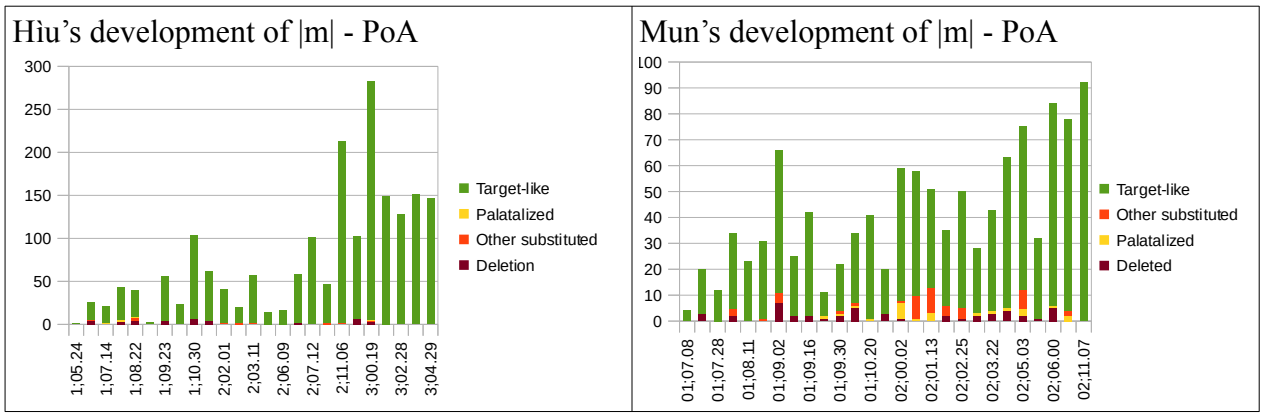


Table 6: The development of |b, v, m| in terms of PoA

In most of the cases where Hìu and Mun unsuccessfully attempted |b|, |v|, and |m|, these sounds were either deleted or palatalized. However, the palatalized phones are mostly related to the presence of another palatal or palatalized consonant in the string, for examples, '*bố Tít'* |***b**o5 tit5*| -> *[**ɲ**o5 ɲit5] (daddy's nickname* – Hìu at 1;07.24*),* or *'màu đỏ'* |***m**ăw2 dɔ4*| -> *[**ɲ**ăw2 cɔ5]* (*red* – Mun at 2;00.02).

In the next section, I describe the development of alveolar consonants by both children.

2.1.2 Alveolar

As mentioned in section 1.1.2.1, Vietnamese allows eight alveolar consonants to appear in syllable onset. These consonants are /t, t^h, d, s, z, n, l, r/. Similar to /p/, the rhotic alveolar /r/ only appears in a limited number of words, mostly loanwords. In Hìu's corpus, there are only six attempts at /r/, and they appear very late in the course of the documented period (one at 3;00.01; four at 3;02.28; one at 3;03.21). In addition, only one case where /r/ is truly an onset of a syllable of a word (loanword 'cà rốt' (*carrot*)), the other instants belong to the pronunciation of the letter R in Vietnamese alphabet. In Mun's corpus, the consonant |r| was attempted 30 times, but there were only two words: |mi1 kɤ2 ro1| (*micro*) and |ka2 rot5| (*carrot*). For the word 'micro', Mun

deleted |r| in all cases; and for the word ‘carrot’, she palatalized |r| in all cases. Therefore, I exclude /r/ from Table 7 to Table 10 below.

The charts in Table 7 to Table 10 reveal a widespread pattern of palatalization which especially affects alveolar obstruents. I describe this phenomenon in detail in Chapter 5. Below, I describe in general the development of the place of articulation of the coronal consonants, beginning with |d|, following by |t|, |s| and |z|, then |t^h|, and finally |n| and |l|.

In the two corpora, Hìu attempted to pronounce the voiced alveolar plosive |d| 2682 times and Mun attempted |d| 2184 times. Based on the ratio of successful attempts to unsuccessful attempts in each recorded session, two stages of the development of |d| are detected in both corpora: the pre-acquisition stage and the acquisition stage. For Hìu, the pre-acquisition stage is from 1;05.24 to 1;10.15, and the acquisition stage is from 1;10.30 onward. For Mun, the pre-acquisition stage lasted from 1;07.08 until 2;01.13 and she only produced more target-like forms than unsuccessful forms between 2;02.05 and 2;11.07.

As shown in Table 7 below, two predominant phonological processes during Hìu’s pre-acquisition stage are deletion (181 times out of total 392 attempts; 46.17%) and palatalization (94 / 392; 23.98%). Deletions are particularly predominant at 1;07.14 (with 49 instances of deleted |d|) and at 1;09.23 (with 100 instances of deleted |d|). The majority of deleted |d| in these two sessions belong to only two words ‘đâu’ (|dɤ̆w1| - *where*), ‘đây’ (|dɤ̆j1| - *here, this*). This can be considered mainly a lexical issue rather than a phonological one; the mispronunciations in such cases can indeed be classified as reflecting a property of the lexical item, as opposed to a property of the child’s phonological system as a whole. Although Hìu showed more successful productions between 1:10.30 and 2:03.11, he only fully acquired |d| at age 2;05.20. From 2;05.20 toward the

end of the recorded sessions, |d| is produced accurately in most cases, with an exception of 19 deleted instances in session 2;06.07 and a few more in session 3;00.01 and 3;00.19. Again, almost all these cases of deletion involve only two words ‘đây’ (|dɤ̆j1| - *here, this*) and ‘đấy’ (|dɤ̆j5| - a particle which often appears at the end of interrogative sentences).

Palatalization was noticeably more prominent in Mun’s production of |d|. Moreover, palatalization lasted until the last recorded session. Mun had a total of 2184 attempts at |d|, of which 1054 attempts were successful (48.26%), 983 attempts were palatalized (45%), 104 deleted (4.8%), in addition to 43 cases of unsystematic substitutions (1.96%). Between 1;07.08 and 2;01.13, palatalization is more prominent than target-like production (912 instances of palatalization, compared to 705 target-like forms). It is only from 2;02.05 through the remainder of the recorded period that the target-like forms became majority compared to palatalized and deleted forms.

Table 7 illustrates the development of |d| by the two children, in terms of PoA.

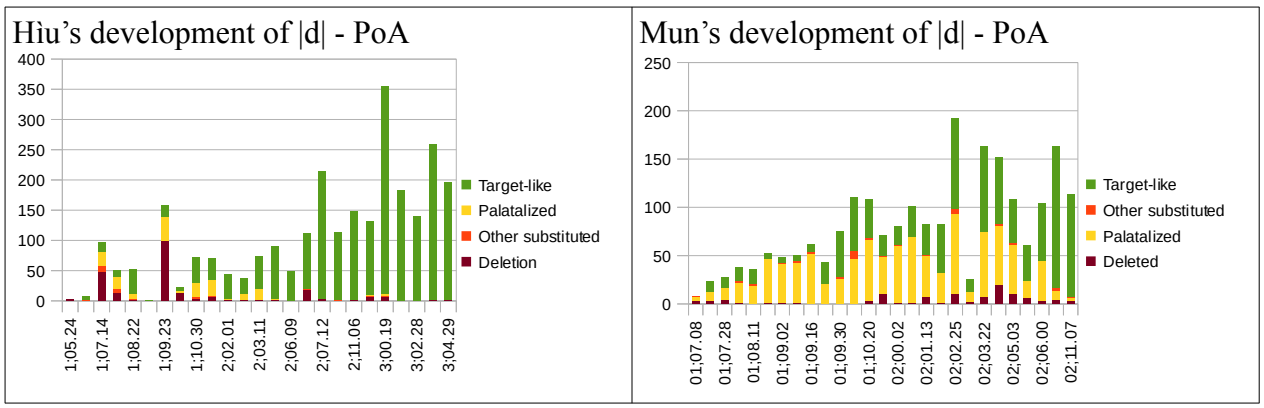


Table 7: The development of |d| in terms of PoA

I now continue my descriptions with the development of |t|, |s|, and |z|.

Overall, |t|, |z| and |s| showed both similarities and difference in the two children's productions. Two stages of development are detected in both corpora, however, Hìu came out of the pre-acquisition stage of |t| and |z| earlier than Mun. Both children moved into the acquisition stage of |s| roughly at the same age of 2 years and 5 months.

Starting with Hìu, there were very few successful attempts at the beginning (a little more for |t| but only a few for |s| and |z|). Hìu acquired |t| and |z| at 2;02.01, however there are some fluctuation of |z| at 2;06.09 and 2;06.27. |s| was acquired a few months later, at 2;05.20. However, for all these three consonants, there was still fluctuation after the consonants could be considered to be acquired, as they were not completely stable until age 3;02.06. Besides some deletion, palatalization was a common phonological process for |t|, |s|, and |z| during and beyond the substitution stage. Palatalization lasted until 3;02.28 for |t| and until 3;04.29 for |s| and |z|. Of the total 1029 attempts at |t|, there were 329 cases of palatalization (31.97 %). For |s|, it was 329 cases out of total 1373 attempts (23.96 %), and 404 cases out of 1648 attempts (24.51 %). Besides palatalization, between 2;06.27 and 3;03.21, |z| was pronounced as a voiced dental fricative 55 times out of total 1088 (5 %). While this dentalization affected 9 words in total, around half of the cases belong to the word 'gì' (|zi2| - *what*) and a few instances belong to the word 'rồi' (|zoj2| - *already*).

Compared to Hìu, Mun had much more palatalized |t, s, z|, and she also came out of the palatalization stage later than Hìu. Of her 721 attempts at |t|, only 191 attempts were target-like (26.5%) while Mun produced 489 palatalized instances (67.8%). Palatalization only subsided at 2;11.07 for |t|. For |z|, of the total 1460 attempts, only 278 cases were successful (19.04%), while 1048 cases were palatalized (71.8%). Even at 2;11.07, palatalization still accounts for nearly half of her |z|. Similarly, of the total 799 attempts at |s|, 546 cases were palatalized (68.3%) while she

only pronounced the consonant correctly 179 times (22.4%). Palatalization resolved itself for these alveolars at 2;06.00.

Table 8 shows similarities and differences between the two children's path of developing the three consonants |t, s, and z|.

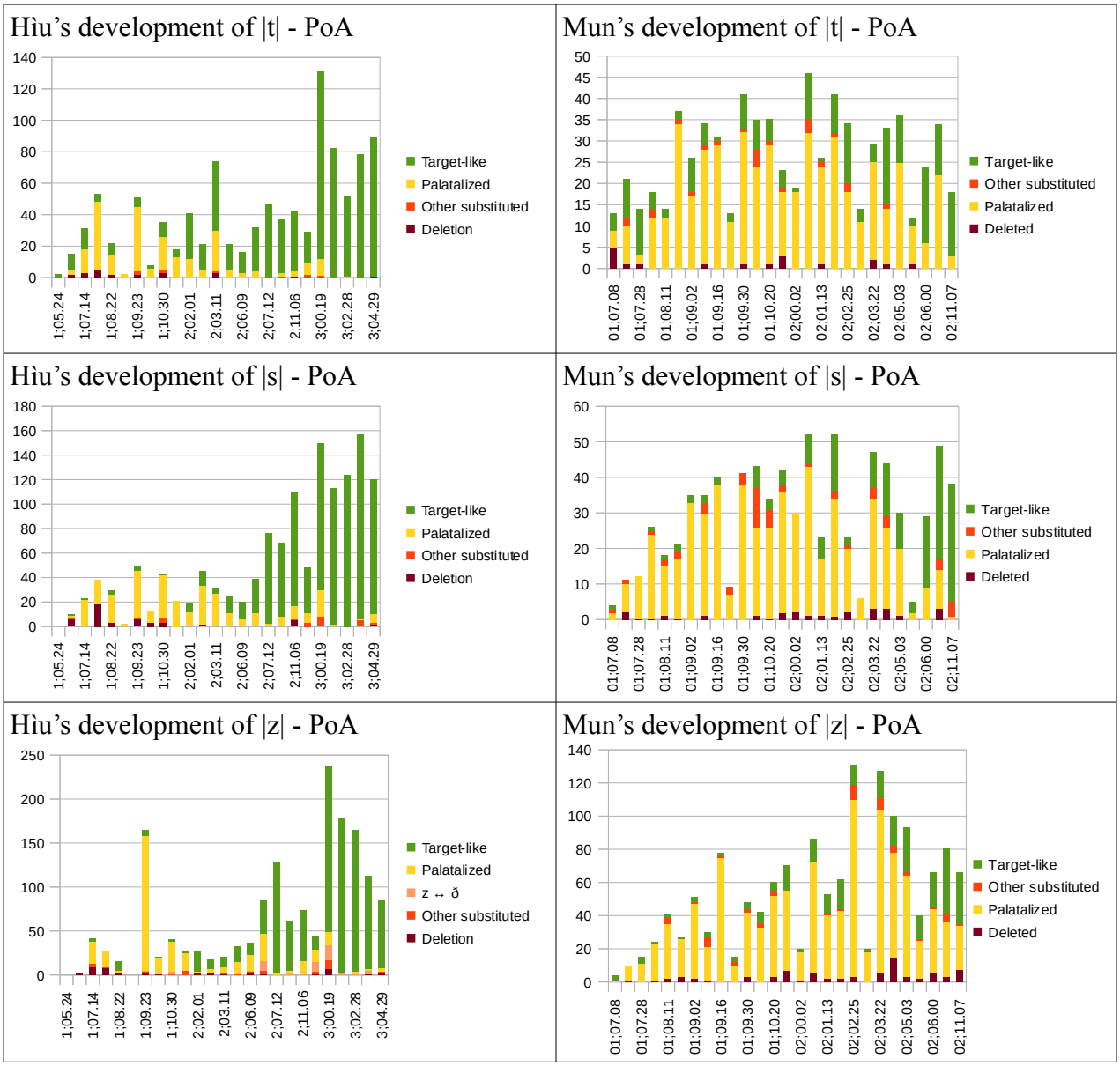


Table 8: The development of |t|, |s|, |z| in terms of PoA

I now move on to describe the development of |t^{h}| by the two children.

Neither Hìu nor Mun fully acquired this consonant by the end of the observation period, although they both produced more successful forms between ages 2;06 and 2;11. Moreover, Hìu's corpus shows the trend to move back to palatalization from age 3;02.06 to 3;04.29.

Hìu hardly attempted |t^h| between 1;05.24 and 1;09.07. |t^h| only appears a few times at 1;07.10 and 1;08.22 with some successful attempts besides cases of deletion and substitution, most of which relate to assimilation to an adjacent consonant, as shown in the word *'trực thăng'* |*tɕɯk6* ***t***^{h}*ăŋ1*| -> *[**k**ăŋ1] or [**g**ăŋ1]* (*helicopter,* at 1;07.10).

Between 1;09.23 and 2;06.09 there were only a few attempts at |t^h| per session. The number of attempts increases from 2;06.27 toward 3;04.29. Successful rate is at 42% to 75% between 2;06.27 and 3;02.06. However between 3;02.28 and 3;04.29, only 35% to 39% of the total attempts are target-like forms. Similar to |t|, |s| and |z|, 90.69 % of unsuccessful |t^h| are instances of palatalization (263 out of 290 instances of unsuccessful attempts). This represents 49.43 % of the total number of |t^h| attempted in the whole of Hìu's corpus (263 out of 532).

Compared to Hìu, Mun attempted |t^h| earlier, at age 1;07.21. Throughout the corpus, palatalization accounts for 85.14% of her unsuccessful attempts and 54.48% of the total number of attempts. Between 2;06.00 and 2;11.07, she had more target-like products than palatalized ones (75% to 88% of all forms are target-like, compared to 8% to 20% are palatalized). |t^h|, however, was not fully acquired by the end of the recorded period.

Table 9 illustrates the development of |t^h| by Hìu and Mun, in terms of PoA.

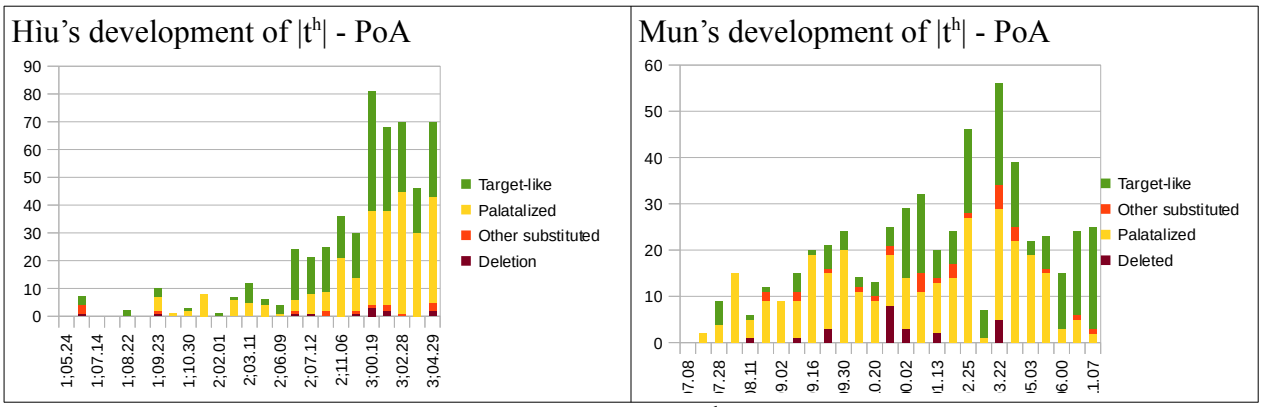


Table 9: The development of |t^h| in terms of PoA

I now conclude section 2.1.2 with the description of |n| and |l| as follows.

As shown in Table 10, both corpora show two stages of development although the transition from the pre-acquisition stage to the acquisition stage is clearer in Hìu's corpus than in Mun's corpus. Both children acquired |n| roughly at the same age (1 year and 10 months). However, their development of |l| is different.

Hìu made only a few attempts at these consonants during the first eight sessions, until 1;10.15. |n| is acquired at 1;10.30 and |l| is acquired at 1;11.19. After this age, Hìu's production of |n| and |l| is fairly stable with only a few cases of deletion and palatalization.

Mun started to produce more target-like forms at around age 2;00 for both consonants. However, compared to Hìu, overall, she had fewer successful attempts and more palatalization. Between the two consonants, Mun acquired |n| earlier than |l|. The rates of target-like forms out of total attempts are 69.58% for |n| (842 out of 1210 instances) and only 52.7% for |l| (370 out of 702 cases). Palatalization accounts for 22.06% of |n| and 40.45% of |l| in Mun's corpus.

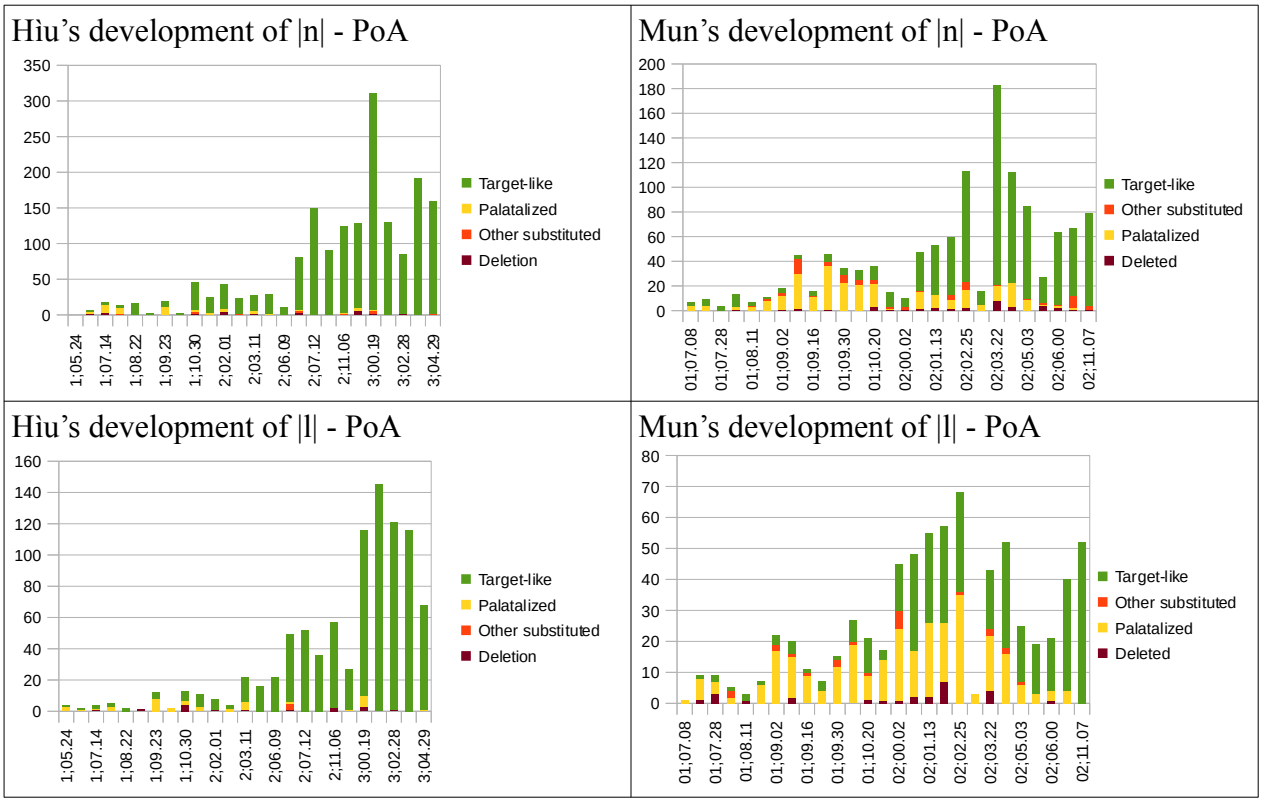


Table 10: The development of |n| and |l| in terms of PoA

Now that I have described the development of Hìu's coronal consonants, I move on to the description of palatal and velar consonants, in section 2.1.3 and 2.1.4 below.

2.1.3 Palatal

Vietnamese has two palatal consonants: |ɲ| and |tɕ|. As we can see in Table 11, Hìu and Mun acquired the PoA of these consonants from an early age. Hìu had a brief stage of deletion of |ɲ|, which lasted between 1;05.24 and 1;07.14. He acquired |ɲ| at age 1;07.24. There was only one stage (i.e. the stage of successful acquisition) for Hìu's |tɕ| and Mun's |tɕ| and |ɲ|. However, overall, Mun's productions showed more variation than Hìu's.

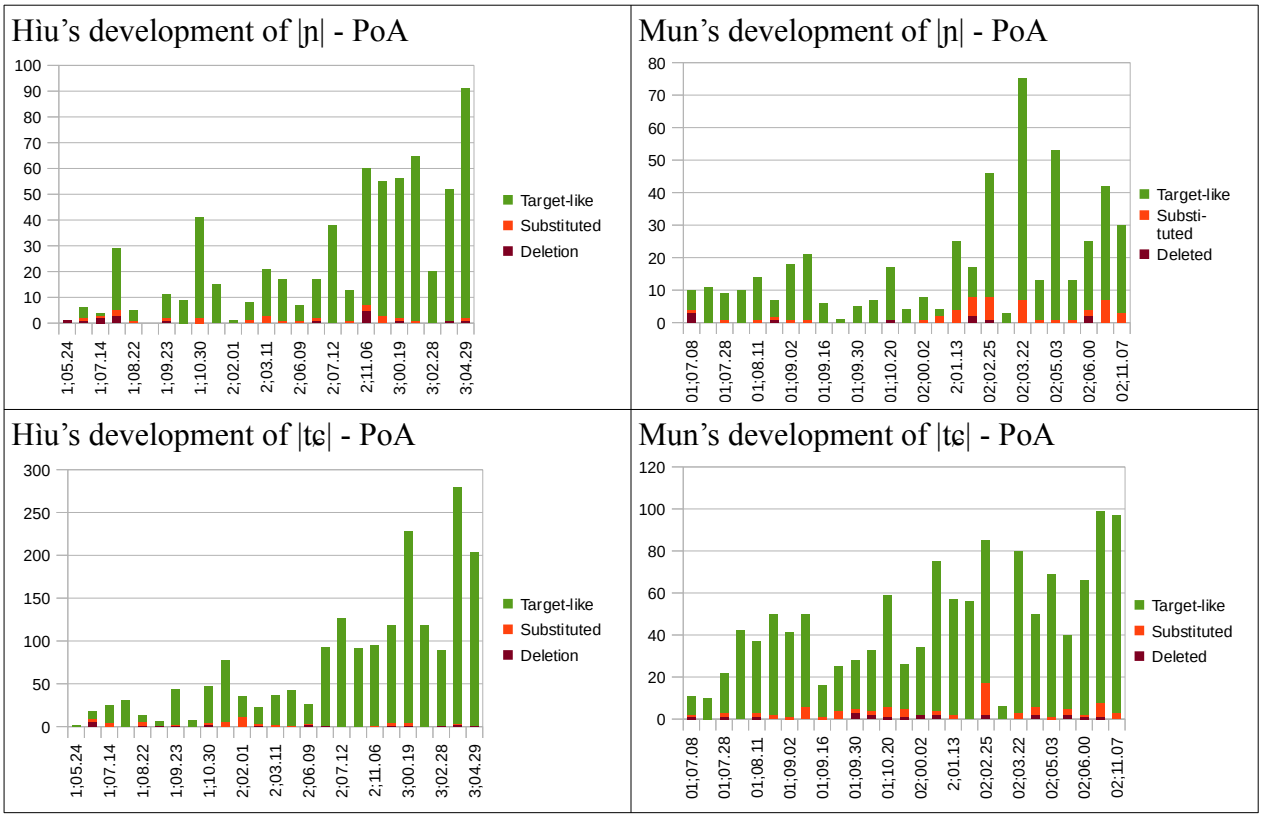


Table 11: The development of |ɲ| and |tɕ| in terms of PoA

In general, 93.61% of Hiù's productions of |ɲ| (601 of 642 attempts) and 97.47% of his productions of |tɕ| (1810 of 1857 attempts) are target-like. In comparison, only 88.26% of Mun's productions of |ɲ| (436 of 494 attempts) and 92.48% of her productions of |tɕ| (1169 of 1264 attempts) are target-like. Mun had more substitutions of both consonants compared to Hiù. She substituted |ɲ| 48 times out of total 494 attempts (9.72%) and substituted |tɕ| 73 times out of 1264 attempts (5.77%), while the rate of substitution of |ɲ| and |tɕ| in Hiù's corpus was only 3.74% and 2.53%, respectively.

Specifically, among the substituted instances, both children showed a tendency to replace |ɲ| and |tɕ| with an alveolar consonant. Hiù substituted |ɲ| with either [n] or [l] 17 times out of 17 cases of substitution in total, and |tɕ| with either [t] or [d] 28 times out of 47 cases in total. Similarly, Mun

pronounced |ɲ| as [n] 34 times out of 48 substituted cases, and |tɕ| as [t] or [d] 54 times out of total 73 instances of substitution.

2.1.4 Velar

Vietnamese allows four velar consonants in syllable onset position. These consonants include /k, ŋ, x, ɣ/. Overall, regarding the place of articulation, except for the development of |x|, both children acquired velar consonants relatively early, during the first few sessions recorded. Except for |x|, all velar consonants showed a relatively high rate of accuracy, as illustrated in Table 12.

Consonant	Child	Total of attempts		Target-like		Deleted		Substituted	
		Number	%	Number	%	Number	%	Number	%
|ŋ|	Hìu	344	100	324	94.18	12	3.48	8	2.32
	Mun	325	100	300	92.3	9	2.77	16	4.92
|k|	Hìu	3697	100	3528	95.42	141	3.81	28	0.75
	Mun	3859	100	3688	95.56	164	4.25	45	1.16
|ɣ|	Hìu	251	100	233	92.82	7	2.79	11	4.38
	Mun	312	100	290	92.95	11	3.52	10	3.20
|x|	Hìu	475	100	222	46.73	65	13.68	188	39.57
	Mun	525	100	118	22.47	236	44.95	146	27.81

Table 12: Rate of accuracy of velar consonants in terms of PoA

|k| was well acquired from an early age by both children, and there was only one stage of development, namely the acquisition stage of |k| in the two corpora. Although the rate of inaccuracy for |k| is very low (169 unsuccessful attempts out of total 3697 attempts by Hìu; 4.57%, and 209 out of 3859 attempts by Mun; 5.4%), there is a notable phenomenon regarding the deletion of |k|. At 1;08.22 and 1;09.23, Hìu deleted |k| 83 times in total, of which 74 instances belong to the word *'con' (|kɔn1|* - *a noun classifier denoting animals*), similar to the other functional categories described above. In other four cases, Hìu did not pronounce the whole

words, all of which were either function words (*'của'* |*kuə4*| - *possession word*), or noun classifiers (*'quả'* |*kwa4*| – *denoting fruits or round-shape objects, 'con'* |*kɔn1*| – *denoting animals, 'cái'* |*kaj5*| – *denoting objects*). These cases of deletion again can be considered to belong to a lexical issue rather than phonological development. At 2;01.13, Mun deleted |k| 22 times, nearly 10% of the total |k| attempted in this session. However, deletion was incurred by a fusion of |k| and the medial |w| in 17 out of 22 cases, as shown in (10).

(10) Examples of |k| deleted due to fusion of |k| and the medial |w| at 2;01.13

Word	IPA Target	IPA Actual	Gloss
quay	|kwăj1|	[păj1]	*videotape*
		[băj1]	
		[văj1]	
		[măj1]	
qua	|kwa1|	[pa2]	*cross*
quả	|kwa4|	[ba6]	*a classifier denoting fruits or round-shape objects*
		[ba4]	

Table 13 displays the development of |k| by both children, in terms of PoA.

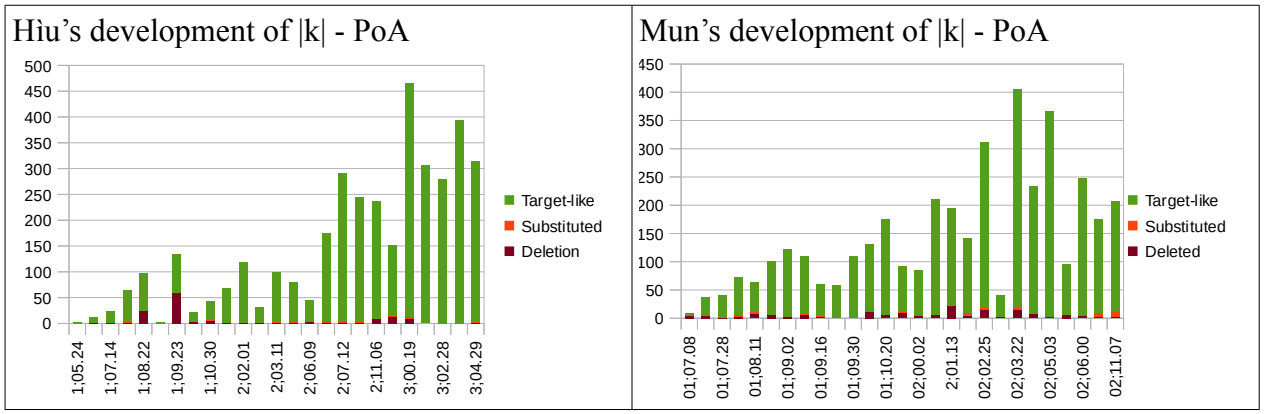


Table 13: The development of |k| in terms of PoA

Compared to |k|, the children's attempts at |ŋ| and |ɣ| were less frequent and their productions were more fluctuating, which relates to the fact that not many words in Vietnamese display these two onsets. Hìu acquired |ŋ| at age 1;09.07 and |ɣ| at age 1;07.14. Although he had a brief stage of deletion of |ŋ| at the beginning which lasted between 1;05.24 and 1;07.24, there were no notable patterns attested among the deleted and substituted cases. Likewise, the number of times when Mun deleted or substituted |ŋ| or |ɣ| with another consonant is relatively low (25 times out of total 325 attempts at |ŋ|; 7.69%, and 21 times out of total 312 attempts at |ɣ|; 6.73%). Also similar to Hìu, Mun did not display any specific patterns regarding the deletion or substitution of |ŋ| and |ɣ|. She acquired |ŋ| at 1;07.08 and |ɣ| at 1;07.21.

Table 14 below illustrates the development of |ŋ| and |ɣ| by Hìu and Mun, in terms of PoA.

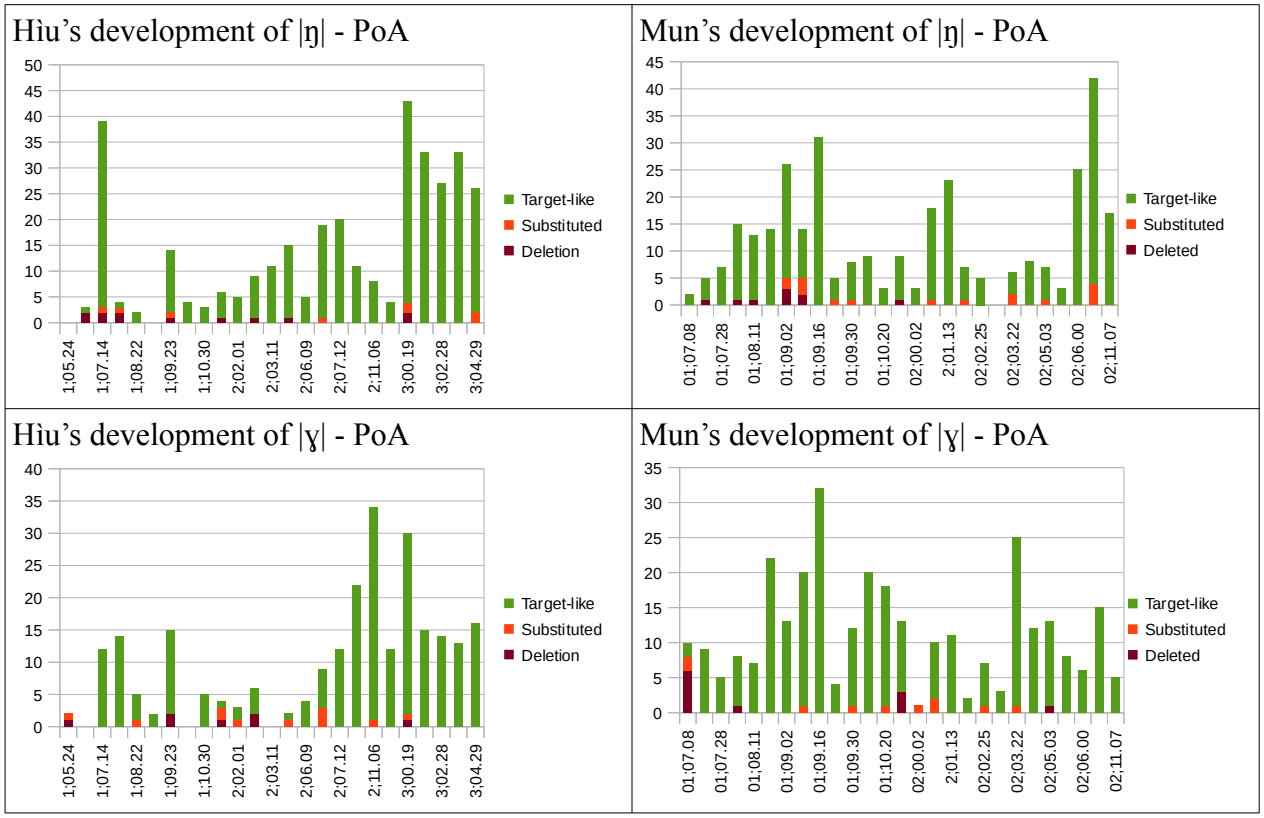


Table 14: The development of |ŋ| and |ɣ| in terms of PoA

I now move on to the description of |x|. This consonant occurs less frequently compared to other onset consonants in the corpora, which again can be attributed to the frequency of |x| in Vietnamese. Of the total 475 attempts at |x|, Hìu deleted |x| 65 times (13.68%), substituted |x| with [h] 182 times (38.31%), and substituted |x| with other consonants 6 times (1.26%). He had 222 target-like attempts (46.73%). Mun attempted |x| 525 times in total, of which she deleted |x| 236 times (44.95%), substituted |x| with [h] 127 times (24.19%), and with other consonants 19 times (3.61%). She was successful 118 times (22.47%). Neither child fully acquired |x| by the end of the observation period, although Hìu had more target-like forms than the unsuccessful attempts between age 3;02.06 and 3;04.29 (during the last four recorded sessions).

As we can see in Table 15, Hìu and Mun displayed two different pathways in their development of |x| in terms of PoA. For Hìu, the deletion stage is from the beginning of the recorded period to age 1;11.19, but for Mun, deletion of |x| extended until 2;11.07 (the last recorded session). Hìu substituted |x| with [h] more than he deleted the consonant, but Mun deleted |x| more than she substituted it. In addition, Hìu had overall more accurate forms than Mun did.

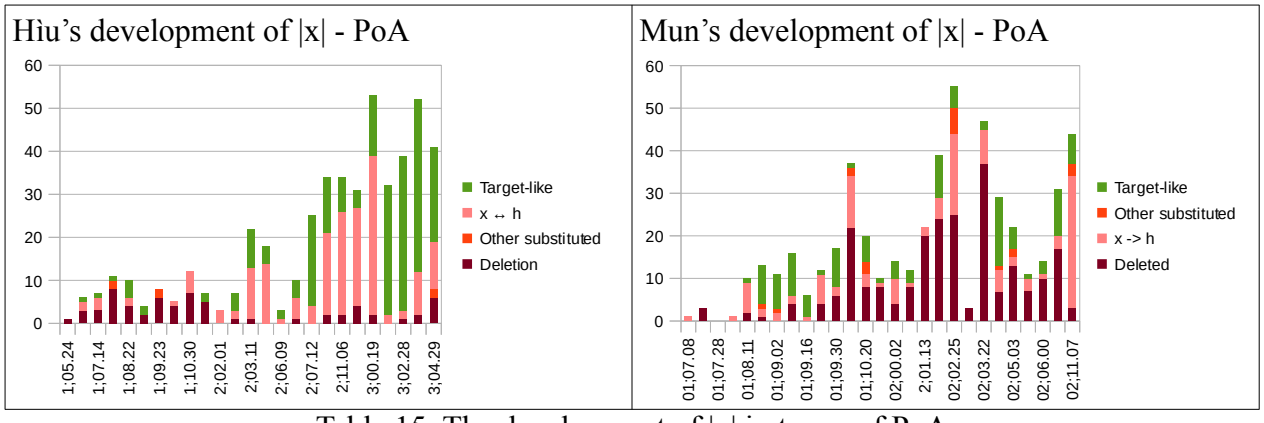


Table 15: The development of |x| in terms of PoA

A noteworthy issue regarding the development of |x| by both children is the contribution of the lexical item *'không'* |*xoŋ1*| (*no*) in both corpora. For Hìu, of the 475 attempts at |x|, the word *'không'* appeared 277 times (58.31%) and accounted for 92 out of 182 times (50.55%) he pronounced |x| as [h]. For Mun, of the 525 attempts at |x|, the word *'không'* appeared 344 times (65.52%) and accounted for 213 out of 236 times (90.25%) she deleted |x|. Table 16 shows how the development of |x| in terms of PoA would be if the word *'không'* is excluded from the corpora. As we can see, deletion was much prominent, especially for Mun, as of 2;00.02.

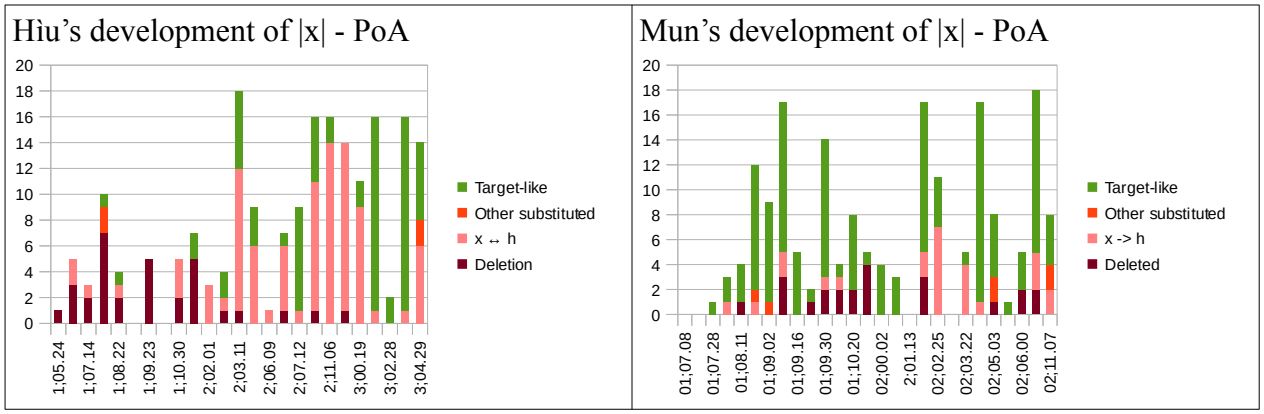


Table 16: The development of |x| (PoA) excluding the word 'không'

However, as can be seen in Table 16, the pattern of |x| being pronounced as the laryngeal consonant [h] is still significant for both children, especially for Hìu. Examples of this pattern are shown in (11) below.

(11) Examples of |x| pronounced as [h] by Hìu:

Word	IPA Target	IPA Actual	Age	Gloss
khóc nhè	|xɔk5 ɲɛ2|	[hɔk5 ɲɛ2]	2;02.01	*cry*
khỉ	|xi4|	[hi4]	2;02.01	*monkey*
khác nhau	|xak5 ɲăw1|	[hak5 ɲăw1]	2;06.09	*different*
khế	|xe5|	[he5]	2;10.17	*star fruit*
khăn mặt	|xăn1 măt6|	[hăn1 măt6]	2;11.06	*face cloth*

In the next section, I describe the children's development of laryngeal onsets in terms of place of articulation.

2.1.5 Laryngeal

Recall from Chapter 1 section 1.1.2.1 that the voiceless laryngeal /h/ is the only guttural consonant in Vietnamese. As we see in Table 17, Hìu showed a stage of deletion in the development of |h| between age 1;05.24 and 1;09.23 and he did not acquire |h| until age 1;10.15. In contrast, there was no development stages in Mun's production of |h| and she did not fully acquire this consonant by the end of the observation period.

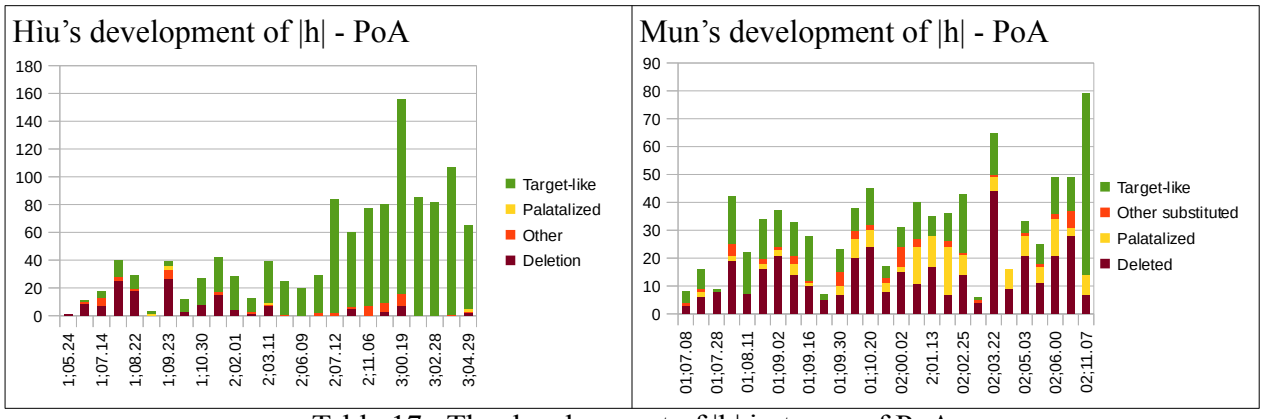


Table 17: The development of |h| in terms of PoA

For Hìu, between age 1;05.24 and age 1;09.23, |h| was deleted 87 times, out of the total 141 times it is attempted (61.7 %). The deletion affects a number of different words and does not relate to a particular lexical item. From 1;10.05 toward the end of the corpus, Hìu's pronunciation of |h| is mostly target-like (938 out of 1031 instances; 90.98 %), except for some deletion and substitution (93 out of 1031; 9.02 %).

Mun, however, had fewer successful attempts at |h| overall. Of the total 866 attempts, she pronounced |h| correctly 309 times (35.68%) whereas she deleted |h| 377 times (43.53%), palatalized it 130 times (15%), and substituted it with other consonants 50 times (5.77%). The deletion of |h| cannot be attributed to a particular lexical item. On the other hand, the palatalization of |h| could be divided among three groups. The first group contains the proper name *'Huyền' (the investigator's name)* in which |h| was palatalized 50 times. The second group consists of palatalized |h| as results of assimilation to an adjacent palatal or palatalized consonant (n=48), as shown in (12). The third group includes all other cases for which no particular source of explanation can be identified (n=32). Examples from this group are provided in (13).

(12) Examples of palatalized |h| due to consonant harmony:

Word	IPA Target	IPA Actual	Age	Gloss
đồng hồ	|doŋ2 **h**o2|	[ɟo2 **ɟ**o2]	1;07.21	*clock*
hình	|**h**iŋ2|	[**j**iŋ2]	1;08.04	*Shape*
váy hồng	|văj5 **h**oŋ2|	[vaj3 **j**ɤm2]	1;09.02	*pink dress*
đi học bài	|di1 **h**ɔk6 baj2|	[ɲi1 **c**ăp6 paj2]	1;11.10	*Go to study*
chụp hình	|tɕup6 **h**iŋ2|	[**j**ɤp6 ciŋ2]	2;00.02	*Take a picture*

(13) Examples of palatalized |h| without any reasons:

Word	IPA Target	IPA Actual	Age	Gloss
hoa	|**h**wa1|	[**c**wa1]	1;08.25	*Flower*
hải cẩu	|**h**aj4 kɤ̆w4|	[**c**æ1 kɤ̆w6]	1;08.25	*Seal*
hươu cao cổ	|**h**iəw1 kaw1 ko4|	[**ɲ**iəw1 kə1 ko4]	1;11.10	*giraffe*
cá heo	|ka5 **h**ew1|	[ka3 **c**ɛw1]	1;09.30	*dolphin*

This completes my description of the children's development of place of articulation of syllable onsets. I now move to describing their development of manner of articulation in the same position.

2.2 Manner of articulation

2.2.1 Plosive

The plosive onset consonants in Vietnamese consist of /p, b, t, d, t^h, k/. Overall, both children acquired this manner of articulation (MoA) in syllable onset position early on and maintained it in a steady fashion throughout both datasets. I start my description of the plosive MoA with |p| and |b| as follows.

As we can see in Table 18, Hìu and Mun produced target-like forms of |p| and |b| from their first attempts at these consonants. Both children showed only one stage of development of these two consonants, namely the acquisition stage. Comparatively, Mun displayed more variations than Hìu. For both children, the fact that |p| was attempted late and not many times may be attributed to the relatively low frequency of this consonant in Vietnamese, as already mentioned in section 2.2.2.1. Except for one case by Hìu and three by Mun where |p| was pronounced as the fricative [v], all other tokens of |p| were target-like in terms of manner of articulation. Regarding |b|, Hìu had a total of 2192 attempts. He deleted it only 23 times (1.05 %), substituted it 57 times (2.6 %), and produced the target-like forms in the remainder of the instances (2112 times out of 2192 attempts; 96.35%). Mun attempted |b| 1391 times. She deleted it 33 times (2.37%), substituted it 85 times (6.1%), of which spirantization contributed 55 cases (3.95%), nasalization 14 cases (1%), and approximant production 16 cases (1.15%). She had 1273 target-like forms (91.52%).

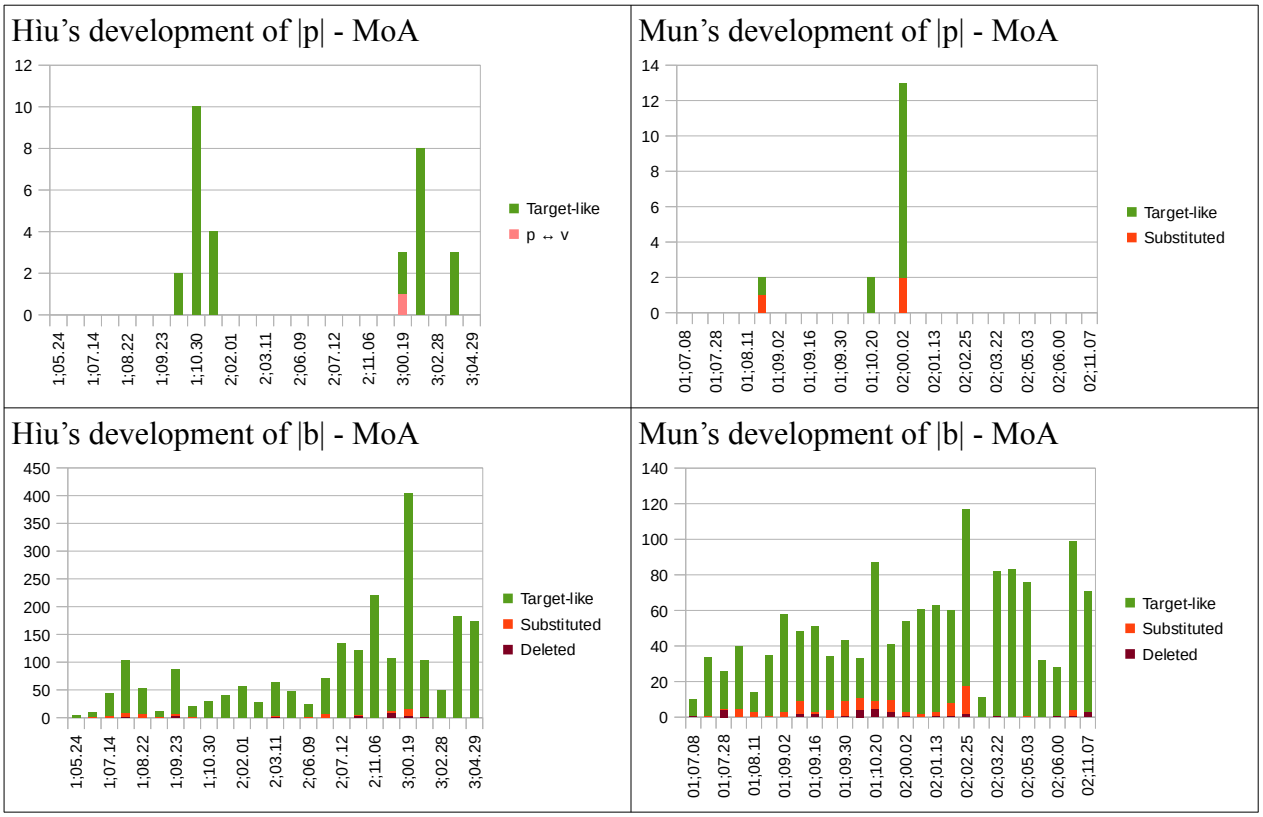


Table 18: The development of |p| and |b| in terms of MoA

Although |t| was not as reliably produced as |p| and |b|, in general, both children acquired this consonant without significant difficulties, as we can see in Table 19. There was only one stage of development of |t|, starting at the first recorded session in both corpora. Except for a few cases where Hìu pronounced |t| as the palatal nasal [ɲ] and some other cases of substitution and deletion, he produced target-like-form |t| 958 times out of total 1029 attempts (93.1%) and as early as at 1;05.24. Mun had a total of 721 attempts at |t|, of which she deleted it 18 times, nasalized it 18 times, and produced it as a continuant 16 times. She pronounced |t| accurately 669 times (92.78%). Table 19 showed the development of the MoA of |t| by the two children.

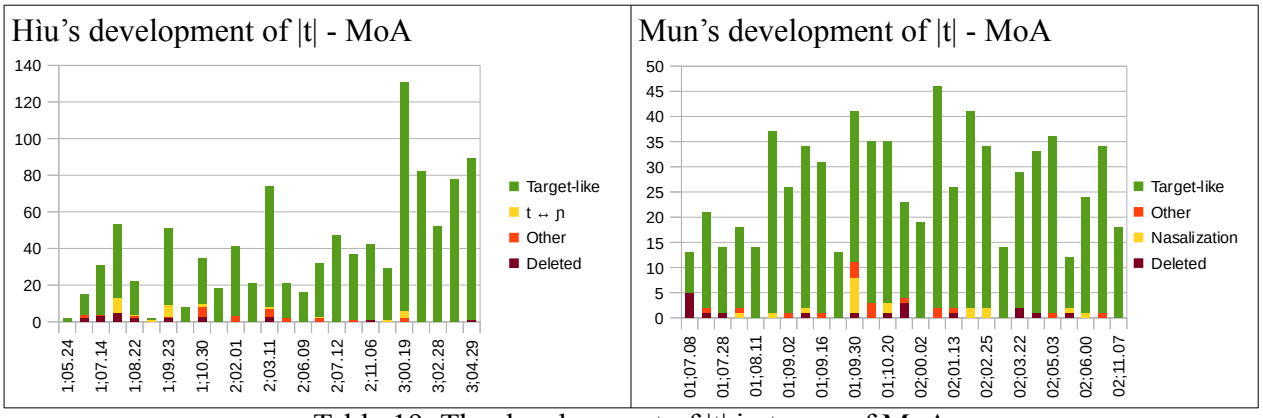


Table 19: The development of |t| in terms of MoA

The development of |d| by both children showed more fluctuations compared to the plosive onsets just described, as shown in Table 20, although both children had acquired |d| by the very beginning of the recorded period (Hìu at 1;07.10 and Mun at 1;07.08) and only displayed one stage of acquisition of |d|. Hìu deleted |d| many times in early sessions, especially at 1;07.14 and 1;09.23. However, as I already discussed in section 2.1.2 above, this deletion mostly related to a lexical issue. In the second half of the corpus, especially at 3;00.01 and 3;00.19, |d| was pronounced as the flap [ɾ] 123 times out of total 1992 attempts (6.17 %), mostly relating to high rate of speech and involving different words, as shown in the following examples:

(14) Examples of |d| pronounced as [ɾ] by Hìu:

Word	IPA Target	IPA Actual	Age	Gloss
đây	**d**ɤ̆j1	**ɾ**ɤ̆j1	3;00.01	*here*
đuôi	**d**uəj1	**ɾ**uəj1	3;00.01	*tail*
đỏ	**d**ɔ4	**ɾ**ɔ2	3;00.01	*red*
đứng	**d**ɯŋ5	**ɾ**ɯŋ5	3;00.01	*to stand*
đâu	**d**ɤ̆w1	**ɾ**ɤ̆w1	3;00.19	*where*
đấy	**d**ɤ̆j5	**ɾ**ɤ̆j1	3;00.19	*a particle word*
đúng	**d**uŋ5	**ɾ**uŋ5	3;00.19	*correct*

As for Mun, of the unsuccessful attempts (326 out of 2184 total attempts at |d|; 14.93%), deletion and approximant production account for the majority of the data, and do not involve specific lexical items. She deleted |d| 104 times (4.76%) and pronounced |d| as an approximant 122 times (5.58%). The majority of approximant productions for |d| involved the substitution of |d| with [j] (118 out of 122 cases; 96.72%), most of which can be attributed to the presence of an adjacent glide or front vowel in the word, as shown in (15):

(15) Examples of |d| pronounced as [j] by Mun:

Word	IPA Target	IPA Actual	Age	Gloss
đây	**d**ɤ̆j1	**j**ɤ̆j1	1;08.11	*here*
để	**d**e4	**j**e4	1;08.25	*put*
đổ	**d**o4	**j**o4	1;08.25	*fall*
đầu	**d**ɤ̆w2	**j**ɤ̆w2	1;09.09	*head*
đi	**d**i1	**j**i1	1;09.16	*go*
đâu	**d**ɤ̆w1	**j**ɤ̆w1	1;09.30	*where*
đà điểu	da2 **d**iəw4	ɟa2 **j**iəw4	1;10.06	*ostrich*

Table 20 illustrates the development of |d| by the two children, in terms of PoA.

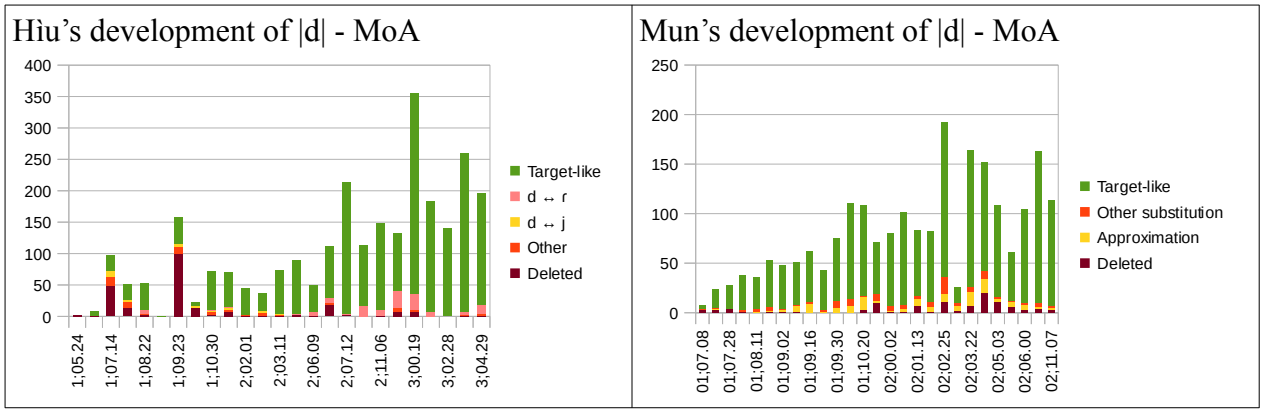


Table 20: The development of |d| in terms of MoA

I now move on to the description of |t^h|. In general, both children did not acquire this consonant at the end of the observation period, in terms of MoA. The majority of their productions were de-aspirated: 423 out of 532 total attempts (79.5%) for Hìu, and 413 out of 547 total attempts (75.5%) for Mun. Hìu only attempted |t^h| a few times at the beginning. Between 2;06.27 and 3;04.29, he had a few instances of flapping (17 times out of 471 total attempts; 3.6%), very little deletion (10 out of 471; 2.1%) and some other substitution (17 out of 471; 3.6%). Mun attempted |t^h| since age 1;07.21 and she started to show more fluctuation between age 1;09.09 and 2;04.13. During this period, she deleted |t^h| 22 times out of 385 attempts (5.7%), nasalized it 41 times (10.65%), and substituted it with other consonants 32 times (8.3%). Especially, between age 1;11.10 and 2;03.22, out of 34 instances of nasalized |t^h|, 27 occurences belonged to the word 'Thảo Ly' (a proper name), which may due to the fact that the liquid consonant |l| in 'Ly' was often nasalized. I discuss the liquid MoA further in section 2.2.5.

Table 21 shows how the MoA of |t^h| was developed by Hìu and Mun.

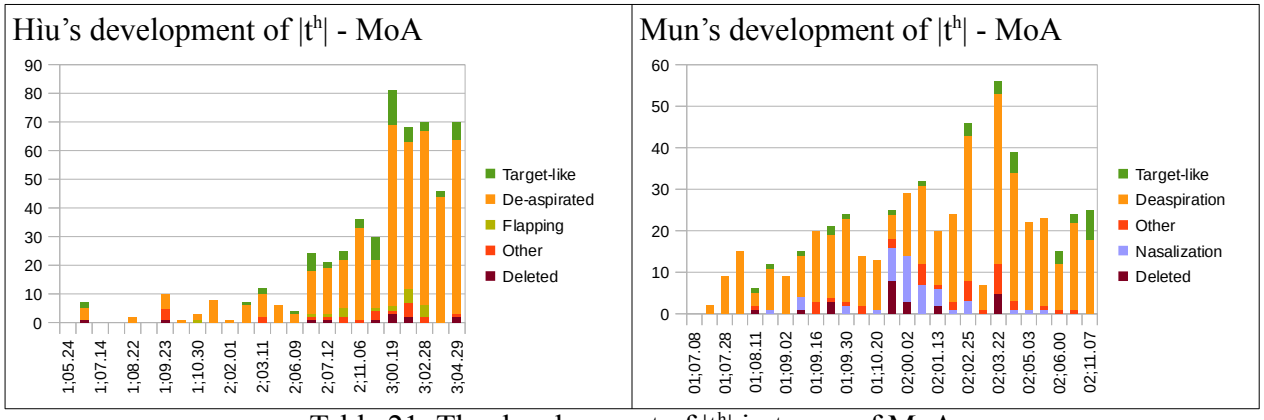


Table 21: The development of |t^h| in terms of MoA

I now conclude the description of the plosive MoA with the development of |k| as follows.

The MoA of the consonant |k| was well acquired in general. Both children had acquired |k| by the first recorded session. Hìu had 3456 target-like forms out of 3697 attempts (93.48%), and Mun had 3555 target-like forms out of 3859 attempts (92.12%). At 1;08.22, Hìu deleted |k| 24 times out of 97 attempts (24.7%), and, at 1;09.23, he deleted |k| 59 times out of 134 attempts (44%). However, all the deleted instances at 1;08.23 and 51 out of 59 instances at 1;09.23 relate to the word *'con'* (*a classifier for animals).* This can be considered a lexical issue rather than a phonological one. At 3;00.19, he pronounced |k| as the fricative [ɣ] 21 times out of 466 attempts (4.5%) and 17 times out of 314 attempts (5.4%) at 3;04.29. From 1;07.08 to 2;11.07, Mun deleted |k| 164 times out of total 3859 attempts (4.25%). She pronounced |k| as a fricative consonant 75 times (1.94%), and as a nasal consonant 55 times (1.42%). Other substituted consonants accounted for only 10 instances (0.26%).

Table 22 displays the development of |k| by both children, in terms of MoA.

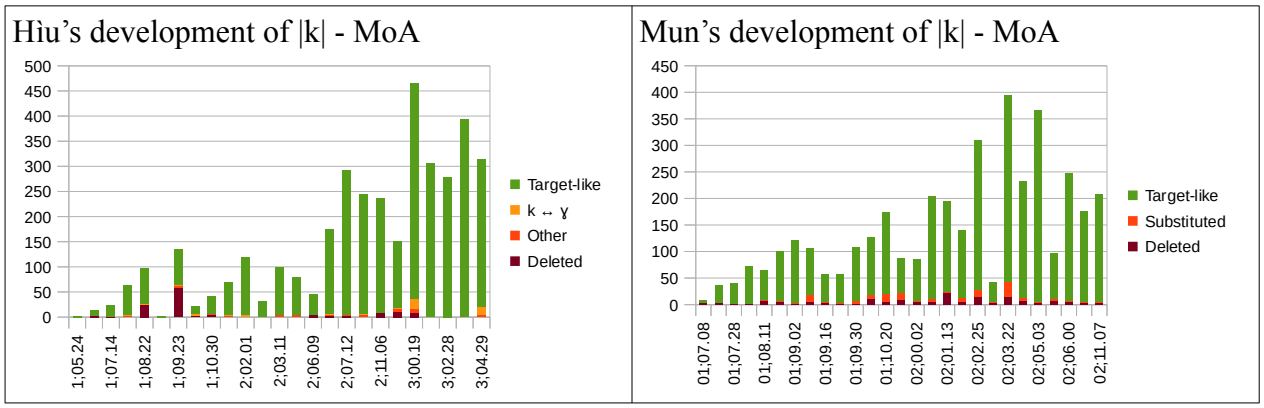


Table 22: The development of |k| in terms of MoA

Now that I have finished the description of all plosive consonants, I move on to the next section to describe the development of the fricative MoA.

2.2.2 Fricative

The fricative onset consonants in Vietnamese are /f, v, s, z, x, ɣ, h/. Overall, fricative onsets were acquired later than plosive onsets, for both children. As we can see from Table 23 to Table 26, stopping is a significant phonological process that happens to this MoA. I start my description of the fricative MoA with the development of |f| and |v|, as follows.

For Hìu, there were only five attempts at |f| (two of which were substituted and three other attempts were target-like) between ages 1;05.24 and 2;06.27. He acquired |f| at age 2;07.12. After this age, Hìu produced this sound accurately in general (84 out of 90 attempts were target-like; 93%). He only showed one case of deletion and three cases of stopping. |v| was attempted from the beginning and appeared in more tokens than |f|. There were two stages of development of |v|. The pre-acquisition stage lasted from age 1;05.24 to age 1;10.15. During this period, Hìu pronounced |v| as a stop consonant 43 times out of 105 attempts (41%). From 1;10.30 toward the end of the observation period, |v| was target-appropriate in general (516 out of 605 attempts; 85%), except for some substitution at 3;00.01 and 3;00.19.

Table 23 shows that overall Mun had more attempts at |f| than Hìu did (157 compared to 90). However, there was no clear stages of development, and her rate of accuracy was lower, as only 66 out of her 157 attempts were successful (42.03%). Stopping accounted for 39.49% of her |f| (62 out of 157 attempts), but lexical issues also contributed to this phonological pattern. As already mentioned in section 2.1, between 2;04.13 and 2;06.00, the word *'phô mai'* |**f**o1 maj1| *(French 'fromage')* was pronounced as *[***k**o1 maj1*]* 22 times, accounting for more than one third of the stopped |f| in total. Besides stoping, Mun also substituted |f| with approximants. At 2;00.22, Mun substituted |f| with [ʋ] four times (out of 21 total attempts in this session), all of which belonged to the word *'phim'* |fim1| (*film*). At 2;01.13, she substituted |f| with [w] five times (out

of 7 total attempts in this session), all of which belonged to the word *'Phát'* |fat5| *(a proper name)*.

Mun had fewer attempts at |v| and showed more fluctuation in terms of MoA than Hìu did, but she acquired |v| a few months earlier (at 1;07.28) than Hìu (at 1;10.30). She produced 398 successful attempts out of 594 total instances (67%) compared to 555 out of 710 attempts by Hìu (78.2%). Stopping is also a main pattern in Mun's productions, accounting for 123 out of 594 total attempts (20.7%). At 1;10.06, |v| was produced as [b] 18 times out of 27 attempts in that session, of which 14 instances belonged to the word *'vừa'* |vɯə2| (*fit*), but other words such as *'voi'* |vɔj1| (*elephant*) and *'viên'* |viən1| (classifier, denoting *round piece*) were also affected by stopping. Lexical difficulty does not seem to be a contributor to the stopping of |v|, as throughout the corpus many other words were also affected by stopping. This holds true for the production of |v| as an approximant as well. For example, at 2;06.00, Mun pronounced |v| as [w] 18 times, of which the word *'vào'* |vaw2| (*enter*) appeared 4 times, and the word *'vàng'* |vaŋ2| (*yellow*) appeared 4 times.

Table 23 illustrates the development of |f| and |v| by Hìu and Mun, in terms of MoA.

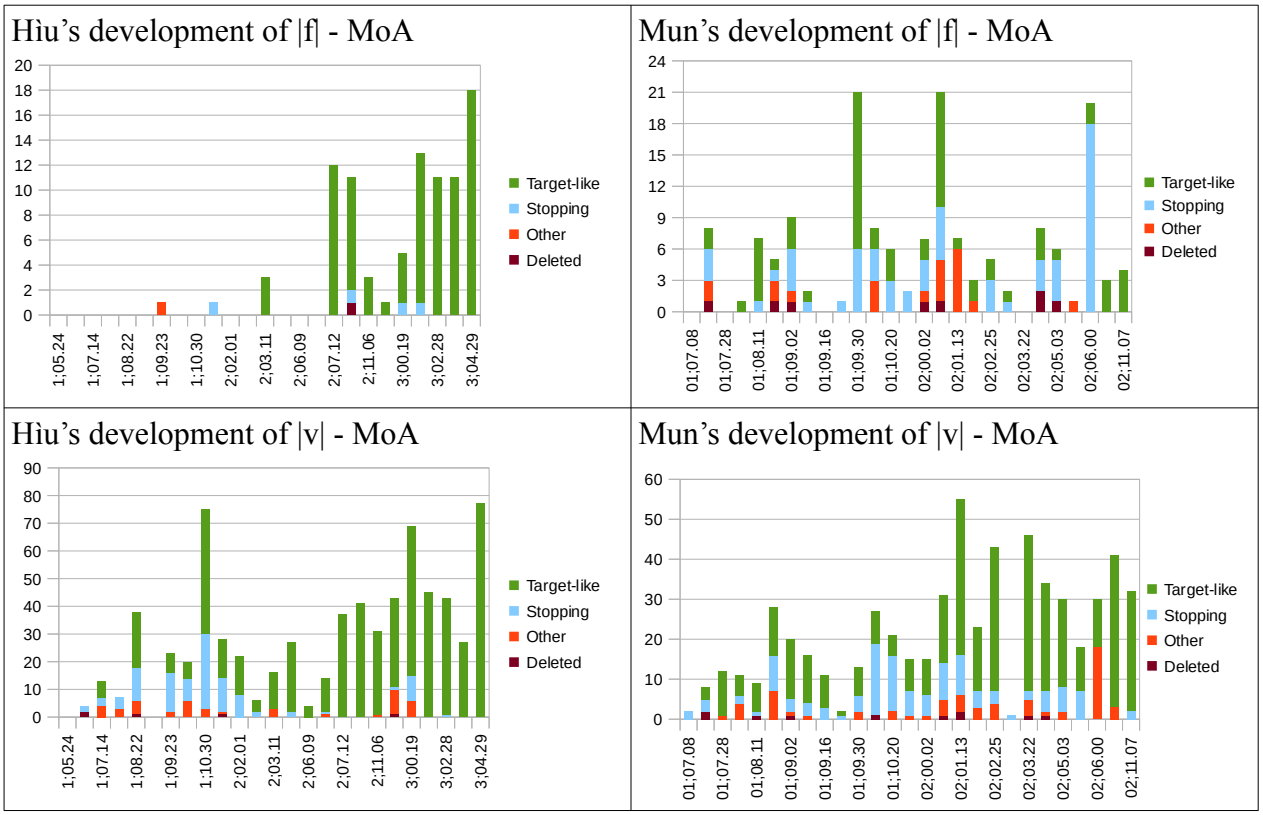


Table 23: The development of |f| and |v| in terms of MoA

I now move on to the description of |s| and |z|. Table 24 shows both similarities and differences between Hìu and Mun regarding the development of MoA for these consonants. Hìu acquired |s| at age 2;06.09, when more than 65% of his productions of |s| were target-like. He acquired |z| a month later, at age 2;07.12. Mun acquired |s| at roughly the same age as Hìu, at 2;05.17, when more than 60% of her productions of |s| were target-like. However, she did not fully acquire |z|, as at age 2;11.07 (the end of the observation period) she only produced target-like forms 56% of the times. Both children showed two different stages of development of |s| but those stages of |z| were only detected in Hìu's corpus.

During the pre-acquisition stage of |s|, between 1;07.10 and 2;05.20, Hìu mostly substituted |s| with a stop consonant (232 times out of 348 attempts; 67%). He deleted |s| 42 times (12%) and

produced |s| accurately 38 times (11%). Hìu's pronunciation of |s| became relatively stable and accurate at age 2;06.09. Between that age and the end of the documented period, he produced 931 target-like forms out of 1025 attempts at |s| (91%).

Hìu's pre-acquisition stage of |z| lasted from age 1;07.10 to 2;06.27. During this period, stopping and approximant productions were the most prominent patterns. Of 560 attempts at |z|, 207 instances emerged as the approximant [j] (36.96%) and 127 instances emerged as a stop (22.67%). However, the majority of approximant productions of |z| occurred in one session (1;09.23, n=118) and belonged to only two words 'gì' (|zi2| *what*; n=114) and 'rắn' (|zăn5| *snake*; n=4). As already mentioned in section 2.1.2 of the current chapter, lexical issues play a role in this phonological pattern. Between 2;07.12 and 3;04.29, the target-like forms made up the majority of |z| productions (979 target-like forms out of 1088 attempts; 90%).

Mun started to produce more target-like forms of |s| than the unsuccessful attempts at age 2;05.17. Between 1;07.08 and 2;05.03, the pre-acquisition stage of |s|, similar to Hìu, stopping is a significant trend of substitution for Mun's productions of |s| (418 times out of 678 attempts; 61.65%). She deleted |s| 21 times (3%) and substituted with consonants other than stops 86 times (12%). Between 2;05.17 and 2;11.07, she had 94 accurate productions of |s| out of 121 total attempts (77.68%).

Mun did not fully acquire |z| at the end of the documented period, neither did she show any clear stage of development of the MoA of this consonant. Overall, of the total 1460 attempts at |z|, she produced target-like forms only 363 times (24.86%). Stopping accounted for the majority of production of |z| (n=609; 41.71%). Gliding to [j] was also a prominent phonological pattern

accounting for 22.39% of |z| (n=327). Table 24 Illustrates the development of the MoA of |z| and |z| by the two children.

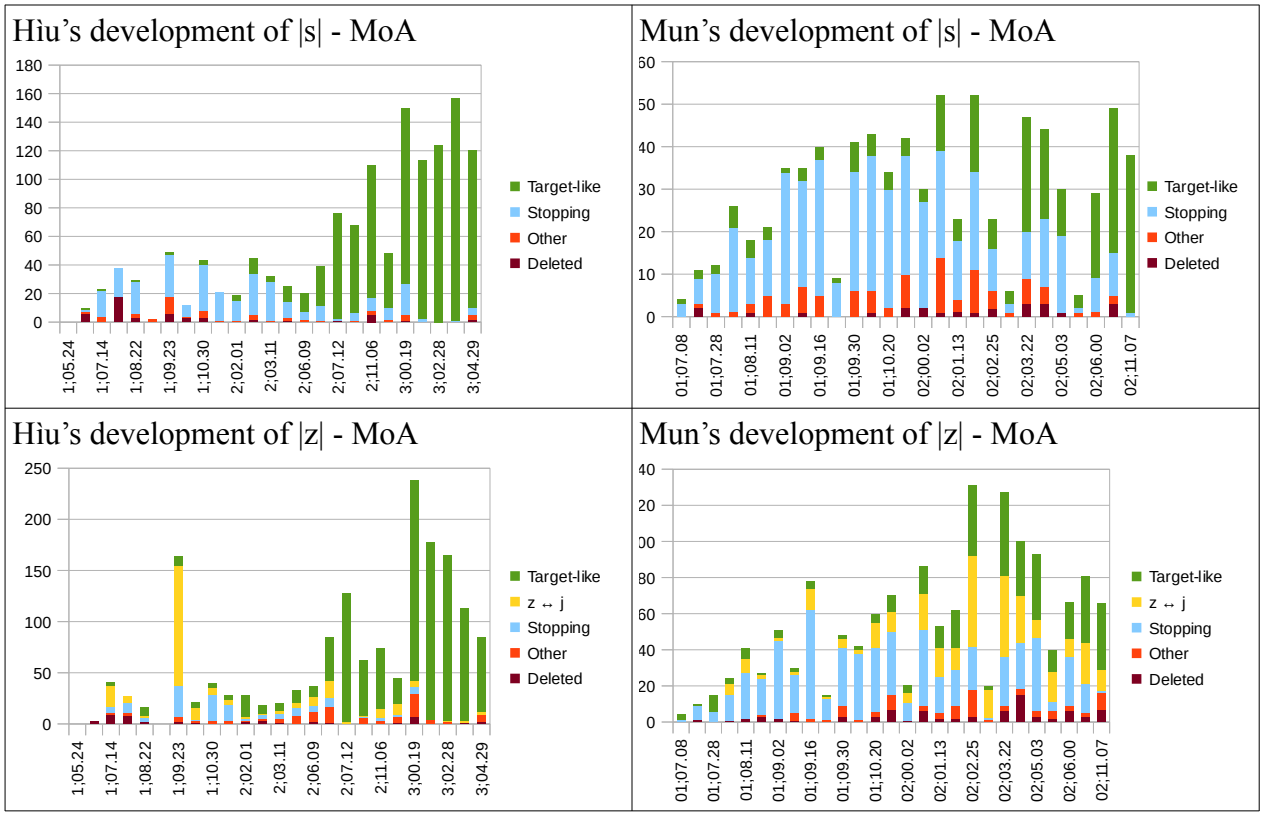


Table 24: The development of |s| and |z| in terms of MoA

I now move on to the description of the rest of the fricative consonants, including |ɣ|, |x|, and |h|. As we can see in Table 25, both children attempted at |ɣ| from early on but only Hìu had early success at this consonant, starting at 1;07.04. Mun did not produce any target-like forms until 1;09.09. Hìu acquired |ɣ| at 2;02.01 while Mun acquired the MoA of this consonant at 2;02.25. Overall, Hìu had higher successful rate than Mun (77.7%; n=195 out of 251 attempts by Hìu compared to 38.14%; n=119 out of 312 attempts by Mun). Mun, however, produced more stopped instances (161 out of 312 attempts; 51.6%) than Hìu (43 out of 251 attempts; 17.13%).

Both children showed two clear stages of the development of |ɣ| in terms of MoA, and stopping is the major phonological pattern attested in the pre-acquisition stage in both corpora. Between 1;05.24 and 1;11.19, Hìu produced |ɣ| as a stop consonant 31 times out of 59 total attempts (53%). Comparatively, between 1;07.08 and 2;02.05, stopping occurred 156 times out of 218 attempts at |ɣ| (71.55%) in Mun's corpus. During the acquisition stage, 90% of Hìu's productions of |ɣ| (172 out of 192 attempts) and 89.36% of Mun's productions of |ɣ| (84 out of 94 attempts) were target-like. Table 25 shows the similarities and differences in the development of the MoA of |ɣ| by the two children.

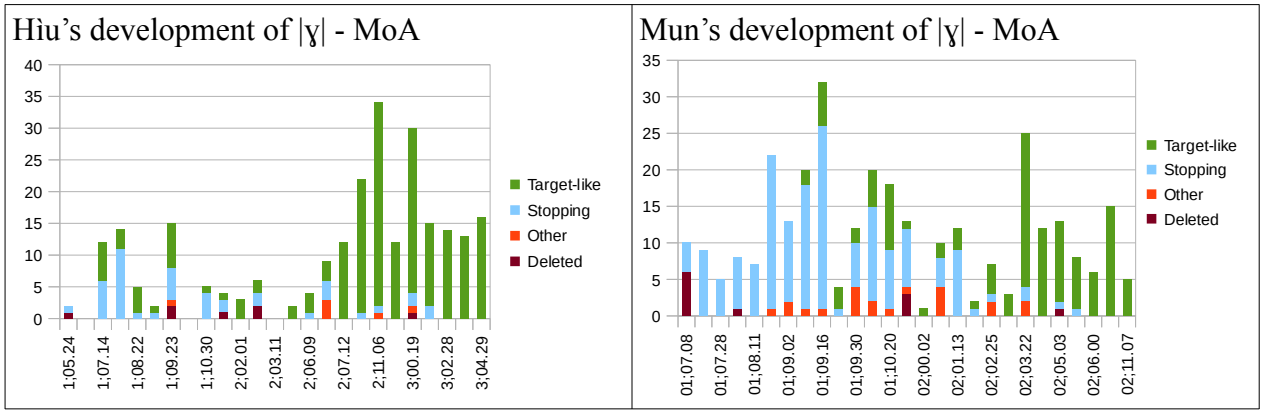


Table 25: The development of |ɣ| in terms of MoA

In terms of manner of articulation, |x| and |h| display similar development patterns for both children, as can be seen in Table 26, with deletion consisting of the most important trend. While Hìu showed two clear stages: deletion (from 1;05.24 to 1;11.19 for |x| and from 1;05.24 to 1;09.23 for |h|) and successful pronunciations (from 2;02.01 to 3;04.29 for |x| and from 1;10.15 to 3;04.29 for |h|), Mun did not have any clear stages in her development of either |x| or |h|. Moreover, she was less successful with more deletions and more stop substitutions compared to Hìu. Deletion accounted for 44.95% of Mun's total attempts at |x| (236 out of 525) and 43.53% of |h| (377 out of 866 attempts). Stopping came in second place with a rate of 21.33% (157 out of

525 attempts) for |x| and 12.93% (112 out of 866 attempts) for |h|. Only 29.90% (157 out of 525 attempts) of |x| and 39.95% (346 out of 866 attempts) of |h| were produced target-like. In contrast, Hìu had 82% of his |x| (391 out of 475 attempts) and 83% of his |h| (974 out of 1172 attempts) as target-like. He deleted |x| 65 times out out 475 attempts (13.7%) and deleted |h| 142 times out of 475 attempts (12%). Stopping accounted for only 2.52% of |x| (n=12) and 3% of |h| (n=35).

Recall from Chapter 1, section 2 that previous studies also reported that |x| and |ɣ| are acquired late by most Vietnamese-learning children. This holds true of Hìu and Mun.

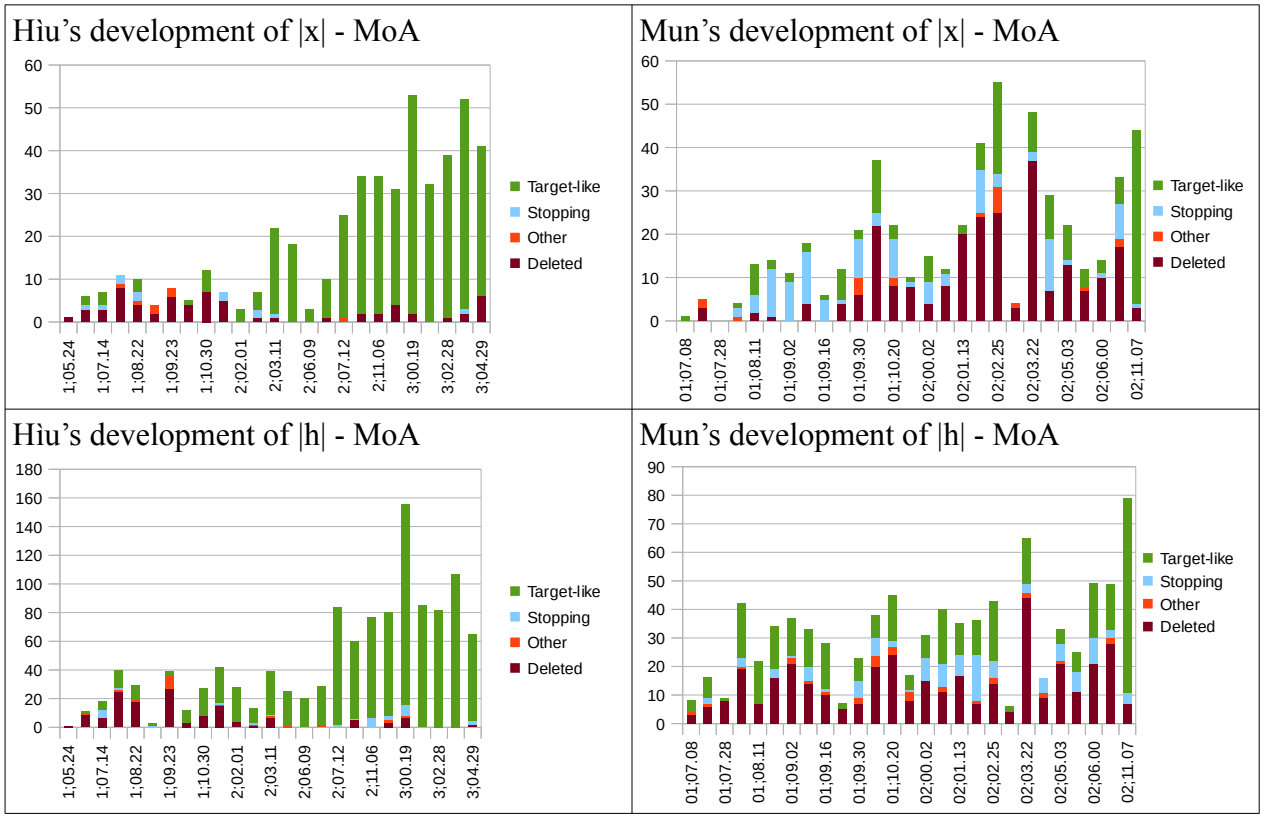


Table 26: The development of |x| and |h| in terms of MoA

The description of |x| and |h| concludes the current section. I now move on to section 2.2.3 to describe the development of the affricate MoA.

2.2.3 Affricate

/tɕ/ is the only affricate consonant in Vietnamese. Both Hìu and Mun de-affricated it to a stop or a fricative consonant and failed to acquire this MoA by the end of the documented period, as shown in Table 27.

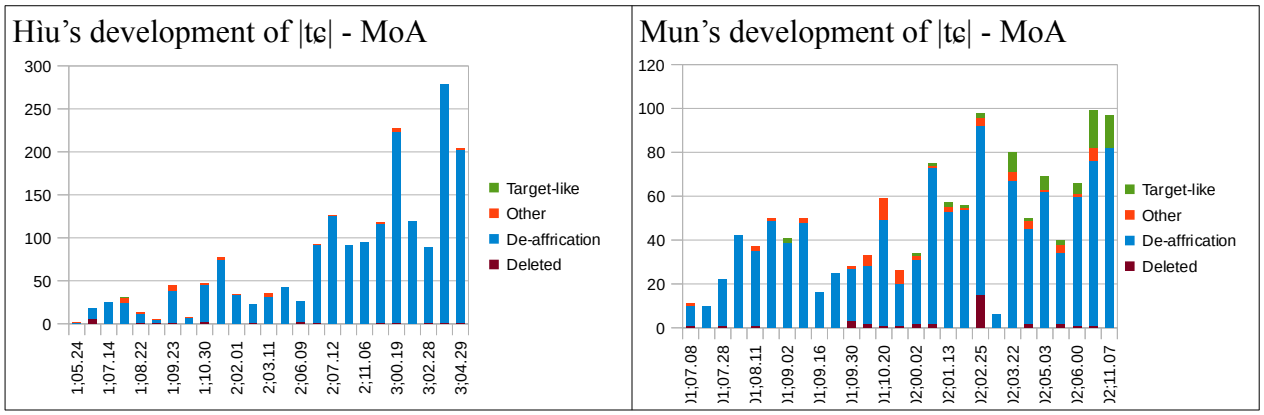


Table 27: The development of |tɕ| in terms of MoA

Of the total 1878 attempts at |tɕ|, Hìu deleted this onset 21 times (1.11%), de-affricated it 1820 times (96.91%), substituted it with other MoA (either nasal or approximant) 36 times (1.91%), and only had one target-like form. Similarly, Mun had a total of 1277 attempts at |tɕ|, of which 35 instances were deleted (2.74%), 1120 instances were de-affricated (87.7%), 58 cases of other substitution (4.54%), and 64 target-like forms (5.01%).

2.2.4 Nasal

Vietnamese has four nasal consonants in syllable onset position. These nasals are /m, n, ɲ, ŋ/. Both children acquired |ɲ| and |ŋ| early and pronounced them accurately throughout the corpus, with only a few deletions and substitutions, as can be seen in Table 28. For |ɲ|, Hìu had 615 target-like forms out of total 642 attempts (95.79%). He deleted |ɲ| 17 times (2.65%) and substituted it only 10 times (1.55%). Similarly, Mun had 461 target-like forms out of total 494

attempts at |ɲ|. She deleted it only 10 times (2.02%) and substituted it 23 times (4.66%). For |ŋ|, Hìu had 325 target-like forms out of total 344 attempts (94%). He deleted it 12 times (3%) and substituted it 7 times (2%). Out of 325 attempts at |ŋ|, Mun was successful 309 times (95.08%). She deleted it 9 times (2.77%) and substituted it 7 times (2.15%).

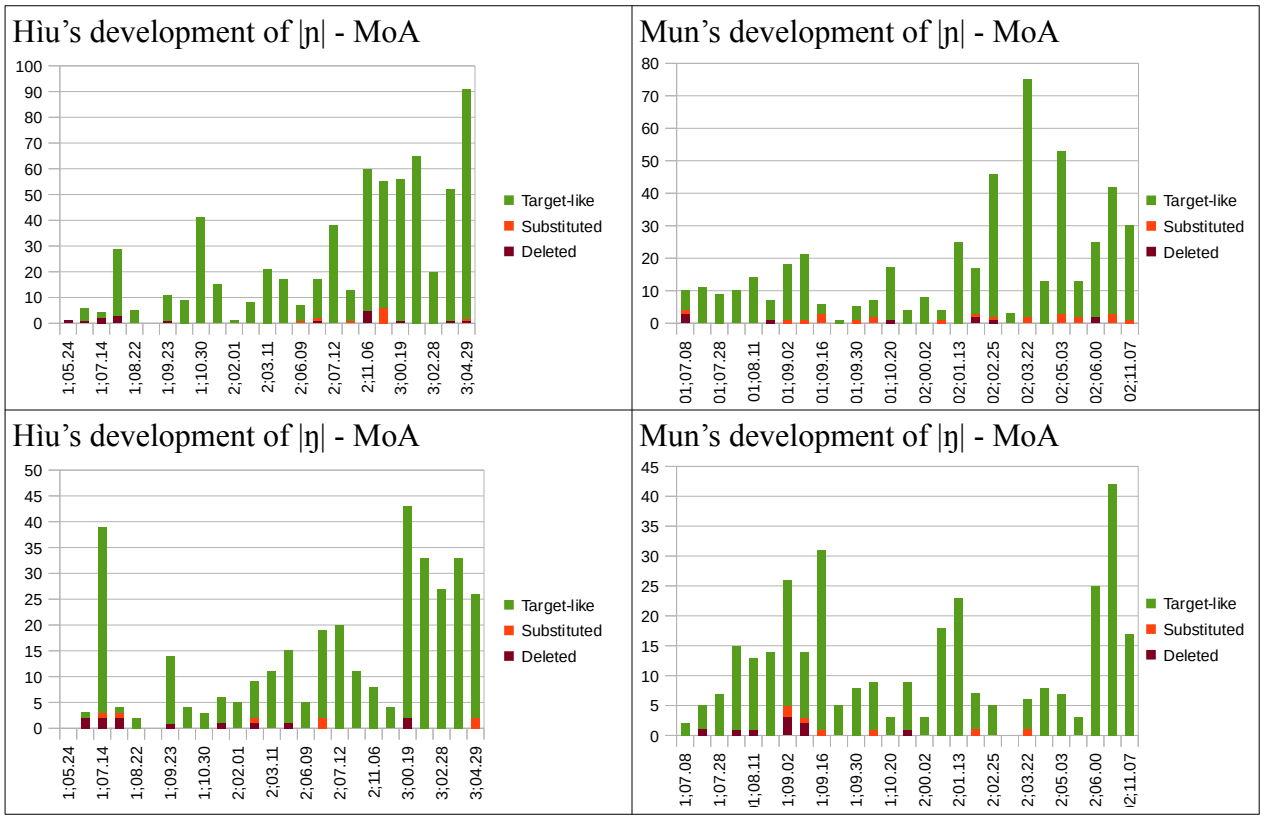


Table 28: The development of |ɲ| and |ŋ| in terms of MoA

The development of MoA of |m| and |n|, however, differed between the two children. Hìu was proficient at |m| with 96.4% accuracy (1837 target-like forms out of 1906 attempts) but he had more substitution of |n| between 2;06.27 and 3;04.29. Of a total of 1773 attempts at |n|, he pronounced this consonant as [l] 211 times (12.17%) and as [ɾ] 199 times (11.48%). He produced 1286 target-like forms of |n| (74.2%), deleting it 24 times (1.38%) and substituting it with consonants other than [l] or [ɾ] only 13 times (0.75%). In contrast, Mun had nearly equal rates of target-like forms of |m| and |n|. Of 1133 attempts at |m|, she pronounced it accurately 919 times

(81.11%), deleted it 48 times (4.24%), substituted it with [b] or [p] 114 times (10.06%), and with other consonants 52 times (4.59%). Of total 1210 attempts at |n|, she had 1020 target-like forms (84.3%), deleted it 35 times (34.3%), substituted it with [c] or [ɟ] 65 times (6.37%), with [j] 33 times (3.24%), and with other consonants 57 times (5.59%). Table 29 and Table 30 illustrate the development of |m| and |n| in terms of MoA by both children.

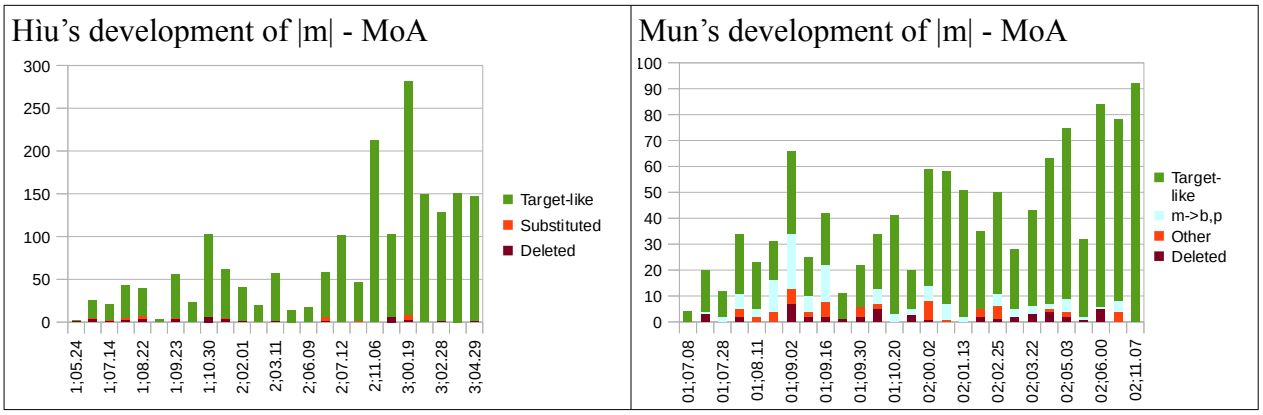


Table 29: The development of |m| in terms of MoA

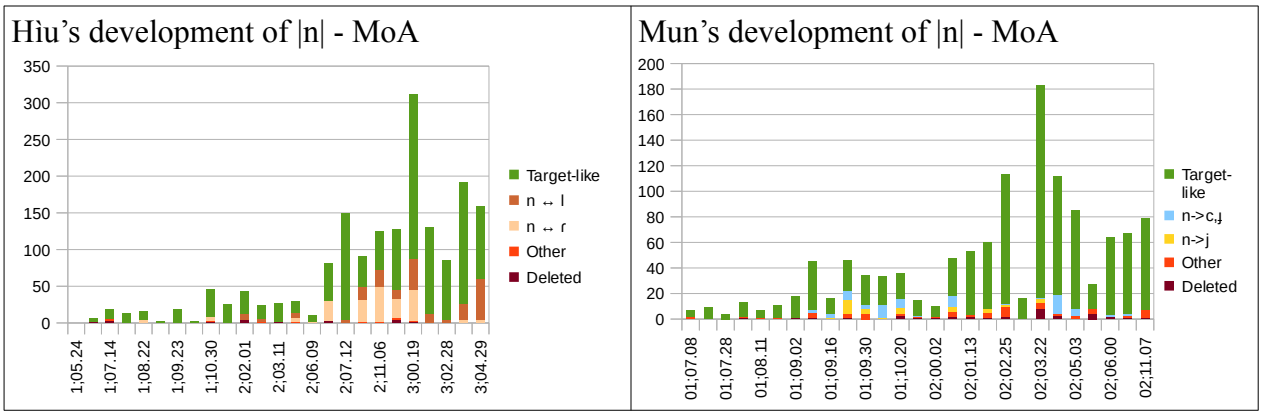


Table 30: The development of |n| in terms of MoA

2.2.5 Liquid

/l/ is the only liquid consonant in Vietnamese. Hìu acquired this consonant at 2;05.20, later than most other consonants, while Mun did not acquire |l| by age 2;11.07, the end of the observation period. Table 31 displays the developmental patterns of |l| by the two children.

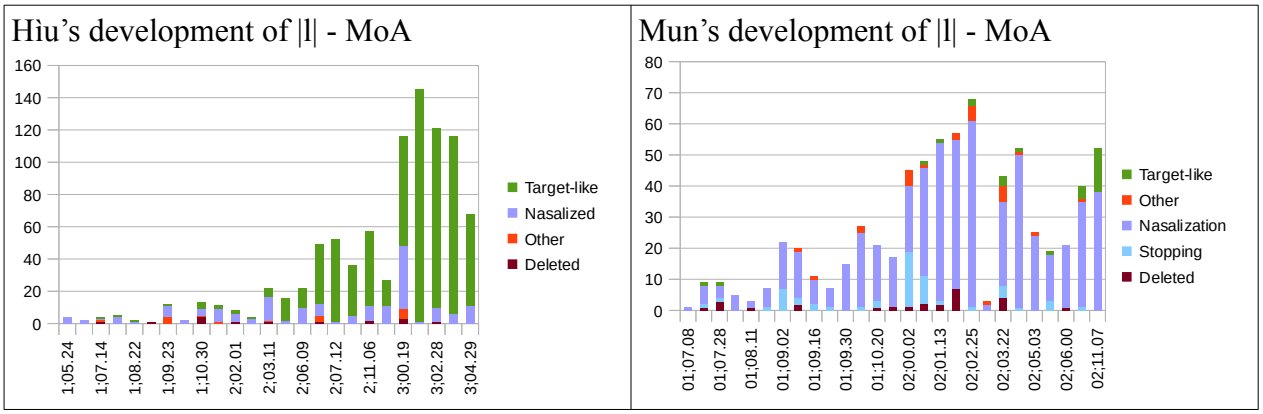


Table 31: The development of |l| in terms of MoA

Hìu showed two stages of development of |l|, although nasalization, the main phonological pattern, lasted from the beginning to the end of the documented period. Before 2;05.20, Hìu had very few attempts at |l| especially during the first six sessions, and most of these liquid onsets were substituted (64 times out of 90 attempts). He deleted |l| 8 times (8.9%). Especially, nasalization accounts for 56 of 90 attempts (62%) during this pre-acquisition stage. From 2;05.20 onward, in every session, there were more target-like forms than unsuccessful attempts. During this stage, Hìu pronounced |l| correctly 697 times out of 825 attempts (84.48%). He deleted it only 7 times (0.8%) and substituted it with [n] 111 times (13.45%).

In contrast, Mun only had 29 accurate forms out of 702 total attempts at |l| (4.13%) between 1;07.08 and 2;11.07. She deleted it 26 times (3.7%) and substituted it with a stop consonant 56 times (7.97%). Nasalization occurred 565 times (80.48%), of which Mun pronounced |l| as [n] 327 times (46.58%) and as [ɲ] 224 times (31.9%).

As I already mentioned in Chapter 1, sections 1.1.2.1 and 2.1.2, the process of substituting |l| with [n] reflects a property of the Northern dialect of Vietnamese where |l| and |n| are often interchangeable.

2.3 Interim summary

Throughout the subsections above, I have reported on Hìu's and Mun's development of syllable onsets in terms of place and manner of articulation. The subsections from 2.1.1 to 2.1.5 report the children's development of labials, alveolars, palatals, velars, and laryngeals. Of these five PoA, both children acquired labials, palatals and laryngeals faster than alveolars and velars. Palatalization affected all coronal onsets, especially |t, t^h, s, z|. Hìu did not fully acquire |t^h| until age 3;04.29 and, during the last four sessions, the palatalized forms still outnumbered the target-like ones (146 compared to 98). Mun also did not fully acquire |t, t^h, z| by 2;11.07 (the last recorded session). However, for |t^h|, she had more target-like forms than palatalized forms during the last three sessions. Of the velar onsets, |x| and |ɣ| clearly contrast with each other. Both children acquired |ɣ| at roughly the same age (1;07.14 for Hìu and 1;07.21 for Mun) but did not succeed at |x| by the last recorded session. Regarding manner of articulation, which were reported in the sub-sections from 2.2.1 to 2.2.5, plosives were acquired the earliest and were the most stable. Stopping affected all fricatives, especially |v, s, z, ɣ|. In contrast to |ɣ|, which was mostly pronounced as a stop during the substitution period, |x| and |h| were similar in that they were both deleted more than stopped and had more target-like forms at the same age (2;02.01 for Hìu and 2;11.07 for Mun). Neither child fully acquired the affricate manner by the end of the observation period. Lastly, their development of nasals and liquid reflects the properties of the Northern dialect of Vietnamese where |n| and |l| are used interchangeably. Table 32 to Table 36 summarize a timeline of the acquisition of syllable-onsets by both children regarding both PoA and MoA.

Abbreviations: D - Deleted; P – Palatalized; D.as – De-aspirated; N - Nasalized; S – Stopped; Apr - Approximant; D.af – De-affricated

Small letters (ex. h, b, etc.): Actual realizations of the targeted consonants

Grey cells: No attempts

✓ *Majority of productions are target-like forms*

	1;05.24	1;07.10	1;07.14	1;07.24	1;08.22	1;09.07	1;09.23	1;10.15	1;10.30	1;11.19	2;02.01	2;02.21	2;03.11	2;05.20	2;06.09	2;06.27	2;07.12	2;10.17	2;11.06	3;00.01	3;00.19	3;02.06	3;02.28	3;03.21	3;04.29
b	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
p								✓	✓	✓											✓	✓		✓	
f							✓			✓			✓				✓	✓	✓	✓	✓	✓	✓	✓	✓
v		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
m	D	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
d	D	✓	D	P	✓	✓	D	D	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
t	✓	✓	P	P	P	P	P	P	P	P	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
tʰ		✓			✓		P	P	P	P	✓	P	✓	P	✓	✓	✓	✓	P	✓	✓	P	P	P	P
s		D	P	P	P	P	P	P	P	P	P	P	P	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
z		D	P	P	✓		P	P	P	P	✓	✓	✓	✓	P	P	✓	✓	✓	✓	✓	✓	✓	✓	✓
n		P	P	P	✓	✓	P	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
l	P	P	✓	P	✓	D	P	P	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
tɕ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ɲ	D	✓	D	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
k	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
x	D	D	D	D	D	D	D	D	D	D	h	✓	h	h	✓	h	✓	h	h	h	h	✓	✓	✓	✓
ŋ		D	✓	D		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ɣ	D		✓	✓	✓	✓	✓		✓	b	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
h	D	D	D	D	D	✓	D	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 32: Hìu's development of consonantal PoA

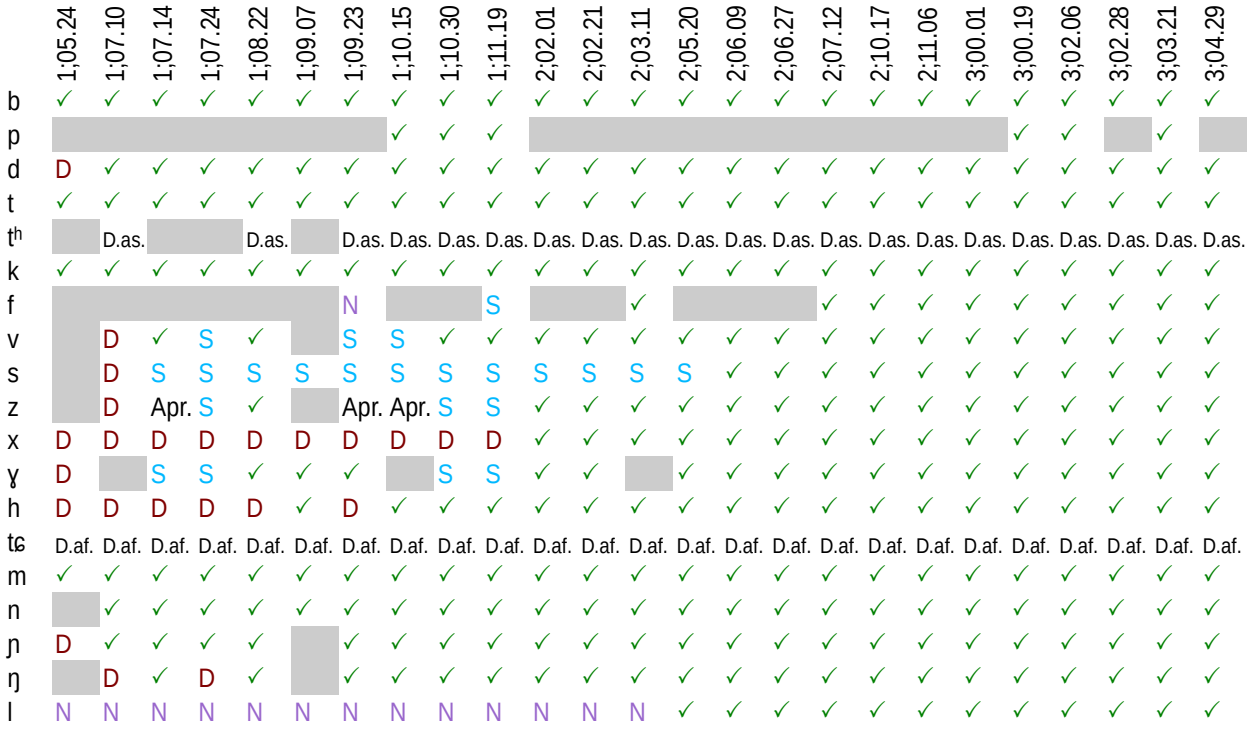


Table 33: Hìu's development of consonantal MoA

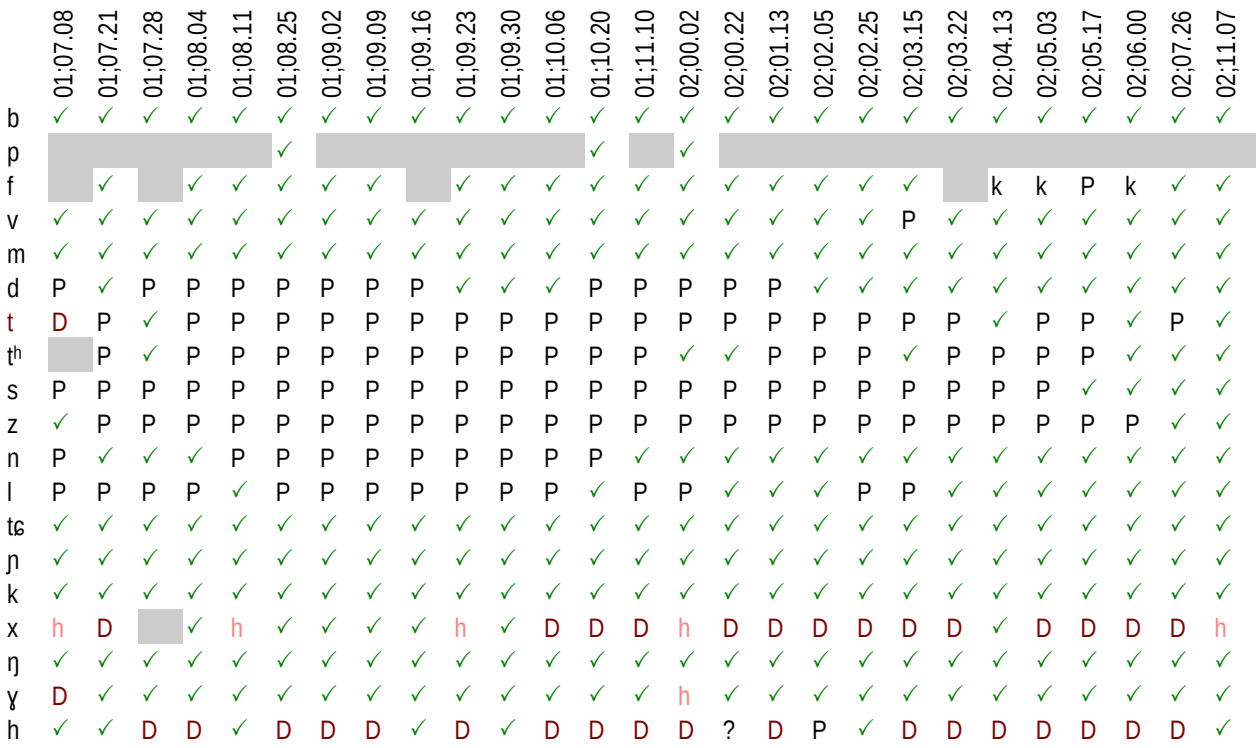


Table 34: Mun's development of consonantal PoA

	01;07.08	01;07.21	01;07.28	01;08.04	01;08.11	01;08.25	01;09.02	01;09.09	01;09.16	01;09.23	01;09.30	01;10.06	01;10.20	01;11.10	02;00.02	02;00.22	02;01.13	02;02.05	02;02.25	02;03.15	02;03.22	02;04.13	02;05.03	02;05.17	02;06.00	02;07.26	02;11.07
b	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
p						✓							✓		✓													
d	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
t	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
tʰ		D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.	D.as.
k	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
f		S		✓	✓	Apr.	S	S		S	✓	S	S	S	S	✓	k	✓	S	S		S	S	k	S	✓	✓
v	S	S	✓	✓	✓	✓	✓	✓	✓	✓	✓	S	S	✓	✓	✓	✓	✓	✓	S	✓	✓	✓	✓	✓	✓	✓
s	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	✓	✓	✓	S	✓	✓	✓	✓
z	✓	S	✓	S	S	S	S	S	S	S	S	S	S	S	S	S	S	✓	Apr.	Apr.	✓	✓	S	Apr.	S	✓	✓
x	✓	D		S	✓	S	S	S	S	✓	S	D	S	D	D	D	D	D	D	D	D	S	D	D	D	D	✓
ɣ	D	S	S	S	S	S	S	S	S	✓	S	S	✓	S	✓	S	S	S	✓	✓	✓	✓	✓	✓	✓	✓	✓
h	✓	✓	D	D	✓	D	D	D	✓	D	✓	D	D	D	D	✓	D	S	✓	D	D	D	D	D	D	D	✓
tɕ	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.	D.af.
m	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ɲ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ŋ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
l	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Table 35: Mun's development of consonantal MoA

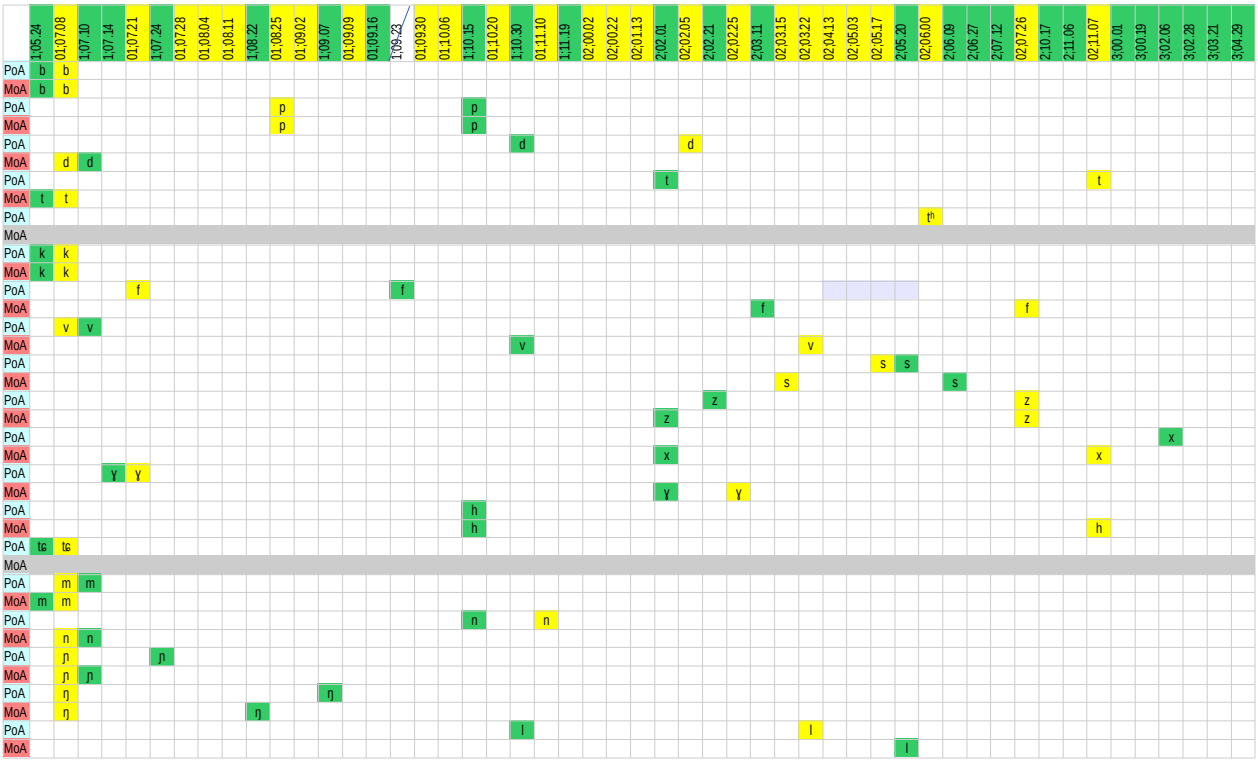


Table 36: Timeline of onset development by two children
(green: Hìu, yellow: Mun)

Now that I have concluded my description of the children's development of the syllable onsets regarding both place of articulation and manner of articulation, I will turn to describing their syllable codas in the following section.

3. The development of syllable codas

Recall from Chapter 1, section 1.1.2.1 that Vietnamese has six consonants and two glides in coda position. The consonants are /p, t, k, m, n, ŋ/ and the glides are /j, w/. The two velars /k/ and /ŋ/ are phonetically realized as [c] and [ɲ] following front vowels /i, e, ɛ/, and as [kp] and [ŋm] following back rounded vowels /u, o, ɔ/. Because these phonetic realizations are important to the learners of the language, I actually included them in my transcription as target forms that the children should learn.

Similar to the previous section about onset consonants, in this section, I will describe all consonants and glides in terms of place and manner of articulation, starting with place of articulation.

3.1 Place of articulation

3.1.1 Labial

Both children acquired the labial codas |p|, |m|, and |w| very well from early ages and these consonants remained stable throughout the corpora, with very few cases of deletion and substitution. There was only one stage of acquisition of these coda consonants in the two corpora.

Hìu attempted coda |p| 206 times in the whole corpus and pronounced it accurately 200 times (97.08 %). He deleted it only three times and substituted it three times. Mun attempted coda |p| 390 times, of which 91.02% was target-like (n=355), 5.12% was substituted (n=20, with [t] substitution accounting for 19 instances), and 3.84% were deleted (n=15).

Hìu had a total of 1228 attempts at the coda |m|, of which 1203 attempts were target-like (97.96 %), only 15 cases of deletion (1.22%) and 10 instances of substitution (0.81%). Of the total 1027 attempts at the coda |m|, Mun had 983 target-like forms (95.71%). She deleted it 24 times (2.33%), and substituted it 20 times (1.94%). 17 out of the 20 substituted instances were cases of |m| pronounced as [n].

For Hìu, the coda |w| appeared 2621 times between 1;05.24 and 3;04.29 (the entire observed period). Out of this total, it was deleted 60 times (2.28%), and substituted only once. The remainder (2560 cases, 97.67 %) were target-like. For Mun, of the total of 2205 attempts at |w|, 2078 attempts were target-like (94.24%). She deleted it 111 times (5.03%), and substituted it 16 times (0.72%).

Table 37 illustrates Hìu's and Mun's development of the labial codas.

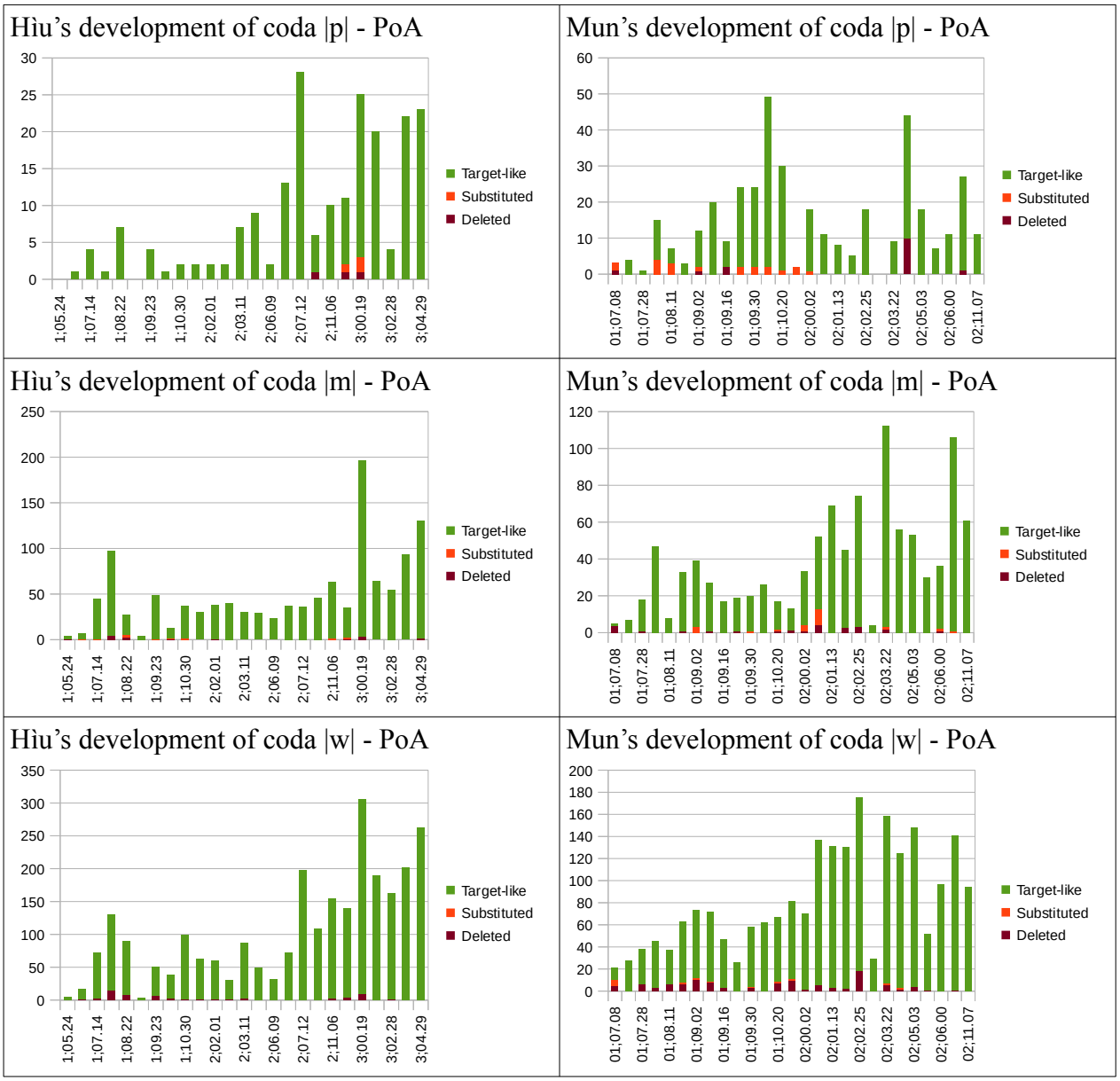


Table 37: The development of labial codas

3.1.2 Alveolar

The development of coronal codas showed differences between the two children. Overall, Hìu acquired |t| and |n| earlier and better than Mun did. His pronunciations of these consonantal codas

were also more stable than Mun's. Nevertheless, despite the variations attested in Mun's corpus, both children only showed one stage of acquisition of the codas |t| and |n|.

In the early sessions, Hìu displayed a minor pattern of backing, i.e. he pronounced |t| as [c] or [k] and |n| as [ŋ]. However, the number of these cases was not significant. For |t|, this backing process affected only 20 out of 1287 attempts in total (1.55 %), and it occurred with a variety of words, as shown in (16). |n| was pronounced as [ŋ] 34 times out of 2990 attempts in total (1.14 %), and this backing happened to only three words, as illustrated in (17).

(16) Examples of |t| pronounced as [c] or [k] by Hìu:

Word	IPA Target	IPA Actual	Age	Gloss
cảnh sát	|kɛɲ4 sat5|	[ɟak5]	1;07.10	*police*
hát	|hat5|	[ak5]	1;07.10	*sing*
đút	|dut5|	[duk5]	1;07.14	*put into*
rút	|zut5|	[juk5]	1;07.14	*pull out*
bật	|bɤ̆t6|	[bɤ̆k6]	1;07.14	*turn on*
vịt	|vit6|	[bic6]	1;07.24	*duck*
một	|mot6|	[mok6]	2;02.01	*one*
cất	|kɤ̆t5|	[kɤ̆k5]	2;02.21	*put away*
bắt	|băt5|	[băk5]	2;02.21	*catch*

(17) Examples of |n| pronounced as [ŋ] by Hìu:

Word	IPA Target	IPA Actual	Age	Gloss
ngựa vằn	|ŋɯə6 văn2|	[băŋ2] [văŋ2]	1;08.22 1;09.23	*zebra*
rắn	|zăn5|	[zăŋ5] / [dăŋ5]	1;08.22	*snake*
con	|kɔn1|	[ɔ:ŋ1] / [kɔ:ŋ1] / [ăŋ1] / [əŋ1]	1;08.22 1;09.23	*classifier for animals*

Mun, however, struggled more with the coda |t| compared to |n|. Her accuracy rate for |t| was only 81.37% (891 out of 1095 attempts) whereas it was 93.95% for |n| (2625 out of 2794 attempts totally). Of 1095 attempts at |t|, labial substitution accounted for 132 cases (12.05%) and dorsal substitution accounted for 57 instances (5.2%). She deleted |t| 14 times (1.27%). Of the total of 2794 attempts at |n|, deletion constituted 1.43% (n=40), labial substitution made up 3.07% (n=86), and dorsal substitution was 1.54% (n=43).

The substitutions of |t| with [p] appear to all result from an optional process of harmony or assimilation, as exemplified in (18), where each target has at least a labial consonant or glide, or a round vowel. Note as well that 120 out of these 132 instances originate from the word ‘một’ |mot6| (*one*); this lexical item thus single-handedly accounts for the vast majority of cases.

(18) Examples of the coda |t| pronounced as [p] by Mun:

Word	IPA Target	IPA Actual	Age	Gloss
quạt	|kwat6|	[kap6]	1;07.21	*fan*
một	|mot6|	[mop6]	1;08.25	*one*
cà rốt	|ka2 rot5 |	[ca6 cop5]	1;09.02	*carrot*
cánh cụt	|kut6|	[kup6]	1;09.30	*penguin*
bật	|bɤ̆t6|	[bɤ̆p6]	2;02.25	*turn on*
cột	|kot6|	[bop6]	2;02.25	*pillar*

On the other hand, the substitution of |t| with either a palatal coda or a velar coda does not seem to relate to a specific lexical item or an explainable pattern, as exemplified in (19) below:

(19) Examples of the coda |t| pronounced as palatal or velar by Mun:

Word	IPA Target	IPA Actual	Age	Gloss
cất	|kɤ̌t5|	[kek5]	1;08.11	*put away*
		[kɤ̌k5]	1;08.25	
		[kec5]	1;08.11	
chuột	|tɕuət6|	[cuŋ6]	1;10.20	*mouse*
cà rốt	|ka2 rot5 |	[ka1 cuk5]	1;09.09	*carrot*
hết	|het5|	[ec5]	1;07.21	*run out*
bật	|bɤ̌t6|	[bec5]	1;07.28	*turn on*
cắt	|kăt5|	[kɛc5]	1;07.28	*cut*
chặt	|tɕăt6|	[cɛc6]	1;08.25	*tight*
mất	|mɤ̌t5|	[mec5]	1;09.09	*disappear*

Table 38 illustrates the children's development of the coronal codas.

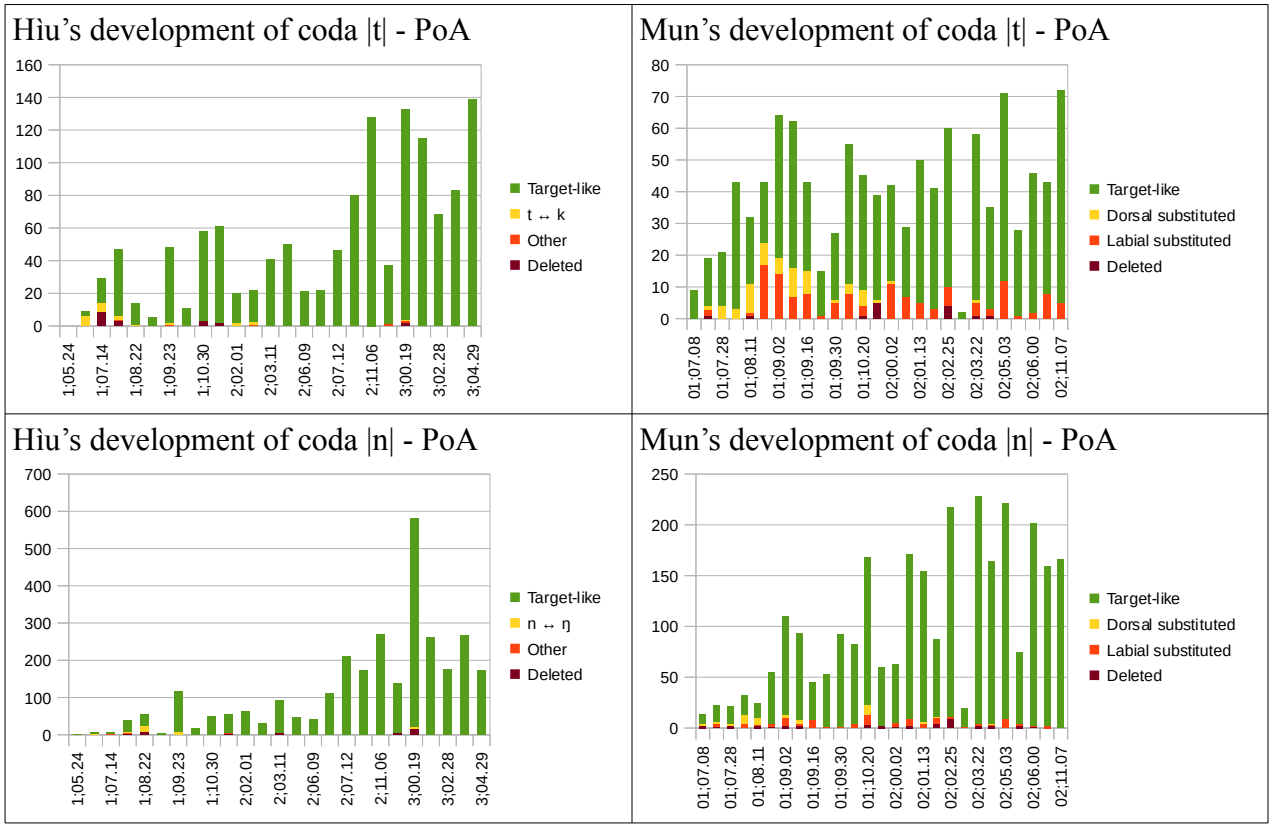


Table 38: The development of coronal codas

3.1.3 Palatal

Both children acquired the coda |j| early and produced it reliably throughout the observation period, with only a few cases of deletion and substitution, as shown in Table 39. Of the total 5408 attempts at |j|, Hìu was successful 5309 times (98.17%). He deleted |j| 89 times (1.64%), and substituted it only 10 times (0.18%). Of the total of 4371 attempts at |j|, Mun had 4264 target-like forms (97.55%). She deleted |j| 101 times (2.31%), and substituted it only 6 times (0.13%).

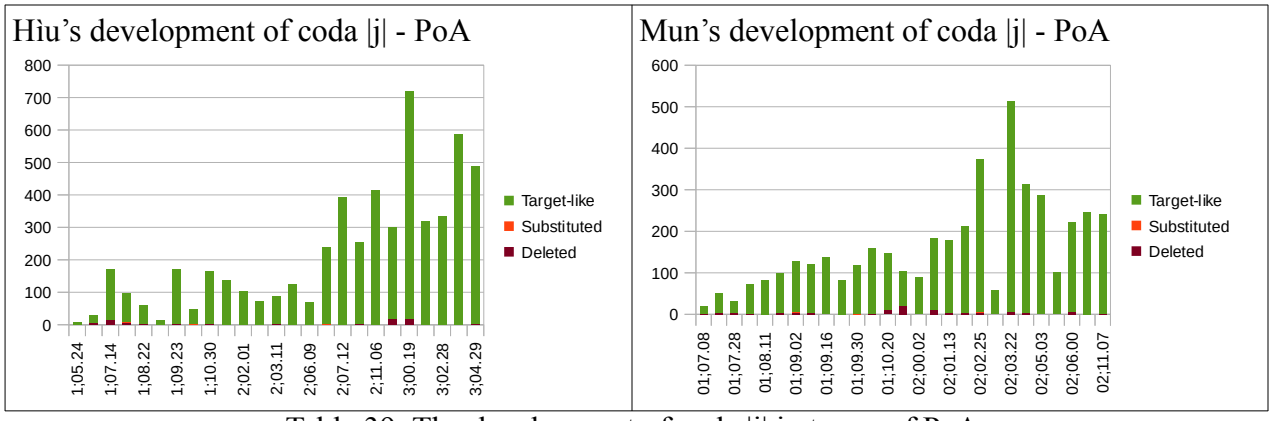


Table 39: The development of coda |j| in terms of PoA

The development of |c| and |ɲ| showed more variations while the number of attempts was much smaller compared to |j|, as displayed in Table 40. Fronting is the main phonological pattern affecting these two codas. Between the two children, Hìu acquired these consonants better than Mun did. And between the two consonants, the acquisition of |c| was less successful than |ɲ|. There were two stages of development of |c| by Hìu, but only one stage attested for |ɲ| by Hìu and |c, ɲ| by Mun.

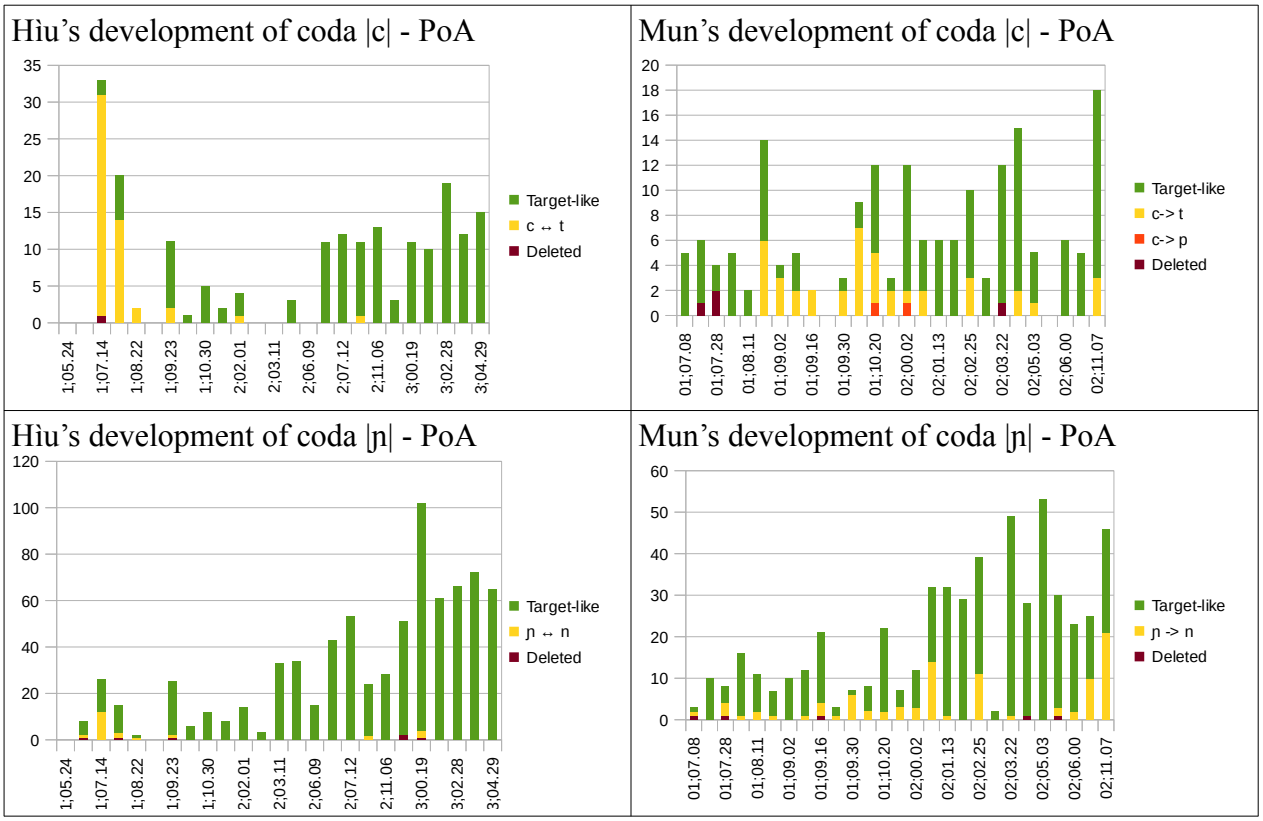


Table 40: The development of codas |c|, |ɲ| in terms of PoA

The stage of pre-acquisition of |c| by Hìu started at 1;07.14 and ended at 1;08.22. Most of the productions of the coda |c| during this period emerged as the alveolar coda |t| (n=46 out of 55 attempts; 83.64%). However, only two words were attempted: |bic5| -> [bit5] (Bích – *a proper name*), and |sic6 sic6| -> [ɟit6 ɟit6] (xịch xịch – *a word to imitate the sound of a train*). From 1;09.23 to 3;04.29 (the end of the documented period), Hìu produced the PoA of the coda |c| correctly in 139 out of 143 attempts (97.2%).

Overall, Mun pronounced |c| accurately in 132 out of total 178 attempts (74.15%). She substituted |c| with [t] 40 times (22.47%), and deleted it four times (2.2%). There were two instances where she pronounced |c| as [p] (1.1%).

Of the total 766 attempts at |ɲ|, Hìu was successful 738 times (96.34%). He substituted |ɲ| with [n] 22 times (2.87%), and deleted it six times (0.78%). Mun had a total of 545 attempts at |ɲ|, of which she had 449 target-like forms (82.38%). She pronounced |ɲ| as [n] 91 times (16.69%), and deleted it five times (0.92%).

Between 1;07.10 and 1;09.23, Hìu pronounced |ɲ| as [n] 16 times out of total 76 attempts (21.05 %), of which it appears 14 times in the word 'anh' (*brother)* |ɛɲ1| -> [ăn1]; the other two words are 'xanh' (*green/blue*) |sɛɲ1| and |dwɛɲ2| (Đoành – *a proper name*). Mun, however, did not seem to attribute the coronal substitution of |c| and |ɲ| to a specific lexical item. I now move on to the description of the two velar codas |ŋ| and |k|.

3.1.4 Velar

The development of codas |k| and |ŋ| showed a clear contrast between the two children. While Hìu hardly had troubles with these consonants, Mun seemed to struggle with them. Although she had more successful attempts at |ŋ| from 2;00.02 and at |k| from 2;06.00 toward 2;11.07, she did not fully acquire |k| or |ŋ| at the end of the observation period. Table 41 illustrates the development of |k| and |ŋ| by Hìu and Mun.

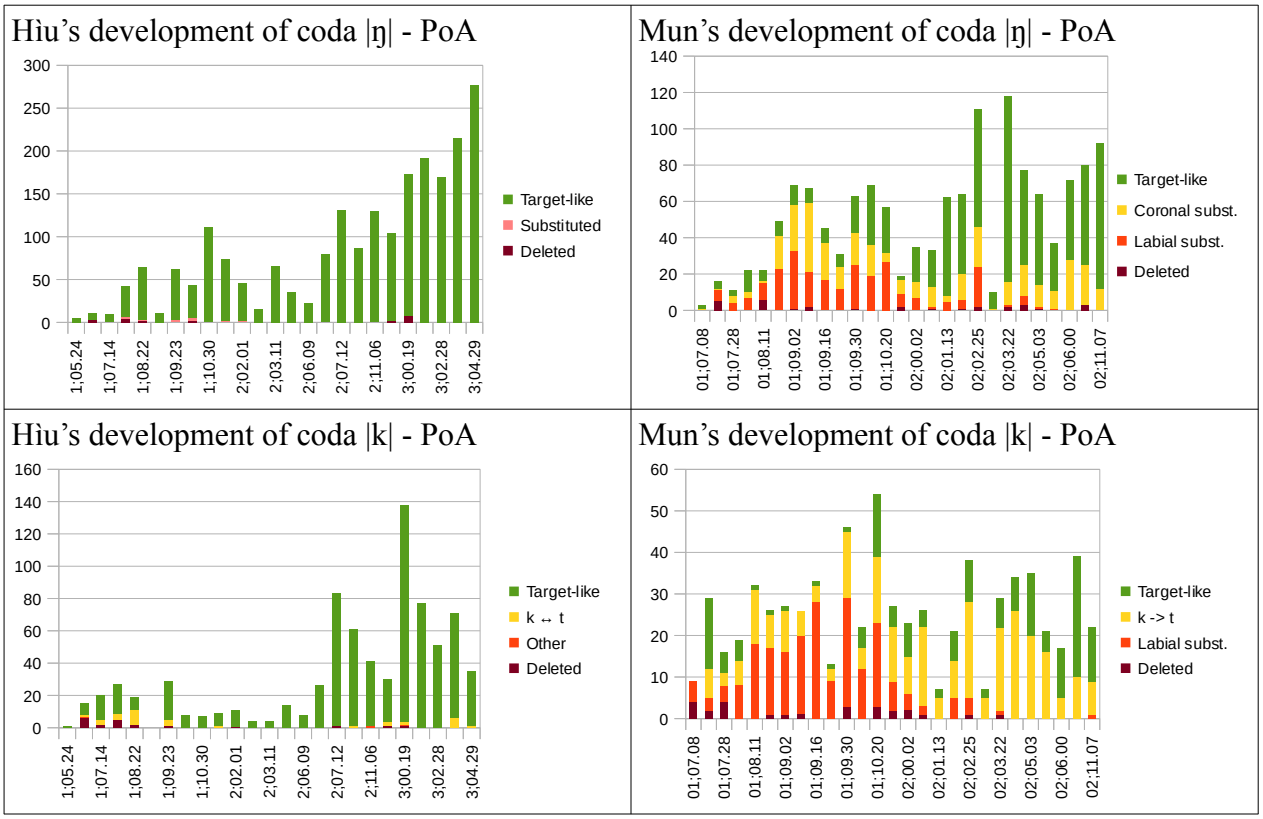


Table 41: The development of codas |ŋ| and |k| in terms of PoA

Of the total 2177 attempts at |ŋ|, Hìu had 2139 target-like forms (98.25%). He deleted this coda consonant 24 times (1.12%) and substituted it 14 times (0.64%).

Of the total of 789 attempts at |k|, Hìu was successful 731 times (92.64%). He deleted |k| 20 times (4.43%), pronounced it as [t] 35 times (2.53%), and substituted it with other consonants only three times (0.38%). Specifically, |k| was pronounced as [t] 21 times out of 111 instances (18.92 %) between 1;05.24 and 1;09.23. Between 2;10.17 and 3;04.29, Hìu pronounced |k| as [t] 13 times out of 504 attempts (2.58 %). Several different words with the coda |k| were affected, as shown in (20).

(20) Examples of |k| pronounced as [t]

Word	IPA Target	IPA Actual	Age	Gloss
cục ta cục tác	|kuk6 ta1 kuk6 tak5|	[kut6 ca1 kut6 cat5]	1;08.22	*sounds made by a hen*
nước đá	|nɯək5 da5|	[nɯt5 ta5]	1;09.23	*ice*
lúc lắc	|luk5 lăk5|	[nut5 dat5]	1;09.23	*shake*
nước	|nɯək5|	[ɲɯət5]	1;09.23	*water*
hoa cúc	|hwa1 kuk5|	[hwa1 kut5]	3;00.01	*chrysanthemum*
các	|kak5|	[kat5]	3;00.01	*plural determiner*
chính xác	|ciŋ5 sak5|	[ciŋ5 sat5]	3;03.21	*exact / exactly*

Mun, on the other hand, had fewer attempts at |ŋ| and |k| but lower successful rate compared to Hìu. Of her total 1399 attempts at |ŋ|, she had 769 target-like forms, (54.96%). Labial substitution was 18.15% (n=254), coronal substitution was 24.66% (n=345), and deletion was 2.14% (n=30). Regarding |k|, she had a total of 698 attempts, of which only 180 instances were target-like (25.78%), 207 cases were labial substitution (29.65%), 285 cases of coronal substitution (40.83%), and deletion accounted for 26 instances (3.72%).

Recall from section 1.1.2.1 that Vietnamese codas /ŋ/ and /k/ are realized as [ŋm] and [kp] following the back rounded singleton vowels /u, o, ɔ/. This accounted for the majority of instances where |ŋ| (n=247) or |k| (n=200) were both pronounced as a singleton labial consonant and the preceding vowel (if they were either |o| or |ɔ|) became unrounded. The remaining instances resulted from assimilation (7 out of 7 for |ŋ| and 3 out of 7 for |k|), as shown in (21) below.

(21) Examples of codas |ŋ| and |k| pronounced as singleton labials by Mun
a. |ŋ| as a labial

Word	IPA Target	IPA Actual	Age	Gloss
miệng	|miəŋ6|	[miəm6]	1;07.21	*mouth*
vuông	|vuəŋ1|	[buəm1]	1;08.25	*square*
xuống	|suəŋ5|	[bum3]	1;10.06	*go down*
	|suəŋ5|	[uəm3]	2;02.25	
vâng	|vɤ̆ŋ1|	[bɤ̆m1]	2;02.25	*yes*
đang (đeo)	|daŋ1|	[daw1]	2;05.03	*(at present)*
vàng	|vaŋ2|	[vav2]	2;05.17	*yellow*

b. |k| as a labial

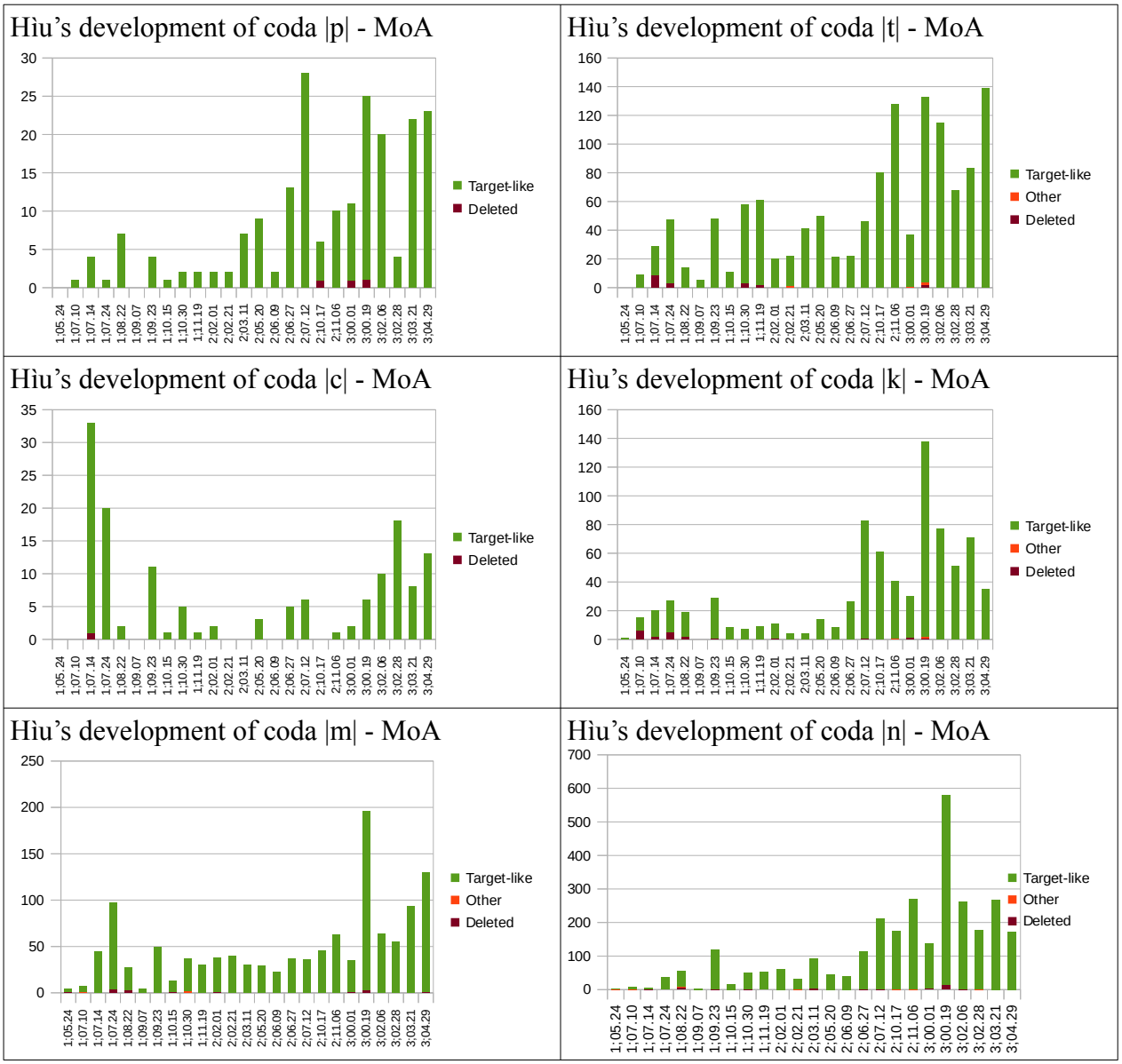
Word	IPA Target	IPA Actual	Age	Gloss
xiếc	|siək5|	[ciəp5]	1;09.02	*circus*
rạp xiếc	|zap6 siək5|	[cat6 ciəp5]	1;09.02	*circus*
thùng rác	|tʰuŋ2 zak5|	[cum2 bap5]	1;09.23	*trash bin*
nước	|nɯək5|	[cɯəp5]	1;10.06	*water*
quạc	|kwak6|	[kap6]	2;02.05	*(a duck's sounds)*
tam giác	|tam1 zak5|	[cam1 ɲap5]	2;02.05	*triangle*
rác	|zak5|	[kap5]	1;09.09	*Trash*

The coronal substitution of |ŋ| and |k|, however, was truly a process of fronting which did not relate to any specific lexical items or assimilation, since it happened in a wide range of contexts, with or without the involvement of front vowels and labial or coronal consonants.

Now that I have completed my description of the PoA of coda consonants, I move on to the next section, regarding the MoA of these consonants.

3.2 Manner of articulation

Both children acquired the manner of articulation of coda consonants and glides early on and produced them throughout the whole corpora without any significant problems. Table 42 and Table 43 show their development of codas regarding manner of articulation.



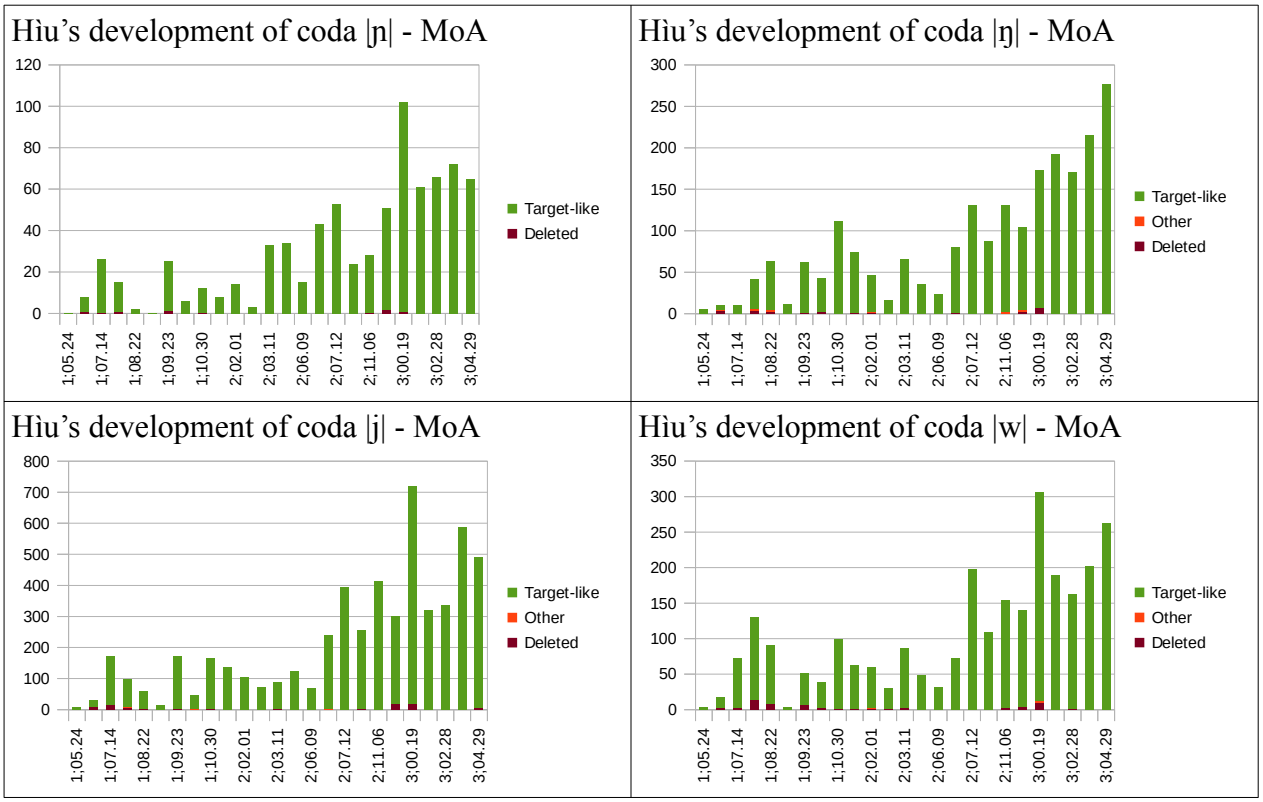
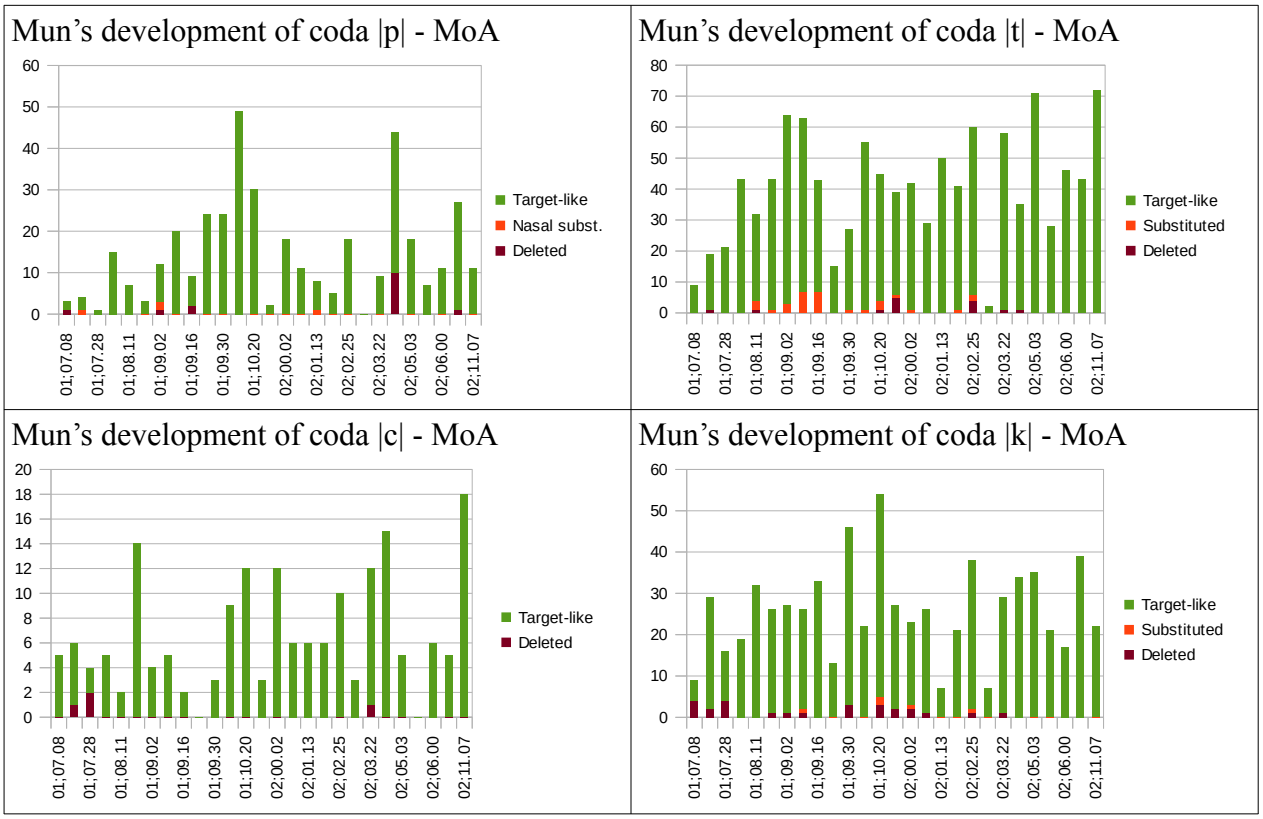


Table 42: Hìu's development of MoA of codas



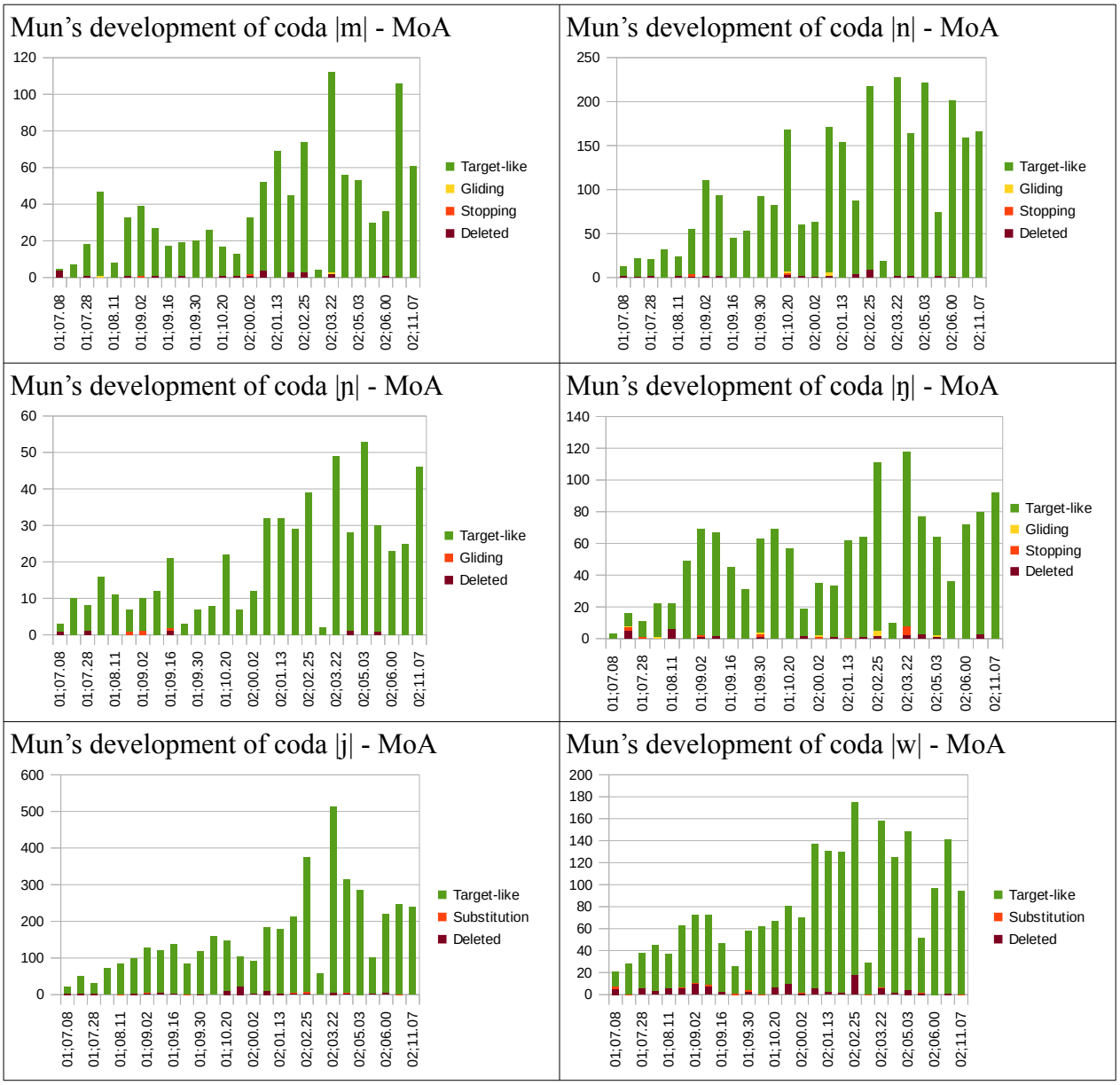


Table 43: Mun's development of MoA of codas

3.3 Interim summary

Section 3 describes Hìu's and Mun's development of syllable codas. In terms of place of articulation, at the beginning of the observed period, there is a mirror image between onsets and codas in a way that backing (palatalization) primarily affects the coronal onsets and fronting primarily affects the palatal and velar codas. However, that is not to say that there is a formal

relationship between backing and fronting in the child's system; we have indeed no evidence to formulate a hypothesis in this direction. More generally, both children were proficient at acquiring consonants in syllable-final position, especially given that they hardly had problems regarding manner of articulation. A summarized timeline of development of PoA and MoA of coda consonants by the two children is provided in the following tables.

Abbreviations: D - Deleted; L – Labialized

Small letters (ex. t, k, n, etc.): Actual realizations of the targeted consonants

Grey cells: No attempts

✓ *Majority of productions are target-like forms*

	1;05.24	1;07.10	1;07.14	1;07.24	1;08.22	1;09.07	1;09.23	1;10.15	1;10.30	1;11.19	2;02.01	2;02.21	2;03.11	2;05.20	2;06.09	2;06.27	2;07.12	2;10.17	2;11.06	3;00.01	3;00.19	3;02.06	3;02.28	3;03.21	3;04.29
p		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
m	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
w	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
t		k	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
c			t	t	✓		✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ɲ		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
j	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
k	✓	✓	✓	✓	t	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ŋ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 44: Hìu's development of PoA in coda position

	1;05.24	1;07.10	1;07.14	1;07.24	1;08.22	1;09.07	1;09.23	1;10.15	1;10.30	1;11.19	2;02.01	2;02.21	2;03.11	2;05.20	2;06.09	2;06.27	2;07.12	2;10.17	2;11.06	3;00.01	3;00.19	3;02.06	3;02.28	3;03.21	3;04.29
p		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
t		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
c			✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
k	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
m	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ɲ		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ŋ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
j	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
w	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 45: Hìu's development of MoA in coda position

	01;07.08	01;07.21	01;07.28	01;08.04	01;08.11	01;08.25	01;09.02	01;09.09	01;09.16	01;09.23	01;09.30	01;10.06	01;10.20	01;11.10	02;00.02	02;00.22	02;01.13	02;02.05	02;02.25	02;03.15	02;03.22	02;04.13	02;05.03	02;05.17	02;06.00	02;07.26	02;11.07
p	t	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	t	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
m	D	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
w	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
t	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
c	✓	✓	✓	✓	✓	✓	t	✓	t		t	t	✓	t	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
ɲ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
j	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
k	L	✓	✓	L	L	L	L	L	L	L	L	L	L	t	t	t	t	t	t	t	t	t	t	✓	✓	✓	✓
ŋ	✓	L	L	L	L	L	L	n	n	L	L	✓	L	n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 46: Mun's development of PoA in coda position

	01;07.08	01;07.21	01;07.28	01;08.04	01;08.11	01;08.25	01;09.02	01;09.09	01;09.16	01;09.23	01;09.30	01;10.06	01;10.20	01;11.10	02;00.02	02;00.22	02;01.13	02;02.05	02;02.25	02;03.15	02;03.22	02;04.13	02;05.03	02;05.17	02;06.00	02;07.26	02;11.07
p	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
t	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
c	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
k	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
m	D	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ɲ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ŋ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
j	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
w	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 47: Mun's development of MoA in coda position

	1;05.24	01;07.08	1;07.10	1;07.14	01;07.21	1;07.24	01;07.28	01;08.04	01;08.11	1;08.22	01;08.25	01;09.02	1;09.07	01;09.09	01;09.16	1;09.23	01;09.30	01;10.06	1;10.15	01;10.20	1;10.30	01;11.10	1;11.19	02;00.02	02;00.22	02;01.13	2;02.01	02;02.05	2;02.21	02;02.25	2;03.11	02;03.15	02;03.22	02;04.13	02;05.03	02;05.17	2;05.20	02;06.00	2;06.09	2;06.27	2;07.12	02;07.26	2;10.17	2;11.06	02;11.07	3;00.01	3;00.19	3;02.06	3;02.28	3;03.21	3;04.29
PoA			p		p																																													
MoA		p	p																																															
PoA		t		t																																														
MoA		t	t																																														
PoA		c								c																																							
MoA		c		c																																													
PoA	k																																				k												
MoA	k	k																																															
PoA	m				m																																												
MoA	m				m																																												
PoA	n	n																																														
MoA	n	n																																														
PoA		ɲ	ɲ																																													
MoA		ɲ	ɲ																																													
PoA	ŋ																						ŋ																									
MoA	ŋ	ŋ																																														
PoA	j	j																																														
MoA	j	j																																														
PoA	w	w																																														
MoA	w	w																																														

Table 48: Timeline of coda development by two children
(green: Hìu, yellow: Mun)

Chapter 5: Discussion

1. Introduction

In this chapter, I discuss two main issues attested in the two corpora. The first one is the order of the development of two children's consonantal systems (sections 2 and 3). The second issue is the most prominent pattern detected in both corpora, which is the palatalization of initial onsets (section 4).

2. Stages of consonantal development

2.1 Onsets

Both children showed two stages of consonantal development: before and after two years of age. Looking at their consonantal inventory from the beginning to the end of the recorded periods, between the age of one year and five months and two years, in terms of PoA, labials, palatals, and velars are dominant. In terms of MoA, nasal and oral stops are well acquired.

Between two and three years of age, the acquisition of alveolars and glottals in terms of PoA and fricatives in terms of MoA is a prominent trend.

2.2 Codas

There is no stages in the development of coda consonants observed in the two children's coda inventories. Both Hìu and Mun had acquired coda consonants fairly early, before the age of one year and nine months, except for the PoA of |ŋ| and |k| by Mun, which was acquired by two years and six months.

3. The emergence of consonants in onset positions

3.1 Early-acquired consonants

|b, k, m, and ɲ| were fully acquired early by both children. Before the age of one year and eight months, both Hìu and Mun could pronounce these consonants accurately in terms of both PoA and MoA.

3.2 Gradually-acquired consonants

|d, t, f, v, s, z, ɣ, n, ŋ, and l| were acquired over the course of several months to more than a year in both children's inventories. Of these consonants, the MoA of |d, t, n, and ŋ| was acquired earlier than their PoA. In contrast to this, the PoA of |f| and |v| was acquired earlier than their MoA. These observations hold true for both children.

The emergence of gradually-acquired consonants also yielded differences between Hìu and Mun. Mun acquired |p| and |s| earlier than Hìu, but her |d, t, f, v, z, and ɣ| emerged later than those produced by Hìu.

3.3 Late-acquired consonants

Neither child fully acquired the MoA of |t^h| and |tɕ| by the end of the observation period. While Hìu only acquired the PoA of |x| at 3;02.06, Mun could not produce the target-like PoA of |x| at 2;11.07, during her last recorded session.

Similarly, Hìu acquired the MoA of |l| at age 2;05.20, seven months after he acquired its PoA, but Mun could not produce the target-like MoA of |l| at all.

Hìu acquired both PoA and MoA of |h| at age 10;10.15 but Mun only acquired the MoA of |h| at 2;11.07. She did not pronounce its PoA correctly by the end of the observation period.

3.4 Compared to results of previous studies

Lưu (1996) reported that |b, m, p| were well acquired early on by child Vietnamese learners, however, the age of acquisition was between two and three years old. She did not mention which consonants were acquired late, and only described that |ɣ, f, p, r, s| are less frequent in the children's speech.

Vũ (2006) also reported |b| and |m| as early-acquired consonants, between 12 and 18 months. Consonants such as |p, k, h, z, c (tɕ), d, v, t, ɣ, f, ŋ, s| are reported to be acquired later, between 19 and 48 months. Consonants like |tʰ, n, x, l| were added to the children's inventories very late, between 49 and 60 months.

Tang & Barlow (2006) noted that only one out of the four children observed in their study had |tʰ| and |tʃ| (equal to |tɕ| in the Northern dialect) in his/her phonemic inventory at the age of 4;4 and 5;5.

Nguyễn and Phạm (2014) also recorded that final consonants are better acquired than initial consonants. According to their study, of the initial consonants |b, ɲ, n, z, v, m| are acquired early while |tʰ, x, ʂ, ʈ, ŋ, ɣ| are acquired late. Especially, at the age of 4;6 to 4;11, 28% of the children they surveyed had errors with |tʰ| and 16.8% of children had errors with |x|.

The current study generally confirms the above findings from previous research. Data from Hìu and Mun show that the two children acquired coda consonants much better than onset consonants. Among onset consonants, |tʰ, tɕ, x| are acquired much later than the others. In future research, it would be important to address these general facts about the development of Vietnamese based on a theory of segmental complexity or on the factors, phonetic, phonological, or prosodic, which may have an influence on the patterns observed.

4. Palatalization of initial onsets

As we saw in the data descriptions presented in the previous chapter, both Hìu and Mun displayed robust patterns of palatalization throughout much of their respective observation periods. In contrast to this, such pattern is, to our knowledge, virtually unattested in the productions of learners of languages such as French or English. However, the literature contains a series of works on backing substitution in Japanese and Mandarin (Putonghua) Chinese produced by Dr. Fangfang Li and her colleagues. I begin with a review of this literature. I then summarize the children's data in light of it.

4.1 Backing of alveolar fricatives in child Japanese and Mandarin Chinese

Li (2008) compared the acquisition of the two voiceless sibilant fricatives |s – ʃ| by English-speaking children against that of Japanese-speaking children. 43 monolingual children aged between two and three years were recruited in Ohio (USA) and Tokyo and Hamamatsu (Japan). The children participated in a word repetition task where they repeated the words they heard from a computer. Two native speakers of American English and Japanese, who are also from the same dialects as the children's and are trained phoneticians, transcribed the audio responses collected from the experiment. The children's production of the two voiceless sibilant fricatives were marked as either correct or incorrect with substitution forms. An independent native speaker of each language then validated the reliability of the transcriptions.

The transcription-based analysis showed that English-speaking children acquired /s/ earlier than /ʃ/ while Japanese-speaking children acquired /ɕ/ earlier than /s/. Specifically, of the 22 English-speaking children, nine two-year-olds and eight three-year-olds had at least 75% correct production of /s/, whereas none of the two-year-old Japanese-speaking children had acquired this

sound. In contrast, six three-year-old English-speaking children and five three-year-old Japanese-speaking children produced the correct form of /ʃ/ or /ɕ/ in 75% or more of the trials.

The author also notes that the most common substitution in English is for /ʃ/ to be produced as [s] (fronting), while in Japanese it is [ɕ] for /s/ (backing). In particular, fronting occurred 116 times among English-speaking children, but only 18 times among Japanese-speaking children. Meanwhile, backing occurred only six times among English-speaking children but 63 times among Japanese-speaking children.

Although the author emphasized that "transcription alone is not adequate to describe phonological acquisition, since it filters children's productions through adults' perceptual norms" (Li et al., 2009: p.122), these results were confirmed through acoustic analysis. In another study of the same issue but expanded language groups to include English, Japanese, and Mandarin Chinese, Li (2008) states that "[b]oth approaches, transcription analysis and acoustic analysis, provide converging evidence for similar fricative acquisition patterns in each language" (p. 102). Children start from some intermediate fricative-like non-differentiated gestures [in all three languages], then separate the categories. However, the acoustic measures reveal that "in English, the initial fricative gesture generally has higher centroid frequency values" (p. 129), making it sound closer to /s/ than /ʃ/, while in Japanese, "the initial fricative productions generally have higher centroid frequencies and higher onset F2 values" (p. 129), causing it to sound more like a /ɕ/ for Japanese listeners.

These acoustic results were further validated in Li (2012) and Li & Munson (2016). Li (2012) reports on 40 English- and 40 Japanese-speaking children who, at two years of age, produced undifferentiated speech forms for /s/ and /ʃ/. In the productions of English-learning children, that

initial merged articulation was in a frequency range centred at around 8000 Hz, closer to a well-formed English /s/ than /ʃ/. In comparison, for Japanese-speaking children, the undifferentiated forms had a frequency range centred at around 6000 Hz, similar to an adult-like production of Japanese /ʃ/. Li & Munson (2016) combined both transcriptions and acoustic measurements to describe the acquisition of voiceless sibilant fricatives in Putonghua-speaking children. The authors claim that "both measures complement each other and both agree on the order of acquisition as /ɕ/ → /ʂ/ → /s/" (Li & Munson, 2016: p.707). The transcription data suggest that [ʂ] and [ɕ] substitutions for /s/ outnumbered the [θ] for /s/ substitution (331 and 86 times, respectively, for [ʂ] and [ɕ], compared to 55 times for [θ]). Similarly, the major substitution for /ɕ/ was [ʂ] (72 times), compared to the only 14 times /ɕ/ was pronounced as [s]. The acoustic measurements suggested the same:

> At age two years, all three fricatives overlap considerably in a range of <8000 Hz for centroid frequency and 2000-3500 Hz for F2 onset. These early forms are ambiguous between a well-formed /ʂ/ and /ɕ/ because they have the acoustic values appropriate for /ʂ/ in the centroid dimension and for /ɕ/ in the F2 dimension. (Li & Munson 2016: p.706)

The authors explained the patterns attested by attributing them to the input frequencies of the fricatives in each language. More specifically, in the adult English lexicon, /s/ is more frequent than /ʃ/, but in the adult Mandarin lexicon, /s/ is the least frequent among the word-initial voiceless sibilant fricatives. The high functional load of /s/ in English in both word-initial and word-final positions may also contribute to the early acquisition of /s/ compared to /ʃ/. For Japanese, because the frequencies of /s/ and /ɕ/ in the adult language do not align with the order of acquisition of these sounds in children, the author suspected that in Japanese child-directed speech, /ɕ/ appears more frequently than /s/. Another factor suggested by the authors was "the

special vocal tract geometry in infants" (Li 2008) or the "children's oromotor development" (Li & Munson 2016). In particular, children's oral cavities are flatter than adults, forming a readily narrow channel necessary for producing alveolopalatal consonants. However, it is unlikely that this physiological issue can be used to account for the cross-linguistic data on a uniform fashion.

In summary, the studies of children acquiring voiceless sibilant fricatives by Li (2008), Li (2012), and Li & Munson (2016) present a clear backing process in Japanese- and Mandarin-speaking children. I now move on to describe a similar pattern of substitution attested in the productions of both Vietnamese learners.

4.2 Description of palatalization pattern in Hìu's and Mun's corpora

In this section, I describe the patterns of palatalization in the two children's corpora, starting with the classes of sounds affected by palatalization (section 4.2.1) followed by a discussion proposing some explanation regarding the factors that may trigger or impact palatalization in children's speech productions (section 4.2.2). According to the analyses in Vu, 2016, which focus only on data from Hìu's corpus, palatalization is completely independent of vowel contexts. There is also nothing in Mun's data suggest an influence of the surrounding vowels; palatalization is, instead, extremely variable and optional, as it may or may not apply across different occurrences of given words, with this variability among occurrences of different words also observed within individual recording sessions.

4.2.1 Classes of sounds affected

The class of consonants affected the most by palatalization process in Vietnamese is alveolars. As we can see in Table 49 and Figure 7, Hìu palatalized |z, s, t^h, t, d, n, l| the most, while the number

of palatalized forms of all other consonants are very small. Similarly, Mun palatalized |z, d, s, t, t^h, l, n| the most, as shown in Table 50 and Figure 8.

PoA	Consonant	# Occurrences	# Palatalization	% Palatalization
Labial	p	30	0	0
	b	2192	12	0.55
	m	1906	6	0.31
	f	88	0	0
	v	710	7	0.99
Alveolar	t	1029	236	22.93
	t^h	532	263	49.44
	d	2682	184	6.86
	n	1733	59	3.4
	l	915	41	4.48
	s	1373	329	23.96
	z	1648	404	24.51
Velar	k	3697	4	0.11
	ŋ	344	10	2.91
	ɣ	251	2	0.79
	x	475	1	0.21
Laryngeal	h	1172	7	0.59

Table 49: Palatalization in Hìu's production

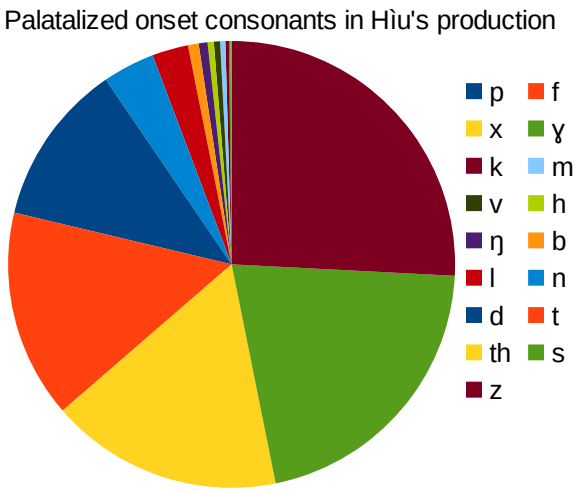


Figure 7: Palatalized onsets in Hìu's production

PoA	Consonant	Total occurrence	# Palatalization	% Palatalization
Labial	p	17	2	11.76
	b	1779	8	0.45
	m	1133	23	2.03
	f	157	10	6.37
	v	594	44	7.41
Alveolar	t	721	489	67.82
	t^h	547	298	54.48
	d	2184	983	45
	n	1210	267	22.06
	l	702	284	40.45
	s	799	546	68.33
	z	1460	1048	71.78
Velar	k	3859	98	2.54
	ŋ	325	11	3.38
	ɣ	312	19	6.09
	x	525	25	4.76
Laryngeal	h	866	130	15.01

Table 50: Palatalization in Mun's productions

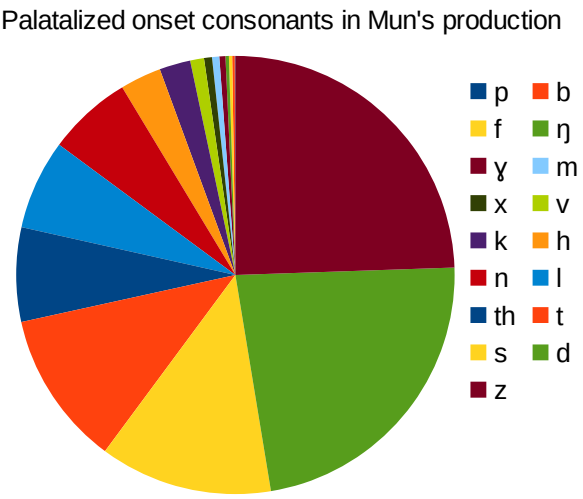


Figure 8: Palatalized onsets in Mun's production

4.2.2 Discussion

Recall from 4.1 that Li and colleagues propose that backing substitutions in their data may reflect certain distributional and frequency-based properties of the children's ambient language, although the data from Japanese suggest that this may not always be the case. In this section, I would like to add to this body of literature by suggesting perhaps a more direct connection to the children's ambient language. Based on a series of personal observations emanating from my study above, I argue that palatalization, at least in the case of the Vietnamese data, is in fact a direct reflection of the properties of child-directed speech in this language.

Indeed, Vietnamese caregivers, mostly female but also male ones, tend to palatalize alveolar word-initial consonants in some specific cases when they are talking to babies. This is especially true when the babies are at a very young age, and even more frequent when the children are sick or upset. For example, when a child is hurt and cries, the caregiver may ask, "Sao thế?" |saw1 tʰe5| (What's the matter?). But instead of pronouncing the question in a standard way, they could say [caw1 ce5] so that their speech sounds more gentle and baby-friendly. The following table

shows more examples of words with palatalized initial consonants that one can hear in adult caregivers' child-directed speech. These words were gathered through private conversations I had with a number of Vietnamese adult caregivers. As we can see, palatalization affects the same range of consonants that are primarily affected by this process in the children's data above.

(22) Palatalized forms attested in the speech of Vietnamese caregivers (non-exhaustive)

Word	Standard pronunciation	Palatalized pronunciation	Gloss
thương	|tʰɯəŋ1|	[cɯəŋ1]	*love, empathize*
đau	|dăw1|	[căw1]	*hurt*
đẹp	|dɛp6|	[cɛp6]	*beautiful*
lắm	|lăm5|	[ɲăm5]	*very*
làm	|lam2|	[ɲam2]	*do*
thịt	|tʰit6|	[cit6]	*meat*
thơm	|tʰɤm1|	[cɤm1]	*smell good*
thích	|tʰic5|	[cic5]	*like*

Example (23) below shows palatalization in caregivers's child-directed speech recorded in some random videos posted on Youtube by the caregivers themselves.

(23) Examples of palatalization by Vietnamese caregivers on YouTube

Phrase	Correct pronunciation	Palatalized pronunciation	Gloss	Youtube link	Time segment
Yêu thế	|iəw1 tʰe5|	[iəw1 ce5]	*How lovely!*	*https://www.youtube.com/watch?v=nSekJ_YPLoY (motherese)*	*1:41-1:49 (5 times)*
Thích thế	|tʰic5 tʰe5|	[cic5 ce5]	*How lovely!*	*https://www.youtube.com/watch?v=nSekJ_YPLoY (motherese)*	*4:12-4:13 (2 times)*
Giỏi thế	|zɔj4 tʰe5|	[jɔj4 ce5]	*You're great!*	*https://www.youtube.com/watch?v=WxMi2H6ymOo*	*1:24-1:26*

				(fatherese)	
Gì đấy	|zi2 dɤ̌j5|	[ci2 čɤ̌j5]	*What?*	*https://www.youtube.com/watch?v=OXgZosZzu24 (motherese)*	*1:14-1:21 (2 times)*

Another central property of palatalization is its optionality, especially given that this process typically does not appear in the speech of adult Vietnamese speakers when they speak to older interlocutors. This optionality is reflected in the corpus data, where palatalization is generally inconsistent and unpredictable. Different productions of the same words can be palatalized or not. This variation is arguably related to the fact that the child is exposed to different pronunciations (palatalized vs. not) of these words.

Although Hìu and Mun generally came out the palatalization period at roughly the same age (2;06.27 for Hìu, except for the consonant |t^h| and 2;07.26 for Mun), for certain consonants such as |d, t, s, n, l|, the respective palatalization periods are shorter for Hìu than for Mun. The differences between Hìu and Mun regarding the length of the palatalization period and proportion of palatalization can be accounted for by differences in their respective language environments. Recall that Hìu was living in Vietnam, where virtually everyone surrounding him was speaking the same dialect of Vietnamese. His language input came from not only his caregivers or family members but also many other people. In comparison, Mun was living in St. John's, Canada, where the dominant language is English and the Vietnamese community is relatively small. Opportunities for her to communicate with adults speaking Vietnamese outside of her home were in this respect relatively rare.

While these differences alone can capture the differences between the two children's resolution of the palatalization stage, it is possible that adult speakers' attitudes toward boys versus girls, or other factors such as the children's relative development of communicative abilities, may have played a role as well. I leave these questions for further research.

Chapter 6: Conclusion

In this thesis, I described the phonological development of two first language learners of Vietnamese from a longitudinal, naturalistic perspective. Starting with background information about the Vietnamese language and a review of the literature on the topic, I established that while a number of phonological processes can generally affect the phonological productions of child Vietnamese speakers, there was little information about the emergence or resolution of these processes over time.

The two longitudinal case studies described in this thesis aim at providing a step toward addressing this knowledge gap. Building on these studies, and focusing on the development of consonants in syllable onsets and codas, my main finding are as follows:

- Coda consonants are acquired earlier and much better than onset consonants. While there are two fairly clear stages in the development of onsets (before and after two years of age) evidenced by both children, there are no such stages in the development of codas because most of the contrast in this position were acquired by the age of one year and nine months. This trend in the data potentially stems from different factors such as the fact that there is a smaller set of coda consonants and consonantal contrasts to be acquired, compared to that of onset consonants, or the pervasive process of palatalization that primarily affects initial consonants. Further research is thus needed to clarify the factors underlying this general observation. In addition, and similar to the development of onsets, the two children showed fewer difficulties acquiring the MoA of consonants compared to acquiring the PoA of consonants in coda position. Here again this preliminary observation should be validated independently of all cases of palatalization.

- In general, |b, k, m, ɲ| are the earliest and best acquired onset consonants by both children, followed by |d, t, f, v, s, z, ɣ, n, ŋ, l|. The latest acquired initial consonants are |t^h, tɕ, x|. This finding resonates with previous studies on the development of Vietnamese consonants. However, in my study, the emergence of consonants was described in terms of both PoA and MoA, showing that there is not always a match in the acquisition of these two phonological dimensions for consonants.
- There are extensive but variable patterns of palatalization primarily affecting alveolar consonants in the onset position produced by both children.

These results each call for further empirical verifications with additional learners as well as for analyses within current models of phonology and phonological development.

I then focused on the process of palatalization, which primarily affects alveolar consonants in the productions of both Hìu and Mun. This process is particularly intriguing given the relative absence, to our knowledge, of such widespread patterning in the acquisition of 'western' languages such as English and French. Further, while this process is robustly attested in some previous studies on Vietnamese development, very little detail was available concerning its application in the speech of individual learners. As we saw in section 2.1.2 of Chapter 3 and section 4 of Chapter 4, the process is indeed widespread in the speech of both children, affecting a full range of alveolar consonants across different word forms. However, it is also very variable, as it gradually emerged in the speech of both children, its resolution was also relatively gradual (especially in the speech of Hìu), and applied only optionally on most of the word forms throughout the development period.

Looking for similar patterns within the acquisition literature, I reported on a series of research works by Dr. Fangfang Li and her colleagues on the acquisition of coronal fricatives by Chinese, English and Japanese child learners. In a nutshell, this research reveals asymmetries between Chinese and Japanese, on the one hand, and English, on the other hand, concerning the direction of place substitution across these languages. While the Asian child learners tend to palatalize target alveolar fricatives, the learners of English instead tend to realize target palatals as alveolars. Addressing these asymmetries, Li and colleagues suggest a range of potential effects stemming from the phonological and distributional properties of each language, including statistical tendencies in usage frequency, but ultimately conclude that additional factors may be at play, including physiological and oromotor development.

My study points to an additional source of explanation: During the course of my own investigation, I came to realize that palatalization is in fact a central feature of child-directed speech ("motherese" and "fatherese") in Vietnamese, something that I was not even aware I was unconsciously doing while talking Vietnamese to young children. While the evidence reported above may seem anecdotal, it is both the widespread nature of this phenomenon and its optionality that are key to capturing my observations about Vietnamese. Besides further research on Vietnamese, it would be interesting to see whether, or to what extent, a similar process may be observed in the acquisition of Chinese and/or Japanese.

It order to support these further areas of research, I will now publish my corpus data as part of the PhonBank and CHILDES databases, through which scholars will be able to directly access both the audio recordings and their corresponding transcripts to further verify my own findings and derive additional ones. It is indeed my hope that these analyses will further our understanding of

the different factors affecting phonological development, both in Vietnamese and across languages.

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