The acquisition of coda consonants in English: markedness or frequency?

BA Thesis
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Abstract

This thesis investigates the early coda production of an English-speaking child A. The study compares two influential frameworks in child language acquisition: Universal Grammar (UG) and the Specific Language Hypothesis (SLGH). While Universal Grammar predicts developmental patterns based on innate knowledge in language acquisition, the Specific Language Grammar Hypothesis proposes that the frequency patterns in specific languages

mainly guide language acquisition. The two theoretical accounts make different predictions for the development of coda consonants, creating an exciting topic of study. Data analysis in this thesis reveals that while child A's productions align with projections posited by Universal Grammar, it also suggests an influence from the distribution of coda consonants in English. By combining Universal Grammar and the Specific Language Grammar Hypothesis, this research found that Frequency-Based Hypothesis contributes to a more comprehensive understanding of child language acquisition. It provides valuable insights into the intricate processes involved.

1. Introduction

1.1 The Nature and Nurture Debate

Whether language acquisition is predominantly governed by innate factors or guided by frequencies in the language to be acquired remains an ongoing discussion in linguistics. This thesis explores these two acquisition mechanisms that could govern child language development, focusing on the development of consonants in the coda position of the syllable. Examining codas provides an adequate testing ground where the known mechanisms diverge in their predictions (Zamuner, 2003; Stites et al., 2004). This research seeks to contribute valuable insights into the broader understanding of language acquisition by delving into this aspect of language development.

The discussion mentioned above in language acquisition revolves around the well-known "nature" vs. "nurture" debate. The former, associated with generative linguistics, argues for an innate language learning capacity known as the Universal Grammar Hypothesis (UGH), first proposed by Chomsky in 1981. This thesis explores UG's predictions for acquisition based on typological evidence (Levelt & van de Vijver, 2004). The study by Levelt & van de Vijver (2004) revealed a sequence of developmental grammars delimiting syllable structure in child language that mirrored grammars found in real-world languages, reinforcing the theory's claim of "universality" concerning child language acquisition. On the other hand, the Specific Language Grammar Hypothesis (SLGH) addresses the importance of patterns occurring in the ambient language and the role of frequency in child language development (Olmsted, 1966, 1971; cited in Zamuner, 2003). Contrary to the UGH, the SLGH posits that innate linguistic capabilities are not required for language acquisition, and instead, the process is primarily nurtured by the child's language environment, interactive experiences, input from caregivers, and the culture in which the children reside. In this ongoing debate, coda acquisition is a valuable means to differentiate and evaluate between these two theoretical accounts (Stites et al., 2004; Zamuner, 2004). By studying coda development in child language, this thesis investigates the interplay between innate language ability and the influence of linguistic frequencies, aiming to contribute a deeper understanding of the nature of language acquisition.

Instead of adopting two conflicting perspectives, we could need both, which is captured by the Frequency-Based Hypothesis (FBH). According to FBH, while humans possess innate language abilities, frequent specific phonological patterns in a given language facilitate language acquisition (Morgan, 1990). The need for both was shown in Levelt & van de Vijver (2004), where it became clear that while UG constraints could capture both cross-linguistic and developmental grammars, the order of subsequent developmental grammars was determined by the frequency of specific syllable types in the language to be acquired. Thus, while the SLGH and FBH focus on frequency-driven approaches, they diverge in their central premise regarding the necessity of innate linguistic capability in language acquisition. The research question for this study is which of these hypotheses best captures the development of consonants in coda position: UGH, SLGH, or is there again a need for both? Below, the two contrasting approaches to acquiring coda consonants, UGH and SLGH, will be introduced in more detail, and their hypotheses regarding this development will be formulated.

1.2 Universal Grammar Hypothesis

During acquisition, prior to the emergence of the coda in a syllable, there exists a CV structure (consonant + vowel), which constitutes the initial syllable type acquired by children. It is widely regarded as the universally unmarked and optimal syllable shape. Moreover, CV structure has been observed in all languages worldwide (Spencer, 1996). The co-occurrence of

CV in languages worldwide and its universal status as the first acquired syllable in child language form the foundational argument of UG, embodying an essential property of the theory - markedness[1] (Zamuner, 2003); a universal feature that plays a role in all language acquisition processes. Markedness plays a crucial role in universal language acquisition; it is embedded deeply in the concept of constraint violation – the essential universal acquisition mechanism proposed in Optimality Theory (McCarthy & Prince, 1993). Optimality Theory (OT) represents a conceptual paradigm, offering a firm theoretical alignment with Universal Grammar Hypothesis. To reflect the UG in OT, phonological outputs (surface structures) result from the conflict between markedness and faithfulness constraints (McCarthy & Prince, 1993). Markedness constraints require outputs to be structurally unmarked, while faithfulness constraints necessitate outputs to faithfully represent their inputs (underlying structures), regardless of the structural markedness (Levelt & van de Vijver, 2004). The hypothesis is that in the initial acquisition stage, all markedness constraints outrank all faithfulness constraints (Gnanadesikan, 1995), resulting the syllable structure limited to CV. For children to progress in phonological development, master more advanced grammatical structures, and produce more complex speech forms, they must allow faithfulness constraints to outrank the markedness constraints that can be violated in their language. This process is also seen as promoting faithfulness constraints, thereby ensuring a more faithful output, or demoting markedness constraints, resulting in the possibility of having outputs with more marked structure (Ohala, 1994, 1996; Tesar & Smolensky, 1993, cited in Zamuner, 2003). This

[1] From Zamuner (2003): "The term 'unmarked' refers to the properties of language that are common and frequent, which can be different from what is frequent in any one language, whereas 'marked' defines properties that are less common and less frequent."

reranking, allowing for the violation of markedness constraints, is an essential step in phonological development for children to produce more complicated phonological structures (Zamuner, 2003).

To provide a more concrete illustration of the violation in language acquisition, OT addresses two fundamental aspects: the initial arrangement of constraints and their subsequent reorganization as children progress towards acquiring a grammar that resembles adult language more closely. In the initial stage, all markedness constraints outrank faithfulness constraints (Gnanadesikan, 1995), leading to a completely unmarked syllable structure in child language, represented as CV. In order to progress to the next developmental stage, children need to be able to violate markedness constraints. This violation leads to rearranging the constraint hierarchy, where the previously violated markedness constraint enables the emergence of the corresponding structure. The process is illustrated below:

Input	Output in stage 1: Markedness >> Faithfulness	Development: Faithfulness >>	Result
CCV	CV	[*Complex-Onset]	CCV
CVC	CV	[No-Coda]	CVC
V	CV	[Onset]	V

Table 1: examples of violations of constraint and resulting structures

The emergence of the coda in child language production results from the possibility to violate [No-Coda], by demoting it below Faithfulness, as captured in OT. Combined with the formerly mentioned universality, knowing that OT can capture cross-linguistic markedness manifested in child language, we can anticipate the order of acquisition based on implicational universals in different languages (Goad, 1997; Jakobson, 1968, cited in Zamuner, 2003). This assertion is further substantiated by detailed factorial typology evidence from Levelt & van de Vijver (2004):

Language	Grammar	Resulting output
Arabela	Markedness >> Faithfulness >> [*Complex-Onset]	CV, CCV
Thargari	Markedness >> Faithfulness >> [No-Coda]	CV, CVC
Cayuvava	Markedness >> Faithfulness >> [Onset]	CV, V

Table 2: Factorial typology in constraint violation mirrored in real-world language

One of the strengths of OT lies in its ability to capture the connection between cross-linguistic markedness and child language development. The similarities observed between adults and children can be attributed to a universal set of constraints and the initial ranking of these constraints in an unmarked sequence (Goad, 1997, cited in Zamuner, 2003).

Based on the foundation we have built on constraint violation and the result of constraint rearrangement in child grammar, we now discuss the UGH predictions about acquiring coda consonants. Firstly, we know that the markedness constraint [No-Coda] must be violated to allow such segment emergence. In the form of OT, UGH predicts that development is captured by demoting relevant Markedness constraints from their initial high-ranked, inviolable position to violable ranks below Faithfulness constraints. If grammars only contained the constraint No-Coda, then demotion of this constraint would predict that all consonants would now be possible outputs. When dominated by Faithfulness constraints, UG predicts that any input consonant will also appear in the winning output. Therefore, the development would accordingly be illustrated as: (1) no codas >> (2) all codas. Refer to the table below:

Input	Output Grammar 1: No-Coda >> Faithfulness	Output Grammar 2: Faithfulness >> No-Coda
/kæt/	[kæ]	[kæt]
/dɔg/	[dɔ]	[dɔg]

Table 3: English example of violation of [No-Coda] constraint

1.2.1 Coda Conditions

However, typologically there are several languages with restrictions on coda consonants. It is well-known that many languages that accept syllable codas limit the set of such segments (Woods, 2005). This limitation is realized by a markedness constraint named Coda Condition (Itô, 1988, cited in Woods, 2005). There are different types of Coda Conditions across languages, but most regard place markedness and sonority considerations (Woods, 2005). A language could choose to prioritize place or sonority. For example, Finnish is a language that only permits coronal codas (Sulkala & Karjalainen, 1992, cited in Woods, 2005), exhibiting the place of articulation concern in CodaCond. It is widely accepted that coronals are less marked than dorsals and labials, meaning coronals are universally acquired earlier than labials and dorsals. As proposed by Woods (2005):

*[C/lab, dor] >> *[C/cor]

Meanwhile, Mandarin only permits two consonants to appear at the coda, nasals /n/ and /ŋ/ (Rattanasone & Demuth, 2014); the Western African language Fanti disallows all obstruents from coda (Welmers, 1946, cited in Woods, 2005). The strict selection of nasal consonants in Mandarin displays the sonority aspect of CodaCond. If a language gives rise to sonority preference, the rank by markedness at the coda should be shown as follows:

*[C/plosive] >> *[C/fricative] >>*[C/nasal] >> *[C/liquid]

The phenomenon of restricted consonant types in syllable position is not confined solely to Mandarin; scholars have extensively documented comparable restrictions or preferences for specific sounds in syllable positions across a diverse array of languages. For example, Japanese exhibits a relatively small inventory of codas, allowing only nasals as singleton codas. In contrast, other consonants can only appear in the coda position through gemination (Sadakata et al., 2014). This confirms again the sonority aspect of the CodaCond, as nasals are favored in the coda position because of their sonorant nature. Similarly, gemination creates a more sonorant effect by lengthening the articulation (Lahiri & Hankamer, 1988). Considering the rigorous restriction observed in the selection of nasal codas, an inference arises, indicating the salient position of this constraint in the constraint hierarchy of both Mandarin and Japanese acquisition. We will use the manifestation of the constraint [*C/nasals] to illustrate the predictions for development (1) no codas, (2) codas, but only nasals, (3) all other consonants:

Input	Output Grammar 1: [*C/nasal] >> No-Coda >> Faithfulness	Output Grammar 2: [*C/nasal] >> Faithfulness >> No-Coda	Output Grammar 3: Faithfulness >> [*C/nasal] >> No-Coda
Maryland	[mɛ.rə.lə]	[mɛ.rə.lən]	[mɛ.rə.lənd]

*Table 4: examples of violation of CodaCond: *[C/nasal]*

As we could infer from above, once the grammar allows coda, but the constraint CodaCond is yet dominant to faithfulness, as shown in output grammar 1, the supposed coda [d] is deleted to ensure the nasal production. Once CodaCond is demoted, outranked by faithfulness, the output grammar 2 allows non-nasals to be produced.

Assuming UG is substantiated, one would expect to find cross-linguistic patterns that correspond to developmental patterns during acquisition as a product of UG due to its innateness. However, it is not the case. The are extensive typological evidence documented regarding constraint violation that failed to be comprehensively accounted by UGH. The idea is that typological linguistic patterns reflect the operation of innate principles guiding language acquisition[2] (Croft, 2002). Production modifications by children such as epenthesis have been identified in various studies and are considered to be a manifestation of the innate principles of UG (Demuth & Fee, 1995; Faingold, 1990; Jakobson, 1941/1968; Levelt et al., 2000; Levelt & van de Vijver, 2004; Mowrer & Burger, 1991; Ohala, 1996; Vihman & Ferguson, 1987, cited in Zamuner, 2003). In short, adult speakers and language-acquiring children modify the structure of words to conform to innate markedness constraints prioritized in their (developmental) grammar.

We will now turn to the predictions of the SLGH.

[2] For instance, in Hawaiian, a language that prohibits consonant clusters, loanwords with consonant clusters undergo modifications through epenthesis to be phonologically integrated. According to the concept of markedness, consonant clusters are disallowed in Hawaiian, and as a result, the language adapts such structures into less marked forms (Zamuner, 2003). This phenomenon is also observed in the English child language, where young children initially delete or modify target consonant clusters in their speech productions to conform to less marked structures.

1.3 Specific Language Grammar Hypothesis

Nonetheless, other research also indicated that frequency plays a significant role in facilitating language acquisition. For instance, /s/, /z/, /n/, /t/, /l/, and /k/ are the most frequent consonants in English coda (Kessler & Treiman, 1997), and Kehoe & Stoel-Gammon (1997) found that the stop consonant /t/ is the first coda acquired by English-speaking children. This contradicts the predictions of UG since stops are neither unmarked in respect of place nor sonority. The early acquisition of /t/, however, aligns perfectly with frequency considerations, as /t/ is the most frequently occurring coda consonant in the English language (Zamuner, 2003). Cross-linguistic evidence has also been adduced; for instance, in the case of Spanish, the precocious acquisition of fricatives codas has been ascribed to the frequency of this segment at coda, notwithstanding its classification as a low-sonority segment (Polo, 2018). Drawing from markedness considerations on sonority alone, one might expect that sonorant consonants in the coda position would be acquired earlier due to their unmarked status in child grammar, and in contrast, obstruent coda consonants would be acquired later (Goad, 1997, cited in Zamuner, 2003; Woods, 2005; Polo, 2018). However, as demonstrated in previous studies, the available evidence indicates that the acquisition process is more complex than anticipated. To further investigate the predominant factor that influences coda acquisition, we reasonably hypothesize that if frequency prevails, we expect the acquisition pattern exhibited by English children to align with the frequency distribution of coda consonants in English; such distribution of frequency was introduced in Stites et al., (2004). Therefore, the acquisition pattern displayed by the child should be:

*stops/coda >> *fricatives/coda >> *liquids/coda >> *nasals/coda >> *affricates/coda

Coda acquisition is an example of the disparity between markedness and frequency in English (Zamuner, 2003). Nasals exist to be a functional ground for building such a test of discrepancy.

On the one hand, based solely on the consideration of markedness, one would anticipate English-speaking children to acquire less marked segments, such as nasals at coda position in the earliest stage, due to the high-ranked status of the positional constraint CodaCond. On the other hand, based on the frequency, English children should acquire stops at the earliest while nasals at a relatively later stage, considering the low frequency of nasal segments in English. In Kehoe & Stoel-Gammon (1997), they found the stop [t] is the first acquired coda consonants for English children, regardless [t] a non-sonorant consonant (Stites et al., 2004), so here it seems that frequency, rather than markedness, determines the order of acquisition of specific coda consonants. Thus, by examining the properties and characteristics associated with codas, we can further refine our understanding of what triggers the reranking of the constraints in development. This transits us to our research question in the next section.

1.4 The Research Question

It is apparent that nasals have a predominant frequency due to their exclusive status for coda in Mandarin, it is also possible that the acquisition of nasal codas is a language-specific phenomenon driven by the significant frequency, so the nasal coda acquisition provides a concrete ground where UGH and SLGH can be tested for universality, frequency, and possible interaction. Suppose the acquisition of nasal is governed by markedness as depicted in OT; the constraint CodaCond is highly ranked in child grammar, which realizes as the earliest nasal acquisition across different languages. However, if the frequency proposed by SLGH takes precedence, we anticipate the acquisition inclines with the frequency distribution in the given language. This thesis substantiates its assertions through observations from a case study involving an English-acquiring child named A.

To conduct a more comprehensive inquiry into this subject matter, we hypothesize that based on the premise that early language acquisition is influenced by universal characters, such as markedness, then it is anticipated that A's speech production would exhibit nasals as the initial acquired codas due to the high-ranked status of CodaCond *[C/nasals]. In the absence of such a pattern, the phenomenon observed in Mandarin is likely specific to the language, given the notable frequency of nasals therein. To subject the validity of UG to further scrutiny, we will examine the frequency distribution of coda consonants in English to seek the potential alignment with child A's acquisition pattern, which refers to the frequency distribution proposed in Stites et al., (2004), which is that the stops will be initially acquired, then fricatives, liquids, and nasals.

2. Methodology

2.1 Data Collection

The speech data of Child A was downloaded from the Providence Corpus on Phonbank.org, available at https://phonbank.talkbank.org/access/Eng-NA/Providence.html. The Providence Corpus is a naturalistic child speech corpus compiled by Katherine Demuth and her assistants at Brown University (McWhinney, 1995). The corpus provides longitudinal recordings of six monolingual English-speaking children and is designed for research investigating child phonological and morphological development. For this study, the data of child A was used. The recordings were conducted within a naturalistic setting, capturing spontaneous interactions between the child and their parents. Participant A's recordings were initiated at 1;04.28 and continued until 3;05.16. Sessions were held biweekly and lasted for an hour each. For this paper, the corpus from Child A, spanning the period of 1;5.12 to 3;5.16, was selected for analysis.

Once the data was downloaded, it was processed using Phon, an analytical program designed for phonological analysis (McWhinney, 1995). Phon assists in the analysis of phonological development and provides various automatic functional tools such as syllable segmentation and splitting recordings into utterances. After importing the data into the interface, I first checked for correct syllabification and syllable alignment in the Project panel. Subsequently, I ran a query with predetermined query settings using Phone, instructing the system to find stressed syllables ending with a singleton coda, and extracted the desired syllables. The query was configured as shown below:

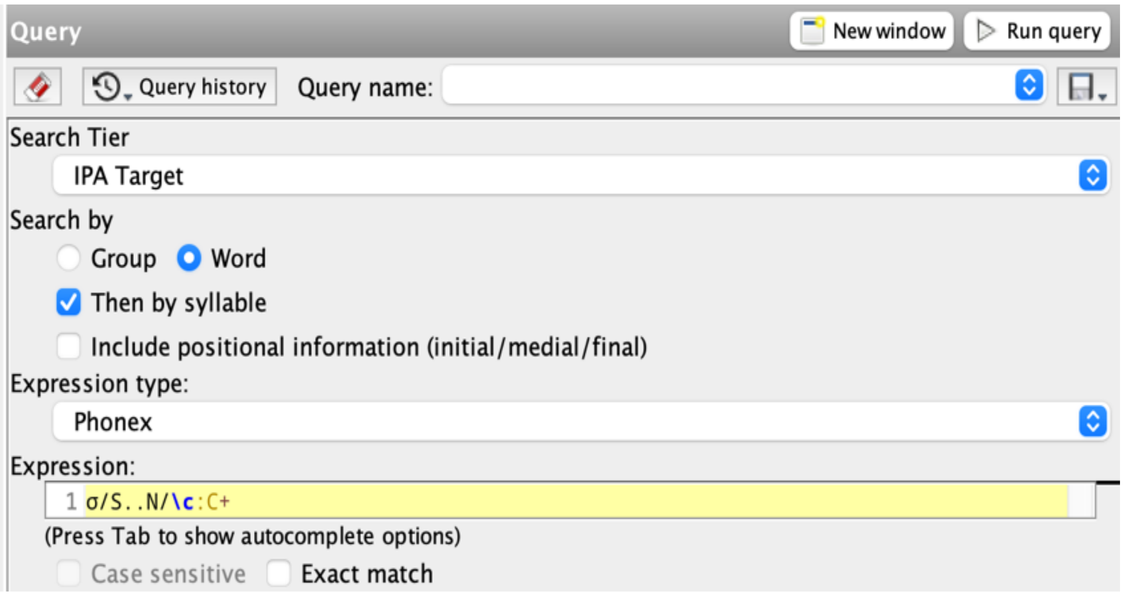

Figure 1: Setting in Phon for general query (1)

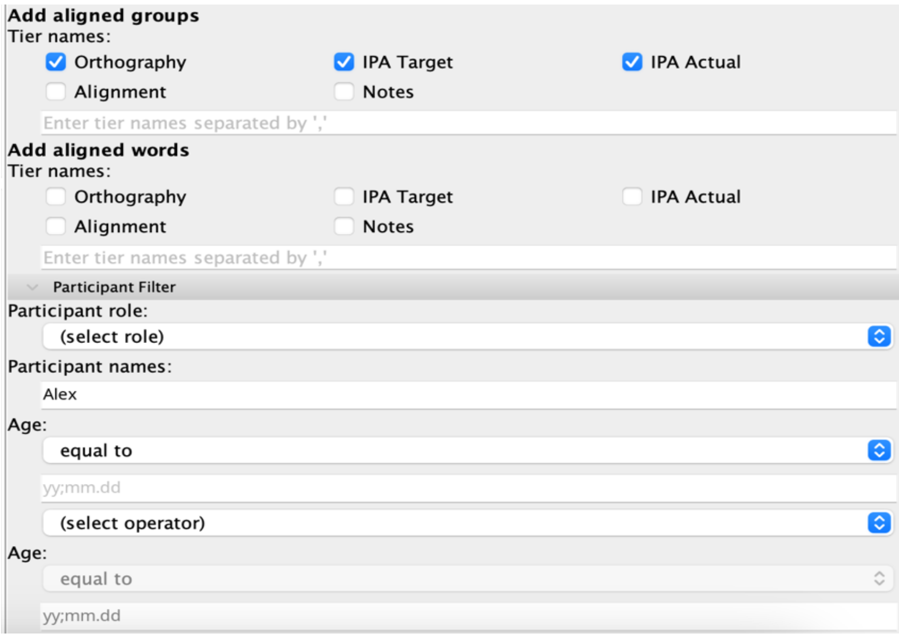

Figure 2: Setting in Phon for general query (2)

As it is illustrated in the picture, the option of three-tier groups, namely "Orthography," "IPA Target," and "IPA Actual," were all selected. "Orthography" represents the orthographic form of the target word that the child attempted to produce, while "IPA Target" and "IPA Actual" provide phonological information about the word. "IPA Target" indicates the phonetically transcribed form of the target word, while "IPA Actual" illustrates how the child has produced it. In this research, our primary interest lies in the IPA Actual production, which contains critical information regarding the child's early coda productions. Therefore, the IPA Target is only considered for detailed analysis if obscured patterns are detected to require further explanation. The results from the query were generated in the form of three individual Excel sheets:

a. Aggregate; a summary of all syllable productions that matched our search criterion

b. Inventory; the phonological inventory produced by the child. The information about IPA Target and Actual remained present as core information.

c. Table; a detailed report with all the information included with the utterances, including Session, Date, Speaker, Age, Record, Group, Tier Range, Result, IPA Target, IPA Actual, Orthography (Group), IPA Target (Group), IPA Actual (Group), and Alignment.

2.2 Procedure

Once the Excel files with results were downloaded, the IPA Actuals from Aggregate were organized alphabetically and stored in pivot tables. Each pivot table represents the IPA Actual of one session, later all the tables from the same period were combined into one spreadsheet for easier overall examination. The pivot tables provide a more precise and more consistent view of the CVC productions at each session, as noisy data andempty entries presented in the raw Excel form were deleted. Once the pivot table from each session was compiled by age, for every produced coda consonants the number of times it occurred in the child's production was recorded. The tables containing detailed information about the frequency of each produced coda consonant at different period of time can be found in the appendix. Consonants are grouped into two tables in the analysis with respective standards: place of articulation and sonority. The former one has a branch of three sub-groups, with them being: coronal, dorsal, and labial. This allows us to directly check for whether the child prefers coronals as predicted by UGH. The latter grouping produced four categories, with respect to the criteria of if the composing segments have combined frequency of no fewer than three in each recorded session (Ingram, 1981); they are nasals [n, ŋ, m], fricatives [s, z, f, v], stops [t, d, k, p, b, g], and the liquids [l, r]; this grouping facilitates both the examination of UGH and SLGH, as the four distinct categories encompass discernible sonority and frequency profiles. Approximants were excluded from the analysis due to its complexity for children at current stage (Stites et al., 2004).

3. Results

Overall, the four most frequent types of singleton coda productions by child A were: nasals, sibilants, stops, and laterals. During the data collection period, child A targeted 212 different English words containing a singleton coda. Based on the observations in the IPA Actual, the child produced a total of 786 variants of these 212 targeted words. Child A achieved these varying productions through modifications, such as deletion and substitution. Coda omissions, modifying CVC to a CV output structure, were disregarded, as there was no longer an actual coda production. We observed coda production for the first time at 1;8.11, but they only appeared systematically after 2;3.26. Before that period, coda production was sporadic. To provide a more enhanced clarity of the findings, the tables were presented below:

Period	Category	Nasals	Fricatives	Stops	Liquids
2;3.26 - 2;11.22		100	90	76	39
3;0.6 - 3;5.16		120	107	25	34
	Total	220	197	101	73

Table 5: total coda production counted by frequency of occurrence in A's production

	Place of Articulation	Coronal	Dorsal	Labial
Period				
2;3.26 - 2;11.22		228	40	15
3;0.6 – 3;5.16		224	42	8
	Total	452	82	23

Table 6: total coda production categorized by place of articulation in A's production

Multiple noteworthy aspects are pertinent to the IPA Actual production of child A. Primarily, coronals exhibit preeminence in production. Across both periods, the production of coronal sounds considerably surpasses that of labial and dorsal sounds. Thus, the rank on markedness aligns with Woods (2005):

*[Cor/coda] >> *[Dor & Lab/coda]

Secondly, when considering the criterion of no fewer than three occurrences, the order of acquisition is as follows:

*nasals & stops / coda >> *fricatives/coda >> *liquids/coda

This hierarchy indicates that nasals and stops emerge as the initial acquired sounds for child A, evincing their appearance in the child's linguistic output during a comparable developmental phase. Subsequently, fricatives manifest as acquired later, while liquids appear the latest. Additionally, a slight divergence is observed in the ranking of total occurrence frequency, wherein a positional reordering of categories occurs:

*nasals/coda >> *fricatives/coda >> *stops/coda >> *liquids/coda

This delineates the prevalence of nasals as the most frequently occurring phonetic elements in the speech of child A, substantiated by the highest frequency of occurrence within the IPA Actual. Fricatives emerge as the second most frequently produced codas, followed by stops and liquids. Remarkably, nasals exhibit the highest frequency and the earliest appearance in child A's coda production, underscoring their salient role at an early developmental stage. Conversely, fricatives manifest a delayed launch but attain substantial prevalence in child A's later speech (observed between 3;0.6 and 3;5.16). In contrast, the production of liquids displays a relatively abrupt and unsystematic pattern, characterized by intermittent instances of comparatively polarized high and low frequencies.

4. Discussion

4.1 Reflection on Universal Grammar

The initial hypothesis proposed that the positional constraint CodaCond would exclusively predict the emergence of nasals in early child speech. However, our research findings diverge from this assertion. Although nasals are the earliest and most frequently produced segments by child A, our observations indicate that both nasals and stops are acquired within a similar developmental period. This suggests that nasal acquisition is not exclusive to child A's speech. Consequently, the observed phenomenon does not align with the original conjecture based on the high-ranked status of CodaCond *[C/nasals]. Thus, the constraint CodaCond presents a different level of challenge to demote compared to Mandarin acquisition in English.

Nevertheless, child A's significant preference for coronal codas can be interpreted as a reflection of UG principles (Zamuner, 2003). As a result, in response to one of the earlier inquiries, while UG successfully predicted considerably better coronal production, *[C/nasals] in Mandarin exhibits a language-specific phenomenon. As stated earlier, markedness constraints are universal properties, and the existing gap in UG fails to explain why certain constraints are more readily demoted in different languages. Within the framework of UG, there is a need for a compelling argument to elucidate why English-acquiring children encounter relatively less difficulty in managing the positional markedness constraint CodaCond.

4.2 Reflection on the Specific Language Grammar Hypothesis

The sequence of language acquisition observed in child A is as follows: *nasals & stops /coda >> *fricatives/coda >> *liquids/coda. When comparing this order of acquisition with the frequency distribution of English codas reported in Stites et al. (2004): *stops/coda >> *fricatives/coda >> *liquids/coda >> *nasals/coda >> *affricates/coda, it becomes evident that the early emergence of nasals cannot be entirely accounted for based on their frequency in the language. Although SLGH to some extent predicts child A's acquisition sequence correctly, it is insufficient to attribute the entire developmental process solely to frequency. The early production of nasals in child A's language development needs to be more adequately explained by their frequency in English, thereby rendering SLGH unable to explain the phenomenon under consideration comprehensively.

4.3 General Discussion

On the one hand, UGH successfully predicts the robust production of coronal sounds. However, it encounters challenges in providing a satisfactory account for the seemingly effortless demotion of the positional constraint CodaCond *[C/nasal] in English. On the other hand, SLGH effectively aligns with the production patterns observed in Child A's speech, nonetheless appeared to be unable to fully account for early nasal production based solely on frequency considerations; meanwhile, the prediction stemming from UGH postulated the preference for sonority aligns with the observed early nasal productions.

The inadequacies both UGH and SLGH exhibited in addressing the aforementioned linguistic phenomena within their respective theoretical domains serve as a focal point for introducing a middle-ground concerning the potential interplay and complementarity between UGH and SLGH. The outcomes suggest a mutual compensatory relationship between the two approaches, wherein they appear to somewhat mitigate each other's limitations. This theoretical framework of interaction finds its place within the realm of Frequency-Based Theory (FBH), posited by Morgan (1990), which contends that language acquisition may result from the interaction between markedness and frequency considerations, which will be expanded in the next section.

4.4 Frequency-Based Hypothesis

While we primarily observe results that align with the presence of innateness under UG (referring to the robust production of coronals and nasals), it is imperative to acknowledge the role of frequency in child grammar (shown in the early emergence of stops and solid productions of fricatives). FBH builds its arguments based on the interplay between markedness and frequency; it provides a possible explanation on why the positional constraint CodaCond seems to be so easily demoted by child A: due to a different frequency distribution of sounds in English, namely a lower frequency for nasals and subsequently a higher frequency for other possible segments. The high frequency of stop codas in English facilitates the acquisition in accordance, creating an environment that is more readily to demote *[C/nasals].

These variations in constraint violation are backed with typological evidence: frequency directs child learners to a specific direction of constraint violation that results in the acquisition, while UG provides them with paths (Levelt & van de Vijver, 2004). The learner's choice of a particular violation is influenced by frequency. This is also confirmed with individual variations observed from children acquiring Dutch; the research by Levelt et al., (2000) found that from CV to the next stage of development in Dutch, it appears that Dutch children prefer the CVC structure over CCV or V. This closely aligns with the child-directed occurrence frequencies of CVC in Dutch; as a result, early acquisition of such structure is facilitated accordingly.

Moreover, it is worth considering that stops and fricatives, characterized by relatively low sonority (Ladefoged, 1982), under UG might not be favored at the coda position due to their non-sonorant nature (Clemence, 1996), but the 'aggressive' early emergence of them in child A's grammar could be attributed to their frequency in English; stops are the most frequent segment in English (Kehoe & Stoel-Gammon, 1997, cited in Stites et al., 2004), and fricatives are commonly applied in English affixation. Thus, the considerable frequency of stops and fricatives fosters their early acquisition accordingly. Last but not least, to account for the reduction in the disparity between the number of nasals and fricative from 3;0.6 – 3;5.16, one hypothesis could be that as the child's linguistic competence advances, he produces more faithful structures, conforming to the required grammar. Sibilants, as one type of the fricatives, are utilized at coda in English to express third-person singular and convey plurality in nouns (Clark & Nikitina, 2009). As evident from the tables, the child demonstrates a notably higher usage of sibilants at three compared to their output at two. With the improvements in overall linguistic capability, this pattern suggests that phonologically, the child gradually perfects their grammar by being more faithful to the inputs.

4.5 Conclusion

The present research reveals that UG yields partially accurate predictions concerning child language, as demonstrated through this study's astute conjecture of coronal production. However, it is imperative to recognize the interplay with the frequency element in facilitating language acquisition. Consequently, the framework of FBH offers a more comprehensive theoretical framework for comprehending child acquisition behavior, where frequency, as a governing factor within the specific language, inevitably influences the acquisition process (Morgan, 1990). To unravel the intricacies of language acquisition from a cognitive perspective, investigations into syllable acquisition provide valuable insights into the multifaceted process of phonological development in children. By discerning patterns across diverse languages, researchers can delve deeper into the trajectory of children's language development and elucidate the underlying mechanisms that mold the linguistic competence of language acquirers.

4.6 Limitations

It is imperative to recognize and address the inherent limitations of this study:

1. Due to the nature of the intervals in original data collection, the sessions were conducted biweekly. This approach, however, raises the possibility of overlooking significant production patterns manifested by the child during the no-session periods. Consequently, the acquisition process presented in the data could be characterized by a diminished level of precision and detail on acquisition patterns, which might not align with the ideal standards of accuracy we seek to achieve.
2. The limited sample size, comprising a solitary child participant, gives rise to apprehensions regarding the extensibility or generalizability of the observed outcomes. Child A's characteristics may indicate a preference for frequency-oriented learning. Consequently, the results derived from this singular case lack the statistical power requisite for asserting definitive conclusions regarding the behavior of child language acquisition.
3. The scope of the investigation was confined solely to coda consonants. While this inquiry yielded valuable insights into the domain of language acquisition, it is imperative to expand such research endeavors to encompass the acquisition of sounds in additional phonetic positions.

Future investigations could be enhanced through the incorporation of more expansive speech corpora, encompassing larger cohorts of children participants or implementing more intensive and closely monitored language development sessions with the subjects. In light of prevailing scholarly discourse about markedness and frequency, a compelling imperative arises to explore a broader spectrum of consonant types occurring in coda positions, thereby engendering a more profound elucidation of the subject matter.

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6. Appendix

Age	*1;8.11*	*1;9.22*	*1;10.6*	*1;11.3*	*1;11.27*
Coda Production					
[t]	1				
[k]	1				
[d]		1			1
[m]			1		1
[n]				1	
[s]				1	1

Table 1: coda production and frequency between 1;8.11 and 1;11.27

Age	*2;3.26*	*2;4.11*	*2;4.25*	*2;5.9*	*2;5.23*	*2;6.6*	*2;8.16*	*2;8.28*	*2;9.13*	*2;9.26*	*2;10.11*	*2;10.25*	*2;11.8*	*2;11.22*
Coda Production														
[n]	9	6	5	3	4	7	3	3	13	4	4	7	7	5
[ŋ]										2	2	1	4	3
[m]			1							1			5	1
[s]		1		7	2	10	6	6	9	4		5	7	5
[z]		1	1		1		1	1	4	3	1		4	1
[t]	2		3	1	3		1	3	3	2	4	5	3	5
[d]	5		1	1	1				2	1			1	
[k]	2	1				3	1		2	2		2	2	2
[g]	1											1		
[p]				1		1						1		
[b]			1	2									1	
[f]				1			1							
[v]				1						1				1
[w]			1	2	1		1		1				3	
[l]	1		8	2		1		2		1	2		1	3
[r]			2			1			1	1	1		1	
[θ]					1				1					
[ʃ]			1		1									
[ʒ]			1			1								
[ʔ]			1		1	1	1	1						
[tʃ]	1	1	6	3	1	1	1	1	1			2		
[dʒ]	3		1			2							1	
[ts]							1							

Table 2: coda production and frequency between 2;3.26 and 2;11.22

Age	*3;0.6*	*3;1.3*	*3;1.19*	*3;2*	*3;2.14*	*3;3.1*	*3;3.13*	*3;3.27*	*3;4.1*	*3;4.24*	*3;5.16*
Coda Inventory											
[n]	6	5	5	8	6	15	9	4	6	9	8
[ŋ]	5	3	10	2	3	3		1	1	2	2
[m]		1	1		1	1	2	1			
[s]	4	6	8	1	6	8	10	6	9	2	6
[z]	11	6	6	5		3	1		1	1	6
[t]		2	3		2	1				1	
[d]		1	1			2	1		1		1
[k]	1		1			1		1	1		
[g]											
[p]											
[b]						1					
[f]							1				
[v]											
[w]	1					1		2		1	
[l]		5	3	4	3				5		
[r]		1	1	3		3		1			

[θ]											
[ʃ]			1		1						1
[ʒ]					1						
[ʔ]											
[tʃ]						1			1		1
[dʒ]						1			1		
[ts]											

Table 3: coda production and frequency between 3;0.6 and 3;5.16