PHONOLOGICAL DEVELOPMENT IN THE EARLY SPEECH OF AN INDONESIAN-GERMAN BILINGUAL CHILD

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Abstract
Current research in bilingual children's language development with one language dominant has shown that one linguistic system can affect the other. This is called Cross-linguistic Influence (CLI). This paper explores whether CLI is experienced by a bilingual child raised in two typologically distinct languages in terms of phonological development. It uses data from the study of a child simultaneously acquiring Indonesian and German between the ages of 12 months - 20 months, with Indonesian as the dominant language. The sound segments developed by the child showed universal tendencies, with the appearance of bilabials prior to alveolar sounds, followed by velar sounds. The sounds were produced mostly in the form of stops, nasals and glides. Three phonological processes were displayed by the child: substitution, assimilation and syllable structures. The front rounded vowel [ʏ], which exists in German but not in the Indonesian sound system, was systematically replaced by the palatal approximant [j]. This approximant exists in the Indonesian sound system but not in the German phonemic inventory. This provides evidence that, in terms of phonological development, the child experienced CLI, but only for certain sound transfers.

Keywords: phonological development, bilingual child

1. Introduction

How bilingual children develop different linguistic systems has proved a controversial issue. Leopold (1978), through a longitudinal study of his daughter's German-English bilingual language development, found that from the outset his child developed a unified linguistic system that consisted of the two different languages. Leopold's finding was supported by Volterra and Taeschner (1978) who proposed three stages of bilingual development from early infancy. These were: (1) initially, the child creates one single system, fusing the two linguistic systems to include elements from both languages; (2) the two lexicons are differentiated by the child, however, the same syntactic rules are applied; and (3) the child is able to differentiate between the two linguistic systems. Volterra

and Taeschner's three stages of development have been criticized by a number of researchers. Much of the criticism relating to the fusion of two different linguistic systems focused on the weak methodological grounds (De Houwer 1990; Meisel 2001).

An alternative to the fusion hypothesis was proposed by De Houwer (1990), who developed the Separate Development Hypothesis (SDH). This hypothesis assumes that children develop two separate linguistic systems from the very beginning of their language development and each system develops independently. Significant empirical findings have been presented to support the SDH. Deuchar and Clark (1996) showed that English-Spanish bilingual children acquire two voicing systems from the very beginning of their bilingual development. No unified English-Spanish system was detected. In their later study of a bilingual English-Spanish child, Deuchar and Quay (1998) reported that mixed utterances in initial development occurred. However, they argued that these mixed utterances appeared to relate to limited lexical resources rather than a single unitary system. They also concluded that the appearance of language-specific morphology provided evidence of two differentiated syntactic systems.

Furthermore, Nicoladis (1998) claimed that a bilingual child raised in both Brazilian-Portuguese and American-English showed the ability to differentiate between the two languages pragmatically. This preceded lexical differentiation. Bosch and Sebastián-Gallés (2001) found that, in terms of phonology, bilingual children have the capacity to distinguish sounds from different languages from the very first months of their life. This was apparent even with closely related languages, such as Spanish and Catalan. Poulin-Dubois and Goodz (2001) showed that infants who are raised bilingually in French and English develop two distinct linguistic systems during the babbling stage of development. This was illustrated by the dominant prosodic features produced in French compared to English.

Another issue related to simultaneous bilingual development is the notion that while the child's linguistic systems are developed separately, one language may influence another (Yip and Matthews 2007; Soriente 2007). This concept is known as cross-linguistic influence (CLI), which relates to transfer and interference (Yip 2013). Many contradictory claims and conclusions are drawn in relation to CLI. Yip (2013) argued that there are a number of reasons for this. First, CLI is found when children are raised with a dominant language. For example, evidence has been found to suggest the influence of Cantonese on English (Yip and Matthews 2007) and Indonesian syntactic transfer on Italian Wh-structures (Soriente 2007). Second, CLI may take place in some language aspects but not in others. While empirical findings suggest that CLI occurs at the *syntactic* level, our study was conducted to find out whether CLI is also experienced at the *phonological* level. This is built on the universal belief that, in acquiring language, children first develop the sounds of the language before they acquire any other linguistic aspects.

This paper therefore investigates phonological development in terms of the sound segments of a child raised in Indonesian and German. It also describes the phonological processes found in the production of early words in a child age between 12 months – 20 months. Since the child was raised with dominant exposure to Indonesian rather than German, this paper will also explore whether the child experienced sound system interference of one language on the other in terms of phonological development. In other words, whether the Indonesian sound system affected the development of the German sound system.

2. Method

The research discussed in this paper focuses on a case study approach, examining the language development of Alyssa, a child exposed to both Indonesian and German from birth. Data were collected between the ages of 12 months – 20 months. The child learned Indonesian from her mother the first author of this paper who is trilingual. She speaks Balinese her native language, Indonesian learned as a second language at school, and English learned in college. She also understands colloquial German. Alyssa learned German from her father, who was born in Germany, in an area with a Hessen dialect. He learned standard German in school and also speaks fluent English and Indonesian. Besides learning from her mother and father, Alyssa has been exposed to both Indonesian and German through her older sister, who speaks both languages fluently. Alyssa's mother and father use Indonesian and German as the general means of communication. The family lives in a small village in Bali, a tiny island in the Indonesian archipelago where Balinese is the native language and Indonesian is the second language. German is only spoken by Alyssa's father and her sister, and sometimes by her grandmother and uncle via Skype. By comparison, Indonesian is dominant, with more people speaking Indonesian to Alyssa than any other language, particularly her mother and a caretaker who babysits her while her mother is working. As most Indonesians live collectively, Alyssa's Indonesian grandmother and other extended family members frequently visit the family and use Indonesian when communicating with the child.

Data were documented in the form of diary records, supplemented by video recordings. The diary recorded conversations between Alyssa's parents, sister, extended family and the child. These records consisted of orthographic notes accompanied by their phonetic transcriptions, as well as contextual information. The videos were recorded in natural conditions when the child was interacting with the rest of the family members. The video data were also orthographically and phonetically transcribed, along with a description of contextual details. The data were transcribed using ELAN by two students of the Faculty of Language and Art of Universitas Pendidikan Ganesha.

3. The Development of Sound Segments

Indonesian and German come from two typologically distinct language systems. Phonetically, Indonesian has fewer vowels than German. German has high front rounded vowels [y] and [ʏ], mid front rounded vowels [ø] and [œ], and open-mid schwa [ɐ], which do not exist in the Indonesian sound system. Moreover, there are fricative sounds in German that do not occur in Indonesian consonant segments. This includes the post alveolar fricatives [ʃ] and [ʒ], palatal fricatives [ç] and [j], the velar fricative [x], and the uvular fricative [ʁ]. In addition, the palatal stops [c] and [ɟ], palatal nasal [ɲ], alveolar trill [r], and semivowels [j] and [w] exist in Indonesian but do not occur in German.

The phonetic data presented in this paper were gathered when the child was aged between 12 months – 20 months. At age 12 months, children are coming to the end of their pre-language period (Ingram, 1973; Ingram, 1992). This was evident with Alyssa, who communicated through crying and babbling, as well as nonverbally using gestures. The sounds that she produced at this age cannot be related to any specific meaning and did not refer to any objects, activities, or persons. The use of nonverbal means of communication accompanied by crying, babbling, and cooing has been reported in numerous research studies (Dardjowidjojo 2000; Iverson and Goldin-Meadow 2005; Özçalişkan and Goldin-Meadow 2005; Rowe and Goldin-Meadow 2009).

At age 12 months, Alyssa produced a low mid vowel [a] intensively. The sound occurred on many occasions. For instance, when she tried to reach a mobile phone, she took it, showed it to her father and, putting the phone to her ear, babbled the sound [a a a]. The same sound occurred when she extended her hand, pointing at some bread held by her sister. The sound, in combination with bilabial stop consonants [p] and [b], was also heard when she was crawling or playing with toys, producing sounds [pa pa pa] or [ba ba ba]. At the same age, she was also combining the low mid vowel [a] with bilabial nasal [m] sounds. Sounds like [ma ma ma] were also frequently produced. Alyssa's production of these sounds in her early development fits with the concept of universality in sound acquisition, as proposed by Jakobson (1971). This concept is outlined as follows: the first vowel a child acquires is A; the first contrast is between vowel and labial consonants; and the first consonant contrast is acquired between oral labial and labial nasal.

When Alyssa reached 13 months, meaningful sounds within Indonesian word production were recorded. They were [dada] *dada* 'goodbye', [ma:m] *makan* 'to eat', dan [a:m] *makan* 'to eat'. The sound [dada] was uttered by the child when she saw someone was leaving, combined with waving her hand. *Dada* is a colloquial way to say goodbye to an acquaintance or familiar person. [ma:m] and [a:m] appeared alternately whenever Alyssa saw food, was offered food, pointed at meals or pointed at rice cookers. Other sounds were still in the form of syllabic utterances, such as [aɪ], [bapa], [baba]. These occurred frequently when

she was 14 months. At this age, the high front vowel [ɪ] started to be acquired, as well as a voiced alveolar sound [d].

When she was 15 months Alyssa started to produce other alveolar consonants [t], and a nasal one [n]. Mid front vowels, [e] and [ɛ] were also starting to appear. The child often babbled [tata], [tada], [maɪ], [nana], [ni], [bɛʔ], [bebɛʔ]. What's more, at this age, a meaningful sound was recorded with reference to a small house lizard, known in Indonesian as [titaʔ] *cicak*. The progressive emergence of alveolar sounds also fits the order of acquisition suggested by Jakobson, with the second consonant contrast developed by children being between labial and alveolar consonants. This is popularly known as the minimal consonantal system, which exists in languages across the world.

At age 16 months, Alyssa started to say words that contain high back vowels [u] and [ʊ]. Moreover, velar stops [k] and [g] and the velar nasal [ŋ] were also produced, as well as the glottal fricative [h]. Those sounds appeared in the production of meaningful words in Indonesian, as in [dah] *sudah* 'already', [kakaʔ] *kakak* 'elder sister', [gaŋgaŋ] *gunggung* 'sound of dogs', [nʊm] *minum* 'to drink', and [dudʊʔ] *duduk* 'to sit down'. In the same period, two German words were produced [bʊmbʊm] *brumbrum* 'sound of a motor' and [bam] *Ball* 'ball'. The sound [bʊmbʊm] was frequently used by the child as she pointed at motorbikes or saw cars, while the word [bam] was used to refer to rounded objects. These words were initially introduced by her father. The appearance of velar stops at this age also corresponds to the law of irreversible solidarity, when the emergence of velar sounds indicates the existence of bilabial and alveolar sounds. In children's language acquisition, this implies that bilabial and alveolar sounds are developed before velar sounds.

Alyssa began to say words containing mid back vowels [o] and [ɔ] at age 17 months. These sounds appeared in the production of [nonɔʔ] *nyonyok* 'breast', produced when the child wanted to be breastfed and often said when she saw her mother. *Nyonyok* itself is originally a Balinese word, but the family always used it to refer to breastfeeding the baby. Up to this age, the child was not able to produce the rounded front vowels that only exist in the German system, such as [y] and [ʏ], mid front rounded vowels [ø] and [œ], and open-mid schwa [ɐ]. For instance, the word *tschüss* 'goodbye' in German was realized with the sound [tʊs], which should be pronounced [tʃʏs]. In this case, Alyssa replaced the front rounded vowel with the back rounded vowel that she had already acquired. At the same age, she also produced a lateral sound [l], which appeared in the German word production [bile] *brille* 'glasses'.

When the child was aged 18 months, two other consonants were developed. These were fricative [s] and palatal nasal [ɲ]. However, the production of [s] only appeared in limited positions, particularly in the final position. In Indonesian, the fricative [s] occurred in the words [abɪs] *habis* 'finished', [as] *awas* 'be careful', [tas] *tas* 'bag', [tilɪs] *tulis* 'to write'. In German it occurred in [aɪs] *eis* 'ice', [tʊs] *tschüss* 'goodbye', [aɪs] *heiss* 'hot'. The palatal nasal sound [ɲ] only occurred in Indonesian word production [iɲaʔ] *minyak* 'oil'.

Palatal stops [c] and [ɟ], which belong to the Indonesian sound segments, were acquired when the child was aged 19 months. The two sounds occurred in the Indonesian words [inɟam] *pinjam* 'to borrow', and [ca] *Alyssa* 'the child's name'. Indonesian semivowels [j] and [w] were also developed almost at the same time when the child said [jʊʔ] *yuk* 'come on', [awas] *awas* 'be careful', and [ajɛt] *karet* 'rubber band'.

At age 20 months, Alyssa continuously produced a larger number of words, both in Indonesian and in German. The number of meaningful words produced in Indonesian was approximately three 3 times greater than those in German. However, the production of sound segments was developed in each language independently. This is discussed more explicitly later in the context of the phonological process experienced by the child. The development of consonants and vowels acquired by Alyssa is illustrated in Table 1.

Table 1. The development of consonants and

Age	Consonants	Vowels
12 months	p b m	a
13 months	d	
14 months		i
15 months	t n ʔ	e ɛ
16 months	k g ŋ h	u ʊ
17 months	l	o ɔ
18 months	s ɲ	
19 months	c ɟ j w	
20 months	no new segment occurred	

All vowel sounds acquired exist in both Indonesian and German sound systems. Most of the consonant sounds also appear in both languages, with the exception of some, such as [ɲ], [c], [ɟ], [j], and [w], which only appear in Indonesian words. Yet, most of the sounds produced by Alyssa were simplified, commonly known as the phonological process (Stempe 1969; Ingram 1979; Yulianto 2009). In the process of producing both sounds in Indonesian and German, even though the words produced share the same segments, each language developed independently and Alyssa showed no sign of confusion.

In the case of sounds that were not yet acquired by the child, Alyssa found a way to simplify her speech to correspond with an adult model by using sounds that she had already acquired. A more detailed description of how Alyssa simplified her speech, and what phonological process she adopted, is discussed in the following section.

4. Analysis of the Phonological Processes

Alyssa experienced significant development in phonological ability between the age of 12 months – 20 months, both in Indonesian and German. However, given that Indonesian input was dominant compared to German, documentation of word production in Indonesian was greater than that of German. In both languages, it was noted that the child simplified adult modelled speech through what is commonly known as phonological processes. These contain a universal set of hierarchically ordered procedures used by children to simplify adult speech models (Stempe 1969; Ingram 1981). Children experience three types of phonological processes: substitution, assimilation and syllable structures (Stempe 1969; Ingram 1981). The three processes were experienced independently by Alyssa in both Indonesian and German. Each process is discussed in more detail below.

4.1. Substitution Process

Substituting sounds that the child cannot yet articulate with other sounds is a common process observed in a child's phonological development. The substitution process can be detected by comparing the child's word production with the adult speech model.

a) Fronting

Fronting is commonly observed in the speech development of children. Ingram (1981) provided evidence that fronting was experienced by children in English, French and Polish. In this process children tend to replace velar and palatal consonants with alveolar consonants. The fronting process was also experienced by Alyssa, in both Indonesian and German, as illustrated in Table 2.

Table 2. Fronting

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
15 months	*cicak*	[cicak]	[titaʔ]	small lizard
17 months	*gigi*	[gigi]	[didi]	tooth
18 months	*anjing*	[anɟɪŋ]	[andɪŋ]	dog
18 months	*jalan*	[ɟalan]	[dalan]	to walk
20 months	*ikut*	[ikʊt]	[itʊt]	to join

German				
Age	Words	Standard phonetic representation	Data	English equivalents
19 months	Buch	[bu:x]	[bʊs]	book
19 months	Licht	[lɪçt]	[lɪs]	light

In Table 2 we can see that in Indonesian the voiceless palatal /c/ was replaced by the voiceless alveolar [t] and the voiced one /ɟ/ was replaced by the voiced alveolar [d]. The voiceless alveolar [t] took the place of the voiceless velar /k/ and the voiced alveolar [d] substituted the voiced velar /g/. The fronting process in Indonesian was only found in two syllables words. As similar process occurred in the replacement of palatal and velar sounds in German.

In German, however, the fronting process was found in single syllable words. Both voiceless palatal fricative /ç/ and the voiceless velar fricative /x/ were replaced by the voiceless alveolar fricative [s]. The fact that Alyssa was unable to pronounce the two German fricatives /ç/ and /x/ aligns with the findings of Leopold (1978) who observed this among German-English bilingual children. We argue, however, that this happen because of the complexity of fricative sound production rather than the lack of support from the paired languages, as claimed by Leopold. At age 19 months, the only alveolar fricative acquired by the child was [s] and this only occurred in the final position. Based on the data shown in Table 2, the process of fronting can be formulated using the following rule:

/c/ ⟶ [t]
/ɟ/ ⟶ [d]
/k/ ⟶ [t]
/g/ ⟶ [d]
/x/ ⟶ [s]
/ç/ ⟶ [s]

The rule is formalized as:

1 $\begin{bmatrix} \text{-ant} \\ \alpha\ \text{ant} \\ \beta\ \text{cont} \\ \gamma\ \text{voi} \end{bmatrix} \longrightarrow \begin{bmatrix} \text{+ ant} \\ \alpha\ \text{cor} \\ \beta\ \text{cont} \\ \gamma\ \text{voi} \end{bmatrix} / \_\_\_\_\_$

From rule 1 it can be determined that in the child's speech development, non anterior sounds are replaced by anterior ones. Furthermore, the replacement also happens in a systematic way. It is systematic in the way that obstruent sounds are replaced by obstruents, continuents by continuents, voiceless by voiceless

and voiced by voiced. In the child's speech, non anterior sounds become anterior ones. This is because when children are very young, they are only able to move the tip of their tongue up to the alveolar ridge. In order to produce palatal and velar sounds, they need to work with the blade and back of the tongue to reach the palate and velum. They still find it hard to do this because their ability is limited.

b) Stopping

Stopping is a phonological process in which fricatives and occasionally other sounds are replaced by stop consonants. Table 3 shows that in the case of Indonesian word production, the fricative sound /s/, at the initial syllable positions, were replaced by stop sounds [t] or [c]. In German, words beginning with the labiodental fricative /f/ were replaced by the bilabial stop [p].

Table 3. Stopping

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
19 months	*susu*	[susu]	[tutu]	milk
20 months	*sana*	[sana]	[cana]	there
20 months	*Pasek*	[pasək]	[pacəʔ]	name of a person
German				
Age	Words	Standard phonetic representation	Data	English equivalents
20 months	*Feuer*	[fɔʏɐ]	[pɔja]	fire
20 months	*Fernsehen*	[fɛrnze:ən]	[pentɪn]	to watch TV

The stopping process can be stated using the following rule:

/s/ ⟶ [t]
/s/ ⟶ [c]
/f/ ⟶ [p]

The rule can be formalized as:

2 $\begin{bmatrix} +\text{cons} \\ +\text{cont} \end{bmatrix} \longrightarrow \begin{bmatrix} +\text{cons} \\ -\text{cont} \end{bmatrix} \; / \; \#\_\_\_\; \$$

In children's language development, fricatives tend to be one of the last sounds acquired. Thus, at the beginning, children try to replace those sounds which correspond to adult modelled speech. One way to do this is by substituting the fricatives with stop sounds, which they find less complex to produce. When producing fricatives, the child somehow has to constrict the vocal tract by placing two articulators close to one another. This causes some hissing sounds or frictions when the air passes through the narrow channel. While in producing stops, the child only needs to bring their lips into tight contact to completely stop the airstream before releasing it again.

c) Major Change oral to nasal

In this process, oral sounds are replaced by nasal sounds. The replacements are homorganic in that the corresponding sounds share the same place of articulation. The changes adopted by Alyssa are shown in Table 4.

Table 4. Major Change

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
18 months	air	[aɪr]	[aɪn]	water
19 months	ambil	[ambɪl]	[ambɪn]	to take
German				
Age	Words	Standard phonetic representation	Data	Englsih equivalents
20 months	geld	[gɛlt]	[gɛn]	money

Liquid consonants [r] and [l] in the final position were replaced by the corresponding nasal sound that shares the same place of articulation, the [n] sound. This phonological case is found in the development of the Indonesian language. Similar replacement is also found in German. The process of major change can be stated using the following rule:

/l/ ⟶ [n]
/r/ ⟶ [n]

The rule can be formulized as:

3 [-nas] ⟶ [+nas] / _____ #

In other positions, the major change is not applied. For instance, in initial positions, alveolar fricatives [l] and [r] are deleted. In producing ‘lagi’ and ‘renang’, Alyssa realized those words using the sounds [adi] and [naŋ]. The major change did not affect the place of articulation. It only changed the manner of articulation. This is because [l] and [r] are complex sounds to produce. At the early stage of their language development, it is easier for a child to produce the alveolar nasal [n], as in creating [n] the child only works with the tip of the tongue touching the alveolar ridge, letting the air pass through the nasal cavity.

d) Trill becomes lateral

The trill sound [r] is replaced by the lateral [l]. This replacement is exclusively found in Indonesian and is not detected in German word production. Table 5 shows that lateral [l] took the place of trill /r/. This replacement occurred when the trill sound was positioned between vowels. This was observed when Alyssa was aged 19 months.

Table 5. Trill becomes lateral

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
19 months	*berat*	[bərat]	[bəlat]	heavy
19 months	*burung*	[burʊŋ]	[bulʊŋ]	bird
19 months	*turun*	[turʊn]	[tulʊn]	to go down

The phonological rule can be stated as:

/r/ ⟶ [l]

The rule can be formalized as:

$$4 \quad \begin{pmatrix} -\text{lat} \\ +\text{trill} \end{pmatrix} \longrightarrow \begin{pmatrix} +\text{lat} \\ -\text{trill} \end{pmatrix} / \text{V} \_\_\_\_ \text{V}$$

Why did Alyssa replace trill with lateral? This can be explained by the fact that at an early age a child still has difficulties in producing trill sounds as this

requires the ability to move the tongue vertically several times. In producing lateral sounds, however, the child only needs to move the tip of the tongue once towards the alveolar ridge. Consequently, a child has to use more effort to produce a trill sound and thus simplifies the process by producing a lateral sound.

4.2. Assimilation

Alyssa also showed evidence of another phonological process in her early speech production - assimilation. This is when a segment changes to correspond with a neighboring sound, either the following or preceding sound. In Alyssa's language development, two assimilations were experienced: nasal harmony and vowel harmony. However, these processes were exclusively found in Indonesian word production.

a) Nasal harmony

Nasal harmony is one method of assimilation that occurs in the child's speech. This is only observed when the initial consonants are bilabial stops. In Alyssa's phonological development, it was noticed that in Indonesian word production, labial stop consonants tended to assimilate to the following nasal, resulting in a nasal sound. This was homorganic with the labial stops. Nasal harmony was only found in Indonesian word production. Examples are shown in Table 6.

Table 6. Nasal harmony

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
19 months	*banyak*	[baɲaʔ]	[maɲaʔ]	many
20 months	*bunga*	[buŋa]	[muŋa]	flower
20 months	*punya*	[puɲa]	[muɲa]	to have

From the data, it can be seen that there are nasal sounds in the second syllables. This influences the stop consonants in the initial position. The stop consonants are replaced by nasal sounds, and the nasal sounds replacing the stop consonants are homorganic with the labial stops. This phonological process can be stated as:

$$/p/, /b/ \longrightarrow [m] / \#\_\_\_\_\_ VK$$
$$[+nas]$$

5 $\begin{bmatrix} +\text{cons} \\ -\text{nas} \\ +\text{bil} \end{bmatrix} \longrightarrow \begin{bmatrix} +\text{cons} \\ +\text{nas} \\ +\text{ bil} \end{bmatrix} \; / \; \#\_\_\_\text{v K}\; [+\text{nas}]$

From rule 5, we can see that Alyssa experienced regressive assimilation. In this case, the back syllable that contains nasal sounds influences the labial stop consonants of the first syllable, becoming labial nasals.

b) Vowel harmony

Vowel harmony, where certain vowels are altered to create another vowel segment, were also found in Alyssa's early speech. This process was observed in Indonesian word production. The same process was not apparent in Alyssa's German word production. Examples of vowel harmony involving the dimension of vowel height are shown in Table 7.

Table 7. Vowel harmony

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
13 months	*maem*	[maəm]	[maam]	to eat
18 months	*tulis*	[tulɪs]	[tilɪs]	to write
18 months	*cuci*	[cuci]	[cici]	to wash
19 months	*minum*	[minʊm]	[munʊm]	to drink
*18 months	*mandi*	[mandi]	[nini]	to shower
*18 months	*habis*	[habɪs]	[ibɪs]	to finish
*19 months	*bangun*	[baŋʊn]	[antaʔ]	to get up
*19 months	*minta*	[minta]	[uŋʊn]	to ask for
German				
Age	Words	Standard phonetic representation	Data	English equivalents
*18 months	*kaput*	[kapʊt]	[pupʊt]	to break
*19 months	*achtung*	[axtʊŋ]	[utʊŋ]	to be careful
*20 months	Feuer	[fƆʏɐ]	[pɔjɐ]	fire

In the Indonesian phonological process, two vowel harmony processes were detected. First, the vowel of the second syllable assimilated with the vowel of the first syllable. Second, the vowels of the first syllables assimilated to the vowels of the second syllables. In Table 7, it can be seen that schwa [ə] in the

second syllable assimilated with the low vowel [a] in the first syllable. The pattern of this process can be described as follows:

/ə/ ⟶ [a] / [a] ____

6 $V \begin{pmatrix} \text{-low} \\ \text{-high} \end{pmatrix} \longrightarrow V$ [+ low] / [+ low] _____

Rule 6 shows us that a vowel that features –low and – high assimilates with the +low vowel because it is preceded by a +low vowel. This process occurred because at the very beginning of Alyssa's speech development, schwa was not yet acquired and the low vowel [a] was the first vowel produced. In addition, it is universally recognized that children acquire vowels that feature +low before they produce a –low vowel.

Table 7 also shows that vowels in the first syllable assimilated with vowels in the second syllables. Such cases are found when the high front vowels [i] or [ɪ] assimilate with the high back vowel [u] and vice versa. Alyssa was assimilating vowels [i] and [ɪ] with the vowel [u] and vice versa. One explanation for this is that they share the same articulatory property, produced in the same tongue height position. This phonological process has the following rule:

6.1 V1⟶ V2 / _____KV2

This type of vowel harmony was not found in any other vowel combination, such as the combination of a high front vowel [i] and low vowel [a], or high back vowel [u] and low vowel [a]. Alyssa did not simplify these combinations using the vowel harmony process. One reason for this may be because the combinations of vowels are too different in terms of height.

4.3. Syllable Structure Process

a) Cluster reduction

Cluster reduction results when a consonant cluster is reduced to a single consonant. In Alyssa's phonological development, cluster reduction was found in both Indonesian and German speech. The appearance clusters is illustrated in Table 8.

Table 8. Cluster reduction

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
18 months	*krupuk*	[krupʊk]	[pupʊʔ]	crackers
20 months	*stop*	[stɔp]	[tɔp]	stop

German				
Age	Words	Standard phonetic representation	Data	English equivalents
17 months	*brumbrum*	[bʁʊmbʁʊm]	[bʊmbʊm]	sound of motor
17 months	*brille*	[bʁɪlə]	[bilɐ]	glasses
18 months	*tschüs*	[tʃy:s]	[tʊs]	good bye
18 months	*zu*	[tsu]	[tu]	to close
19 months	*dreck*	[dʁɛʔ]	[tɛʔ]	dirt
20 months	*stop*	[stɔp]	[tɔp]	stop

In the process of cluster reduction, the deletion of sounds occurs systematically. When the combination of sounds are stops followed by sonorants, then the sonorants are deleted. A similar process occurs when stop consonants are combined with fricatives. In such cases, the fricative sounds tend to be deleted and the stop consonants maintained.

The reduction of consonant clusters can be stated as:

7 $\quad KK \longrightarrow \begin{cases} K\text{ø} \\ 1 \\ [+\text{stop}]\ [+\text{cont}] \\ \text{ø}K \\ \quad 2 \\ [+\text{cont}]\ [+\text{stop}] \end{cases}$

From rule 7 we can see that continuant fricatives are more likely to be deleted than stop sounds because the production of fricatives is more complex. Thus, whenever there are two consonants K and K in one morpheme, if K is a stop consonant and K is fricative, then K is deleted and K prevails. The same tendencies were also reported by Ingram (1973).

b) Deletion of initial onset

The deletion of initial onset was observed frequently in Alyssa's word production for both Indonesian and German. If we look closely at the deletion of onset, as presented in Table 9, we can see that deletion in Indonesian word production was happening particularly in words consisting of two syllables. Here the deletion took place in a basic open CV syllable. While in German word production, it occurred not only in two syllable words but was also found in a single syllable word.

Table 9. Deletion of initial onset

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
17 months	*lagi*	[lagi]	[adi]	more
18 months	*habis*	[habɪs]	[abɪs]	finished
18 months	*renang*	[rənaŋ]	[ənaŋ]	to swim
18 months	*minyak*	[miɲaʔ]	[iɲaʔ]	oil
19 months	*minta*	[minta]	[intaʔ]	to ask for
20 months	*tangan*	[taŋan]	[aŋan]	hand
20 months	*semut*	[səmʊt]	[əmʊt]	ant
20 months	*dingin*	[diŋɪn]	[iŋɪn]	cold
German				
Age	Words	Standard phonetic representation	Data	English equivalents
18 months	*kaput*	[kapʊt]	[apʊt]	broken
18 months	*heiss*	[hais]	[aɪs]	hot
19 months	*Hund*	[hʊnt]	[ʊn]	dog
20 months	*hallo*	[halo]	[alo]	hello
20 months	*Kühlschrank*	[ky:lʃraŋk]	[utaŋ]	fridge

The deletion of onset can be formulated as:

8 K $\longrightarrow$ ø / # ___

c) Deletion of the initial syllable

The deletion of initial syllables was specifically found in Indonesian word production. Yulianto (2009) noted the process of deleting initial syllables among Indonesian monolingual children. He reported 22 words out of 102 utterances

where the initial syllables were deleted by the children under study. The deletions found in Alyssa's speech are presented in Table 10.

Table 10. Deletion of initial syllable

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
16 months	*sudah*	[sudah]	[dah]	already
16 months	*duduk*	[dudʊʔ]	[dʊʔ]	to sit
16 months	*minum*	[minʊm]	[nʊm]	to drink
17 months	*enak*	[enaʔ]	[naʔ]	delicious
18 months	*lobang*	[lobaŋ]	[baŋ]	hole
19 months	*sepatu*	[səpatu]	[patu]	shoes
20 months	*dompet*	[dompɛt]	[pɛt]	purse
20 months	*semangka*	[səmaŋka]	[maŋka]	watermelon

The data shown in Table 10 indicates that the syllables Alyssa deleted were CV, V, and closed CVC syllables. The rule can be formulated as:

9 $ $\longrightarrow$ ø / # ____$

d) Deletion of coda

Another syllable structure process that was noted in Alyssa's early speech was the deletion of coda. Ingram (1981) reported that a CVC syllable is commonly reduced to CV by deleting the final consonant.

Table 11 shows that in Indonesian word production, Alyssa reduced a CVC syllable to a CV syllable and a VC syllable to a V syllable. While in German, a CVCC syllable became a VC or CVC syllable. In other words, when there is a single consonant as coda, then the coda was deleted. While in German words, when a coda consisted of double consonants, only the final consonant of coda was deleted and the pair maintained.

Table 11. Deletion of coda

Indonesian				
Age	Words	Standard phonetic representation	The data	English Equivalents
17 months	*habis*	[habis]	[abe]	finished
18 months	*air*	[aɪr]	[aɪ]	water

German				
Age	Words	Standard phonetic representation	The data	English Equivalents
19 months	*Hund*	[hʊnt]	[ʊn]	dog
19 months	*Geld*	[gɛlt]	[gɛn]	money

The formula of the deletion of final consonants can be stated as:

10 K $\longrightarrow$ ø / ___ #

At age 17 months, Alyssa deleted the fricative consonant [s] at the end of the word in the case of *habis,* 'finished'. The child also deleted the trill [r] at the final position. This might be explained by the fact that the features of the sounds were fricative, causing the deletion. In the German language, when sonorant consonants are followed by a voiceless alveolar consonant [t] in the final position, then the [t] is deleted. In this case, the deletion may be caused by the cluster characteristic.

e) Deletion of semivowels in the middle position

The deletion of semivowels was only found in Indonesian word production. This is understandable given that semivowels are only found in Indonesian phonetics.

As shown in Table 12, Alyssa deleted the sounds [y] and [w].

Table 12. Deletion of semivowels

Indonesian				
Age	Words	Standard phonetic representation	Data	English equivalents
16 months	ayam	[ajam]	[a:m]	chicken
18 months	awas	[awas]	[a:s]	watch out

The deletion of semivowels can be formulated as:

y, w $\longrightarrow$ ø / v ____ v

11 $\begin{bmatrix} -\text{cons} \\ +\text{son} \\ +\text{cont} \end{bmatrix} \longrightarrow$ ø / v____ v

When semivowels occur between vowels, the semivowels tend to be deleted. Why did the child delete semivowels? This might be related to that fact that

semivowels are produced just like vowels. Sounds [y] and [w] are impeded by no articulators in the mouth.

4.4. Ordering Rules

Ordering rules involve two or more phonological processes simultaneously experienced by the child in the production of a single word. This occurred in both Indonesian and German utterances. The first order involved the deletion of the initial syllable followed by fronting. Table 13 illustrates this process in Alyssa's Indonesian word production.

Table 13. Deletion of initial syllable followed by fronting

Words	*Kencing* 'to pee'	*Buka* 'to open'
Standard phonetic representation	[kencɪŋ]	[buka]
Deletion of initial syllable	[cɪŋ]	[kaʔ]
Fronting	[tɪŋ]	[taʔ]
Phonetic realization	[tɪŋ]	[taʔ]
Age	17 months	17 months

The process illustrated in Table 13 is a natural process. At the beginning of Alyssa's speech development, she progressively deleted initial syllables. If we reverse the order to fronting followed by the deletion of initial syllables, this would result in Alyssa producing *[kentɪŋ] and *[buta]. This did not occur at that age and what not a natural process.

The second order commonly observed in the development of the child's utterances was the order of deletion of onset followed by fronting, which was found in Indonesian word development.

The process shown in Table 14 is a natural process. When the process is inverted, that is when fronting is followed by deletion of onset, this results in first phonetic realization, such us *[ladi], *[kati], *[hudan], and *[kutiŋ]. Alyssa did not produce these utterances.

Table 14. Deletion of onset followed by fronting

Words	*lagi*	*kaki*	*hujan*	*kucing*
Standard phonetic representation	[lagi]	[kaki]	[hujan]	[kucɪŋ]
Deletion of initial syllable	[agi]	[aki]	[ujan]	[uciŋ]
Fronting				

Words	*lagi*	*kaki*	*hujan*	*kucing*
Phonetic realization	[adi]	[ati]	[udan]	[utɪŋ]
Age	17 months	19 months	19 months	20 months

The third order is cluster reduction followed by devoicing. This order was found in a German utterance, when Alyssa produced [tɛʔ] to correspond to the word dreck 'dirt', which should be pronounced [dʁɛk]. At first the child reduced the cluster 'dr' by deleting the fricative sound resulting in [dɛʔ]. Afterwards, the voiced alveolar stop [d] was devoiced, becoming [t]. Therefore, the sound produced by the child at age 19 months was [tɛʔ]. In addition, the order cannot be reversed since, at this age, the child could not yet produce the uvular fricative [ʁ]. Therefore, devoicing followed by cluster reduction was also considered unnatural.

5. Cross-Linguistic Influence on a Child's Phonological development

Genesee (2001) argued that the languages of bilingual children need not, nor are they likely to, develop entirely autonomously or interdependently. Certain aspects might develop interdependently while the rest develop autonomously. In the case of the child's phonological development in this study, a transfer of certain sound segments that is the Indonesian palatal approximant [j], was continuously found to replace the front rounded vowel [ʏ] in German word production. Transfer is one form of CLI found in bilingual language development (Genesee 2001; Yip and Matthews 2007).

Even though the replacement of the front rounded vowel [ʏ] with the palatal approximant [j] was only found in the production of the word *feuer* [pɔjɐ], the replacement was happening continuously over quite a long period in the development process. Other words consisting of front rounded vowels in German were not produced by the child until age 20 months. Fikkert (2007) explained that when input forms are too 'difficult' for children to produce, perhaps as a consequence of articulatory limitations or processing problems, they usually find a strategy to deal with these words. Thus, in this study, Alyssa found it easier to produce the palatal approximant [j], for which she only needed to raise the blade of her tongue to her palate. To produce front rounded vowels, however, she not only needed to work with her tongue but also simultaneously shape both her lips in a round position.

6. Summary

Looking at the data of phonological development in a bilingual child, it can be concluded in this case study that sound segments are separately developed, with

limited evidence of the occurrence of a cross-phonological system. In terms of the development of phonological segments, three main conclusions can be drawn. First, sound segments that occur in both Indonesian and German are applied in the word production of both languages. These sounds are consonants [p], [b], [m], [d], [t], [n], [ʔ], [k], [g], [ŋ], [h], [l] and [s], and vowels [a], [i], [ɪ], [e], [ɛ], [u], [ʊ], [o] and [ɔ]. Second, segments that exclusively exist in Indonesian only appeared in Indonesian word production. For example, sounds [ɲ], [c], [ɟ], [j] and [w] were only used by the child when producing Indonesian words and on no account emerged in German. However, the Indonesian palatal approximant [j] was continuously transferred to replace the front rounded vowel when producing the word *feuer* in German. At age 20 months Alyssa had not yet acquired certain vowels belonging to German sounds, such as rounded front vowels [ʏ], [y], [ø], and [œ], as well as the fricative consonants [f], [ʃ], [ʒ], [ç], [x] and [ʁ]. Those sounds were either substituted by other sounds that she had already acquired, or were deleted through phonological processes. For instance, the rounded front vowel [y] was replaced by the rounded back vowel [ʊ]. Fricative consonants [ç], [x] were substituted with fricatives [s] in the final position.

Third, in terms of the phonological processes experienced by the child in this study, fronting, stopping, major change oral to nasal, cluster reduction, and deletion of initial onset were happening in the production of Indonesian and German words. However, certain phonological processes, such as trill becoming lateral, nasal harmony, vowel harmony and deletion of initial syllable, were solely observed in the production of Indonesian words.

These conclusions only apply to this study. Further research needs to be conducted to determine whether such tendencies at the phonological level are apparent among other groups of bilingual children. Do they also develop sound segments independently, with limited cross-phonological influences?

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