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A Constraint-based Approach of Vowel Epenthesis in Greek Child Speech

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Abstract*

This study investigates vowel epenthesis in Greek and aims to answer how this process facilitates language acquisition. More specifically, properties of vowel epenthesis are examined, such as the position and quality of the epenthetic vowel as well as whether it is affected by the stress system of the ambient language. Our findings are based on spontaneous speech collected from three Greek-speaking children aged 1;6.26 - 2;10.9 years old. An inserted vowel is observed at the end of monosyllabic and disyllabic loanwords so as to license a consonant that is not permitted in coda position by resyllabifying it to onset position in the new syllable. It additionally creates trochaic rhythm, which is the default stress pattern in Greek. This is especially shown from disyllabic loanwords and non-loanwords with iambic stress, which changes into trochaic with the addition of the new syllable. Further, only [+anterior] vowels are inserted due to them being always adjacent to a [CORONAL] consonant with which they share the same distinctive feature of place, namely, [+anterior]. The children's data are analyzed according to Optimality Theory (Prince & Smolensky, 1993), in which the ranking of specific constraints can explain and interpret the properties of epenthesis.

1. Introduction

In this paper vowel *epenthesis* in Greek child speech is examined so as to see why children use this process and how it assists them in their linguistic development. Epenthesis is considered the realization of one or more segments that are absent in the underlying representation of a word and its emergence usually creates unmarked CV syllable in children's or adults' speech (cf. Kappa, 2002, p. 23-24; Tzakosta, 2003, p. 259), as illustrated in (1).

	Adult's form	→ Child's form	Child: Age
1.	[eˈksatmisi]	→ [ceˈknatmisi] (evaporation)	Dion: 2;9[1]

(Greek, Tzakosta, 2003, p. 262)

The type of the inserted segment can be a consonant, vowel, glide or a CV syllable (e.g. Lombardi, 2002; Demuth, Culbertson & Alter, 2006; Kappa, 2014). Representative examples follow (2a - c).

	Adult's form	→ Child's form	Child: Age
2.	a. [ˈble]	→ [beˈle] (blue)	Sof: 2;2 (Greek, Kappa, 2002, p. 23)
	b. [lémlué:si]	→ [lémlujé:si] (I am not eating)	Adults' speech (Washo, Midtlyng, 2005, p. 60)
	c. [ˈe.la.to]	→ [ˈte.la.to] (fir)	girl (twin): 2;8.21 (Greek, Poulidakis, 2022, p. 5)

As far as the identity of the epenthetic segment is concerned, it can be *default*, a *full* copy of a non-adjacent segment or to bear some *distinctive features* with another one (see Kitto & Lacy, 1999; Tzakosta, 2003), as shown from (3a - c). In Greek, [e] constitutes the default epenthetic vowel (Malikouti-Drachman & Drachman, 1988).

	Adult's form	→ Child's form	Child: Age
3.	a. [ˈbluza]	→ [beˈlula] (blouse)	Sof: 2;5.9 (Greek, Kappa, 2002, p. 23)
	b. [ˈaloɣo]	→ [ˈðiloɣo] (horse)	Mar: 2;8.22 (Greek, Tzakosta, 2003, p. 262)
	c. [ˈði.o]	→ [ˈði.ðo] (two)	boy (twin): 2;4.20 (Greek, Poulidakis, 2022, p. 4)

Based on the location of the epenthetic segment, epenthesis is divided into *prothesis*, namely, insertion of a vowel before a cluster and *anaptyxis*, that is, insertion of a vowel into the cluster (Abrahamsson, 1999, p. 474; Fleishhacker, 2002, p. 71). The composition of the cluster is proposed to be related with the type of epenthesis that emerges (Fleishhacker, 2002). So, prothesis is considered more frequent when the cluster contains a sequence of [sibilant + stop] (4a), while anaptyxis when it includes [obstruent + sonorant] (4b).

4.	a. [skul] English	→ [iskul] Hindi (school)	(Singh, 1985, p. 270)
	b. [slɔg]	→ [səlɔg] (sleep, marry)	(Temiar, Itô, 1989, p. 252)

Vowel epenthesis is a strategy that has been observed to play a crucial role in adult and child speech. In the former, it can resolve consonantal clusters that are disallowed from one language to another. Farsi speakers learning English as L2 constitutes an example among many (Boudaoud & Cardoso, 2009). In Farsi, sequences containing [s + consonant] are not permitted, since only singleton onsets are allowed. On the other hand, in English sC sequences are legal (5).

5.	[sneik] English	→ [es.neik] Farsi (snake)	(Boudaoud & Cardoso, 2009, p. 8)

In (5), the new syllable created by the epenthetic vowel [e] leads to the resyllabification of [s] from onset to coda position splitting the disallowed cluster [sn] in Farsi. Vowel epenthesis is

also traced in loanwords adaptation. Japanese, for instance, is a language where complex onsets are prohibited and in coda position only a nasal consonant can appear or the first half of a geminate (Itô & Mester, 1995). So, when it borrows words containing illegal structures, epenthetic vowels are inserted as a repair mechanism (6).

6. [Sfiŋks] English → [sufiŋkusu] Japanese (sphinx) (Itô & Mester, 1995, p. 826)

Creole languages constitute another environment where vowel insertion is ascertained for the simplification of complex structures (Alber & Plag, 2001), as this kind of languages favor CV syllables (7).

7. [crabe] French → [carabe] Mauritian Creole French (crab)
(Alber & Plag, 2001, p. 812)

In child speech, vowels and consonants are usually inserted in order for unmarked CV syllables to be created (e.g. Stemberger, 1996; Kappa, 2002; Tzakosta, 2003). Indicative examples follow (8a - d).

	Adult's form	→ Child's form	Child: Age
8.	a. [klɔk]	→ [kəˈlɔk] (clock)	Tom: 1;6.25 (Dutch, Fikkert, 1994, p. 78)
	b. [koːˈnɛin]	→ [tɔˈtɛinə] (rabbit)	Noortje: 2;8.29 (Dutch, Fikkert, 1994, p. 209)
	c. [aːp]	→ [ˈaːpə] (ape)	Tom: 1;4.14 (Dutch, Fikkert, 1994, p. 209)
	d. [ˈa.lo]	→ [ˈla.lo] (other)	boy (non twin): 1;7.7 (Greek, Poulidakis, 2022, p. 4)

Many different reasons have been proposed for the use of epenthesis in language acquisition. First, it simplifies complex structures, such as consonantal clusters by splitting them (Fikkert, 1994; Kappa, 2002; Tzakosta, 2003), as in (8a). In some studies, children present difficulties in the production of consonants located in codas resulting in word final epenthesis in order for them to resyllabified in onset position and survive (Fikkert, 1994), as in (8b). However, some researchers suggest that vowel epenthesis in such cases does not save the coda but its timing unit (Bernhardt & Stemberger, 1998). Other surveys point out that there is a stage where children's utterances constitute *minimal prosodic words* consisting of *binary feet* (e.g. Demuth, 1995, p. 14; Broselow, 2008, p. 122). When this requirement is not satisfied by the use of a coda, then children employ other adjustment processes, such as word final vowel epenthesis (Demuth & Fee, 1995), as in (8c). As far as properties of epenthesis are concerned, it is observed to take place between the edgemost syllables, which are considered psycholinguistically prominent positions (see Slobin, 1973; Pater, 1997; Smith, 2002, among others), while the inserted segment which emerges in one of the two edges is a full copy of the consonant traced at the other edge (Poulidakis, 2022). Representative examples are cited next (9a - b).

	Adult's form	→ Child's form	Child: Age
9.	a. [e.ˈci.nos]	→ [ne.ˈci.nos] (that)	girl (twin): 2;8.14
	b. [Ma.ˈɾi.a]	→ [Ma.ˈɾi.ma] (Maria, name)	girl (non twin): 2;3.20

(Greek, Poulidakis, 2022, p. 5)

In this study we focus on the following questions regarding the process of vowel epenthesis. Why children employ vowel epenthesis? What is the quality of the epenthetic vowel? In which position does the inserted segment emerge? Does the stress system of Greek affect epenthesis?

2. Research Methods

This research is qualitative and investigates vowel epenthesis in a less explored environment in child speech, as the majority of our data constitute loanwords. Further, the generalizations that are deduced from children's words are analyzed based on the *Optimality Theory* framework (Prince & Smolensky, 1993), where constraints ranked in a specific order can capture adequately all the properties of vowel insertion.

Regarding the research process, we obtained verbal and written parental consent before the meetings with the children. The participants were three monolingual Greek-speaking children having no auditory, cognitive or motor impairment. Their age varied from 1;6.26 to 2;10.9 years old. For the collection of their data, the professional tape recorder Marantz PMD661MKII was used. The recordings took place in two nurseries and spontaneous speech was gathered via different activities, such as reading books, painting, playing with bricks, puzzles, balls, dolls. This way there is not interference in the linguistic system of the children allowing us to see the status of their current grammar and how it progresses through the developmental stages they pass. Each child was recorded 1-2 times per week for 15-30 minutes, while the research lasted about 15 months. 26.510 tokens resulted, from which we relied on 16 for our assumptions. So, vowel epenthesis seems to be a quite rare process in the children of the present study. However, we will see in the next section that it arises under specific conditions. All the tokens with vowel insertion except for two appear in the intermediate developmental stage of the children, namely, after 2;0 years old. At this stage, the transition of unmarked structures towards marked is observed, such as consonantal clusters, consonants specified as fricatives, liquids, consonants in coda position, words containing three or more syllables. These features, among others, are proposed to be indications of children's intermediate acquisitional stage (see for Greek, Kappa, 2000, 2009; Tzakosta & Kappa, 2008). Audacity software was used for the processing and conversion of audio material into tokens, which were organized in Microsoft Office Word. The transcription was done by ear only and for this reason data with high certainty of children's utterances were included. Finally, the phonetic transcription of tokens was done according to the *International Phonetic Alphabet*.

3. Discussions

3.1. Description of children's data

Greek is a language with a five-vowel system and, more specifically, [a], [e], [i], [o], [u] are included in its inventory. Vowel epenthesis is ascertained in monosyllabic and disyllabic words. Beginning with the former, 8 tokens are observed with vowel insertion and they all constitute loanwords. Indicative examples are provided below (10a - e).

	Adult's form	→ Child's form	Child: Age
10.	a. [bol]	→ [ˈbo.li] (bowl)	C1: 2;8.21
	b. [bʌax]	→ [ˈbʌa.ti] (yuck)	C1: 2;10.9
	c. [ɾoz]	→ [ˈo.zi] (pink)	C2: 2;3.2
	d. [ɾoz]	→ [ˈlo.ze] (pink)	C2: 2;6.27
	e. [gol]	→ [ˈgo.li] (goal)	C3: 2;7.6

In all monosyllabic productions the inserted vowel is located in the final syllable adjacent to a consonant specified as [CORONAL]. It is always [i], except for example (10d), in which [e] is traced. We assume that the quality of the epenthetic vowel is specific and it is affected by the adjacent consonant, since they share the same distinctive feature of *place*, namely, both are characterized as [+anterior]. Several reasons for the use of epenthesis in these data are suggested. First of all, it licenses a consonant that is not permitted in coda position by resyllabifying it to onset position in the new syllable created by epenthesis. In Greek, the consonants allowed in final coda are [s] and [n] (Malikouti-Drachman & Drachman, 1988; Malikouti-Drachman, 2001). The creation of unmarked CV syllable constitutes another reason for the inserted vowel. Finally, it forms a *trochaic foot*, which is considered the minimal prosodic word in Greek (Kappa, 1998). Two views are proposed regarding the number of syllables a foot can contain. According to Hayes (1982), it includes two syllables, while Selkirk (1981) suggests three. In our study, we adopt the view of Hayes (1982), as it is considered universal. Further, a foot is called *degenerate* when it includes one syllable (Kappa, to appear, p. 166). Returning to children's tokens (10a - e), we claim that the nature of the foot is affected by the ambient language. In particular, Greek is a trochaic language, which builds its trochees leftwards, that is, from right to left (Tzakosta, 2002), while the trochaic rhythm is pointed out as the unmarked pattern of stress (Tzakosta, 1999).

Insertion of a vowel is additionally traced in 8 disyllabic words, from which the halves are loanwords (examples 11a - d).

	Adult's form	→ Child's form	Child: Age
11.	a. [tra.ˈkter]	→ [a.{ˈte.li}[2]] (tractor)	C1: 2;4.29
	b. [ka.ˈskol]	→ [a.{ˈko.li}] (scarf)	C2: 2;3
	c. [tra.ˈkter]	→ [ta.{ˈθte.ɾi}] (tractor)	C2: 2;6.20
	d. [ɾo.ˈbot]	→ [o.{ˈbo.ti}] (robot)	C3: 2;4.28

The properties of epenthesis and the reasons for its use are the same with those concerning monosyllabic words with one difference. The adult's tokens here contain already a binary foot. So, the epenthetic vowel does not create a foot, but it changes an *iambic* foot into a trochaic one due to the latter being the unmarked in Greek. This change is also determined by the position of stress which remains stable. The same hypothesis is additionally shown from the remaining disyllabic tokens which are not loanwords (examples 12a - d).

	Adult's form	→ Child's form	Child: Age
12.	a. [a.ˈftos]	→ [a.{ˈti.os}] (him)	C1: 2;6.17
	b. [tir.ˈja]	→ [ti.{ˈɾi.a}] (cheeses)	C2: 2;2.24
	c. [fo.ˈtça]	→ [o.{ˈti.a}] (fire)	C2: 2;2.24
	d. [a.ˈftos]	→ [a.{ˈti.os}] (him)	C3: 2;5.8

However, the accomplishment of epenthesis is slightly different in these tokens in order for the rhythm to change. More specifically, the new syllable that arises from the epenthetic vowel is located in medial position, since these words do not have or bear an illegal consonant in final coda. This insertion triggers the movement of a consonant specified as [+anterior] to the onset position of the new syllable so as to be adjacent to the inserted vowel, which is also characterized as [+anterior]. The similarity of the distinctive feature of place between the resyllabified consonant and the inserted vowel seems to constitute a necessary condition for the emergence of epenthesis. In addition, the stress here needs to move to medial syllable for the alternation of rhythm and the creation of trochaic foot. It should be noted at this point that in most tokens other processes appear, such as the omission of consonants (10c, 11a - b, d, 12b - c), the simplification of consonantal clusters (11a - c, 12a, c - d), the substitution of some segments to others (10b, d, 11a, c). These processes do not affect the way epenthesis applies and for this reason they are not included in the discussion, since their investigation is beyond the scope of the present paper.

3.2. Analysis of children's data

According to Optimality Theory (Prince & Smolensky, 1993), *Universal Grammar* provides a set of constraints. These constraints are universal and in conflict, but their ranking is language-specific. The result of their conflict leads to the *optimal output*. The progression of children's linguistic development is viewed in this framework as constraint demotion. In initial stages, where children's structures are unmarked, *faithfulness* constraints are dominated by *markedness* constraints. In the intermediate phase, some faithfulness constraints are dominated by markedness ones, while in the final phase, all faithfulness constraints dominate markedness, as in adult's grammar (e.g. Demuth, 1995; Kappa, 2002; Gnanadesikan, 2004). Markedness constraints are responsible for changes made in the *input* as they minimize the articulatory effort required for its production, while faithfulness constraints' aim constitutes the preservation of basic properties between input and output (Prince & Smolensky, 1993).

For the analysis of children's monosyllabic and disyllabic words with vowel epenthesis, we rely on the following constraints.

Markedness constraints

$CODACONDITION_{final}$: prohibits the licensing of particular features in final coda position (Beckman, 2004, p. 106). In our case, all consonants except for [s] and [n].

RHYTHMTYPE-TROCHEE: requires binary feet to be trochaic (Alderete, 1999, p. 40).

AGREE (ANTERIOR): demands [CORONAL] segments to agree in anteriority (Oberly, 2008, p. 48). In our case, the epenthetic vowel must have the same anteriority as the adjacent consonant.

Faithfulness constraints

DEPENDENCY-IO: every segment of the output has a correspondent in the input (McCarthy & Prince, 1995, p. 264). In other words, the insertion of segments that do not appear in the input is not allowed.

In the next table (1), some candidate outputs are presented, while the ranking which leads to the optimal outputs of children has the form $CODACOND_{final}$ >> RHTYPE-TR >> AGREE (ANT) >> DEP-IO.

Table 1
Vowel epenthesis in monosyllabic and disyllabic words

[bol][3]	$CODACOND_{final}$	RHTYPE-TR	AGREE (ANT)	DEP-IO
☞ [ˈbo.li]				*
[ˈbo.lo]			*!	*
[bo.ˈli]		*!		*
[bol]	*!			
[gol]	$CODACOND_{final}$	RHTYPE-TR	AGREE (ANT)	DEP-IO
☞ [ˈgo.li]				*
[ˈgo.lo]			*!	*
[go.ˈli]		*!		*
[gol]	*!			
[ka.ˈskol]	$CODACOND_{final}$	RHTYPE-TR	AGREE (ANT)	DEP-IO
☞ [a.ˈko.li]				*
[ka.ˈsko.lo]			*!	*
[ka.sko.ˈli]		*!		*
[ka.ˈskol]	*!			
[a.ˈftos]	$CODACOND_{final}$	RHTYPE-TR	AGREE (ANT)	DEP-IO
☞ [a.ˈti.os]				*
[a.ˈfta.os]			*!	*
[a.ˈftos]		*!		

Based on table (1), we can see how the same ranking of the constraints drawn for the present study can account for loanwords as well as non-loanwords uttered by the children. In particular, the first constraint disallows all loanwords with illicit consonant located in final coda ([bol], [gol], [ka.ˈskol]). The second higher ranked constraint leads to the rejection of all loanwords, in which epenthesis creates an iambic foot ([bo.ˈli], [go.ˈli], [ka.sko.ˈli]) and all disyllabic non-loanwords, in which the process of insertion is not applied in order for the type of rhythm to change ([a.ˈftos]). The third higher ranked constraint ensures that epenthesis is accomplished and simultaneously the inserted vowel bears the appropriate distinctive features required so as to match with the adjacent consonant and not to be, for instance, a copy of a nearby vowel ([ˈbo.lo], [ˈgo.lo], [ka.ˈsko.lo], [a.ˈfta.os]). So, as optimal outputs surface these, which satisfy all the aforementioned requirements and violate only the lowest ranked constraint due to the emergence of epenthesis ([ˈbo.li], [ˈgo.li], [a.ˈko.li], [a.ˈti.os]). This way, all kind of words presenting the process of vowel epenthesis can be adequately analyzed and interpreted within the Optimality Theory framework.

4. Novelties

This article focuses on a process that does not emerge frequently, namely, vowel epenthesis in Greek child speech and aims to contribute knowledge in a less explored environment, which is the handling of monosyllabic and disyllabic loanwords uttered by Greek-speaking children.

5. Conclusion

This research investigated vowel epenthesis in three Greek-speaking children so as to answer why they employ this process and in which environments it appears. The data examined

are longitudinal and lead to the following generalizations. Vowel epenthesis is traced in monosyllabic and disyllabic loanwords and non-loanwords. Regarding its properties, it is observed in medial or final syllable, while the quality of the inserted vowel is affected by the adjacent [CORONAL] consonant with which they bear the same place, that is, [+anterior]. It is a rare strategy, which the children prefer for several reasons. In monosyllabic loanwords it licenses an illegal consonant located in final coda position to the onset of the new syllable. In addition, it forms unmarked CV syllable and trochaic foot. The type of foot lies in the frequent stress pattern of the ambient language, which is considered trochaic. The same properties and reasons of its emergence are also ascertained in disyllabic loanwords and non-loanwords with the difference that the inserted vowel modifies the iambic foot into trochee. For the alternation of rhythm, the stress needs to remain stable in disyllabic loanwords, while it has to move to medial syllable in disyllabic non-loanwords. For the data analysis, Optimality Theory (Prince & Smolensky, 1993) is adopted, which is a constraint-based model. All the aforementioned observations of vowel epenthesis are captured via the constraints $\text{CODACONDITION}_{\text{final}}$, RHYTHMTYPE-TROCHEE, AGREE (ANTERIOR) and DEPENDENCY-IO in the same ranking, which is $\text{CODACOND}_{\text{final}}$ >> RHTYPE-TR >> AGREE (ANT) >> DEP-IO. It should be noted at this point that our findings concern only the children of the present study and we need more subjects to attest whether our generalizations are universal. Generally, more researches are required so as to examine the processes that appear in loanwords as well as their frequency of emergence, which are a less well studied theme in language acquisition in Greek and cross-linguistically.

Notes

[1] The numbers denote the age of the child. 2;9 for instance means two years and nine months.
[2] {...}: Denotes the foot's boundaries.
[3] As input we consider the adult's output, namely, the stimuli the children receive from their parents.

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Appendix

Child - C1

	Adult's Form	Child's Form	Age	Translation
1	tra.ˈkter	a.ˈte.li	2;4.29	tractor
2	a.ˈftos	a.ˈti.os	2;6.17	him
3	bol	ˈbo.li	2;8.21	bowl
4	bol	ˈpo.li	2;8.21	bowl
5	bʎax	ˈbʎa.ti	2;10.9	yuck

Child - C2

	Adult's Form	Child's Form	Age	Translation
1	gol	ˈgo.li	1;7.14	goal
2	gol	ˈgo.li	1;7.14	goal
3	tir.ˈja	ti.ˈɾi.a	2;2.24	cheeses
4	fo.ˈtça	o.ˈti.a	2;2.24	fire
5	ka.ˈskol	a.ˈko.li	2;3	scarf
6	ɾoz	ˈo.zi	2;3.2	pink
7	tra.ˈxter	ta.ˈθte.ɾi	2;6.20	tractor
8	ɾoz	ˈlo.ze	2;6.27	pink

Child - C3

	Adult's Form	Child's Form	Age	Translation
1	ɾo.ˈbot	o.ˈbo.ti	2;4.28	robot
2	a.ˈftos	a.ˈti.os	2;5.8	him
3	gol	ˈgo.li	2;7.6	goal

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