Exploring Derivation and Schwa Alignment in Tarifit Linguistics (the case of Nador)

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Abstract:

This study explores the intriguing phenomenon of schwa insertion in Tarifit, a Berber language spoken in Nador, Morocco. Employing the analytical lens of Optimality Theory (McCarthy & Prince, 1993; Prince, 1993), we delve into the specific patterns of schwa alignment within derived verbal and nominal forms.

Optimality Theory conceptualizes phonological production as an optimization process, and this research leverages the framework's concept of generalized alignment. The analysis, guided by the hypothesis that schwa insertion adheres to generalized alignment principles, particularly in biconsonantal and triconsonantal roots, reveals distinct patterns of schwa alignment in Tarifit.

These findings provide crucial insights into Tarifit's phonological processes, contributing to a deeper understanding of the language's underlying structure. Additionally, the study highlights the effectiveness of Optimality Theory, particularly generalized alignment, in analyzing schwa insertion within the Amazigh language family, paving the way for further investigation into these intriguing phenomena.

Keywords:

alignment; schwa; Tarifit of Nador; insertion; syllable; prosodic word; morphologic word.

1. Introduction:

This article delves into the role of alignment in shaping segment organization within Tarifit, a Berber language spoken in Nador, Morocco. Our theoretical framework draws from Optimality Theory (OT), as developed by (McCarthy, John J. Prince, Alan, 1993) McCarthy & Prince (1993), Prince & Smolensky (1993), and other linguists (René, 1999) (e.g., Benveniste, 1999).

1 The status of Tarifit

Tarifit, also known as Riffian Berber, belongs to the Afroasiatic language family. It is primarily spoken in the Rif region of Morocco. Let’s explore its consonant and vowel system:

Tarifit boasts a rich set of consonants encompassing voiceless and voiced stops (/p/, /b/, /t/, /d/, /k/, /g/), affricates (/t͡s/, /t͡ʃ/), fricatives (/f/, /s/, /ʃ/, /h/, /ħ/), nasals (/m/, /n/, /ɲ/), a lateral (/l/), a rhotic (/r/), and glides (/j/, /w/). Alongside these consonants, Tarifit utilizes a set of vowel phonemes (/a, i, u/) that play a role in shaping the structure and sound patterns of its syllables. The presence of schwa (/ə/) further adds complexity, with its status within Tarifit phonology remaining an area of ongoing exploration.

2 article Objectives:

This article tackles a gap in Amazigh language studies by delving into Tarifit's alignment phenomenon, particularly schwa insertion. We aim to analyze schwa placement within verbs and nouns using a novel, generalized framework that considers prosody, morphophonology, and phonetics. Through this analysis, we seek to answer key questions: what defines alignment in Tarifit, how it shapes the language's structure, and its overall significance. Our central hypothesis posits that schwa insertion is primarily driven by alignment, influenced by prosodic and phonetic needs. We propose that in roots with two or three consonants, generalized alignment takes precedence within the Phonological Template, overriding other constraints. This investigation aims to enrich the understanding of Tarifit phonology and its intricacies.

3 Literature Review: The Status of Schwa in Tarifit

The phonemic status of schwa in Tarifit has been a subject of scholarly contention, with divergent perspectives shaping the discourse. Proponents of schwa's phonemic status argue its indispensable role within Tarifit's phonological framework, highlighting its significance in syllable structure (F.Dell & O.Tangi, 1992) and stress patterns (Chami, 1979, Faizi R. , 2011). In terms of syllable structure, schwa serves as a nucleus, enabling the formation of varied syllabic configurations and influencing syllable weight, thereby contributing to the language's rhythmic patterns (M.Chtatou, 1980, Aissati, 1989). Moreover, schwa's presence or absence is instrumental in determining stress placement within Tarifit words, illustrating its phonemic relevance in lexical organization (Seghoual, 2002).

Conversely, an opposing viewpoint challenges the notion of schwa as a phoneme in Tarifit, emphasizing observations that question its distinct phonemic status (Boukus, 2009, Bensoukas, 2021, F. Dell, 1984, Elmedlaoui 2006 et all). Critics point out the absence of minimal pairs solely differentiated by the presence or absence of schwa, suggesting that schwa's occurrence does not alter word meanings independently. Instead, they argue that schwa arises from predictable vowel insertion processes within specific word-internal positions, functioning more as a predictable placeholder rather than an autonomous phonemic unit. Furthermore, discussions on moraic weight suggest that schwa lacks inherent heaviness within the syllable structure, influencing its role and prominence in Tarifit's phonological system (Bensoukas, 2013).

4 Methodology

This study adopts a qualitative methodology focused on examining the existing literature regarding the phonemic status of schwa in Tarifit. The research proceeded through several methodical steps. Firstly, a systematic literature search was conducted to gather relevant academic sources on Tarifit phonology and schwa from reputable databases and online platforms. These sources were then meticulously categorized based on their primary stance regarding schwa's phonemic status: either as advocates for its phonemic status or as proponents of an alternative perspective. Subsequently, each categorized source underwent a comprehensive content analysis to extract key arguments, supporting evidence, and reported findings concerning schwa's phonemic status. This analysis aimed at uncovering recurring themes, patterns, and trends across the literature. Finally, a critical evaluation was undertaken to assess the quality and validity of each source, considering factors such as the methodology employed, depth of analysis, and relevance to the research question. Through this systematic approach, the study seeks to provide a nuanced and insightful understanding of the ongoing debate surrounding schwa in Tarifit phonology.

5 Results and Analyses

Our analysis of the existing literature, and our collected data, yielded the following key findings regarding the phonemic status of schwa in Tarifit:

6 Epenthetic Nature of Schwa:

In Tarifit, the schwa serves as an epenthetic vowel, primarily introduced to alleviate consonant cluster (CC or CCC) sequences. Research indicates that schwa's insertion fulfils a pivotal role in adhering to the language's syllabic structure constraints. These constraints necessitate that each syllable begins with a consonant (Onset), avoids ending in a consonant (No-Coda), ensures that underlying segments are parsed in alignment with the syllabic structure (Parse), and mandates that syllable positions are occupied by underlying segments (Fill). Prince & Smolensky (1993) have highlighted these constraints, which collectively guide the systematic insertion of the schwa to maintain the phonological integrity of Tarifit words:

Table 1: schwa at the initial of the word is prohibited (ONSET, PARSE, FILL >> NO-CODA)

Input : /ʒn/	*ONSET*	*NO-CODA*	*PARSE*	*FILL*	*DEP-IO*
a. ☞ *ʒən*		*		*	*
b. *əʒn*	*		*	*	*

In these cases, schwa isn't part of the word's underlying structure and doesn't contribute to its phonological makeup. Optimality Theory (OT) explains this by stating that inserting schwa in the output would violate faithfulness constraints like DEP-IO (faithfulness to the input). While Candidate (1-a) violates NO-CODA, PARSE, FILL, and DEP-IO by omitting the schwa, it at least satisfies the crucial Onset constraint. However, Candidate (2-b), which attempts to force schwa into the **ONSET**, ends up violating all constraints.

7 The Insertion of Schwa in CCC Templates Interacts With *COMPLEX:

In Tarifit phonology, the insertion of schwa within CCC clusters is governed by a complex interplay of conditions. The [+Sonorant] condition requires schwa to be placed before the most sonorous consonant, while the *Complex condition demands that consonants form part of a syllable without creating complex segments. These rules, along with the FILL condition and a prohibition on final schwa, create a delicate balance in determining schwa placement.

*Table 2: the example of complex segments which are prohibitted, the example of / frn/ = PARSE, *COMPLEX >> COND-SON, DEP.*

/frn/verb	COND-SON	PARSE	*COMPLEX	DEP
a. ☞ **fər.n*	*			*
b. *frən*	!	*	*	*
c. *frn.ə*		*	*	*
d. *frn*		*	***!	*

From the table (2), we observe that schwa is inserted to avoid having [+syllabic] consonants. Thus, and for a schwa to appear at the output form and hence prevents [+syllabic] consonants, certain constraints must win, including:

(1)

a. ***ə:** *Assign a violation mark for each schwa in the output.*
b. **DEP*:*** *Assign a violation mark for any segment in the output that does not have a corresponding segment in the input.*

As shown in (2), epenthesis in Tarifit serves the purpose of avoiding open syllables with schwa and preventing syllabic consonants.

Let's examine the example */nbda/* meaning 'we have started,' pronounced as [nəbda], with [ə] inserted before the voiced obstruent [b]. It might be expected that [ə] should be inserted before [n], resulting in *[ənbda]. However, this form is not accepted by Tarifit speakers. Interestingly, in /nb.da/ 'we have started,' Tarifit speakers typically insert schwa before [b], resulting in the preferred form [nəb.da].

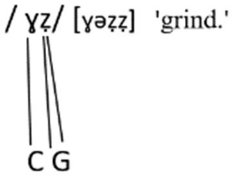
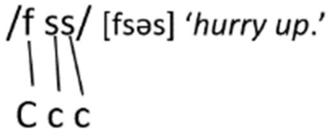
This observation suggests that, contrary to expectations, sonority ranking does not determine the site of schwa insertion in Tarifit. the main question that arises is: are there other factors than sonority that are responsible for the placement of schwa?

8 Schwa is inserted to satisfy alignment.

9 Schwa is controlled by alignment and not by Sonority constraints:

sonority plays no role in the placement of schwa in Tarifit. However, schwa is positioned before the loudest (most sonorous) consonant or between the last two consonants if they have the same sonority index. Here are some examples:

Table 3 the insertion of schwa and geminates

a. Exemples of : CəCC and CCəC	b. The real geminates :	c. False geminates :
[1] <u>CəCC :</u> Bədd " stand-up" Bəʃʃ "urinate" ɣezẓ "chew" **[2] <u>CCəC</u>** Ddəz " crush" wwət "ti hit" ffeɣ "go out"	 *Figure 1*: the example of /ɣẓ/	 *Figure 2*: the example of /fss/

Tarifit's phonological principles dictate that schwa insertion must respect geminate consonant clusters, in line with the established patterns of the language, as outlined by Tangi (1991) and Bouarourou (2014). Schwa is typically inserted before consonants that deviate from the traditional Amazigh CVC structure, as seen in words such as "ənqəb" from /nqb/. This reflects a tolerance for initial CC clusters and a preference for complex onsets.

In Tarifit, schwa placement varies it's positioned between two consonants in bi- and tri-consonantal roots, and it separates pairs of consonants in quadri-consonantal forms. The verb /frn/ illustrates that schwa insertion is influenced by sonority differences, resulting in a [CCəC] configuration when consonants differ in loudness. However, when consonants have similar sonorities, schwa is inserted between them, as in 'munən' and 'smən'. This suggests that factors other than sonority are involved in determining schwa placement in Tarifit and warrants further investigation.

10 The insertion of schwa is conditioned by alignment:

schwa is subject to restrictions in terms of where it can appear. For example, schwa is prohibited in the final position of every word in Tarifit. Also, according to (Chami, 1979), (Aissati, 1989), (Bensoukas k. , 2006) and. All) Tarifit banishes schwa to the final position of the sentence, which means that the schwa is not part of the peripheral vowels. However, the phonological structure of Tarifit is characterized by a distinctive approach to sonority violations, which are most observed at the beginning of prosodic words.

McCarthy and Prince's seminal work in 1993b highlighted the practice of initial epenthesis and its role in generalized alignment, where a schwa is inserted between the final two consonants of verbs to address sonority concerns. This technique is particularly relevant when the consonants have similar sonority levels. Within the framework of Optimality Theory (OT), Tarifit demonstrates a preference for respecting lower-ranked constraints over higher-ranked ones, suggesting that maintaining the structural integrity of verb alignments may take precedence over strict adherence to sonority sequencing.

Wheeler's SONORITY SEQUENCE (SONSEQ) principle, formulated in 2007, underscores the importance of a gradual increase in sonority from the onset to the nucleus, followed by a decrease towards the end of the syllable. For example, consider the verb /ns/, composed of the consonants [n] and [s]. The insertion of a schwa after [n] is in line with the SONSEQ constraint, demonstrating Tarifit's nuanced approach to phonological rules.

*Table 4: syllables should have nuclei= Biconsonantal Verbs: *NUC/C > DEP, SONSEQ, *ə*

/ns/[1]	Sonseq	*Nuc/C	DEP	*ə
a. ns		*!		
b. ☞ nəs	*		*	*

*Table 5: syllables with a schwa vowel are preferred= Tri-consonantal verb: *Nuc/C, *COMPLEX, PARSE-SEG >> DEP, *ə, SONSEQ.*

Input: /ʒiwn/	SONSEQ	*Nuc/C	DEP	*ə	*COMPLEX[2]	PARSE-SEG
a) ʒiwn	*!	*			*	*
b) ☞ ʒiwən			*	*		

The constraints presented in table 4 elucidate why schwa must be positioned in one location rather than another. And Empty structures are actively avoided in Tarifit, as highlighted by (Tangi, 1991) to prevent any potential complexity in the relationship between base and surface forms. This avoidance extends to the phonetic realization of unparsed elements, following the Stray-Erasure convention.

It is important to note that these constraints alone cannot rule out candidates that would insert schwa in the absolute final position of the word, leading to *[nsə], *[jiwnə], or initial *[əns]. For this reason, Tarifit prohibits schwa in open syllables and generally disallows it at the word's beginning due to constraints against initial deletion or insertion: Indeed, in OT, this has different extensions, notably:

(2)

A. ***ə]σ:** *The schwa does not appear in an open syllable.* (MacBride, 1996)

B.***FINAL-ə:** The /ə/ never occurs at the right edge of a prosodic word or phrase.

The constraint *ə]□ explains why schwa fails in open syllables as observed in prior studies ((Guerssel M., 1978); (M.Chtatou, 1980); (Tangi , Dell, 1992). The hierarchical constraint Align disallows schwa in open syllables (*ə] σ) because it requires a Coda. And the constraint in (8) means that epenthetic schwa is limited to closed syllables, excluding open ones. Consequently, schwa is often restricted in various structures, leading to several requirements, such as:

(3)

(a) **#[ə] may not appear at beginning of the word.*

(b) *[ə] must occur in closed syllables.*

The prohibition of schwa in open syllables arises from a conflict between two alignment constraints: ALIGN-C, which favors syllables ending in a coda consonant, and Align-V, which prefers syllables ending in a full vowel (not [ə]). This hierarchy emerges as a result:

(4) ALIGN-C$^{\sigma}$ >> ALIGN-V$^{\sigma}$ >> *ALIGN ə]$^{\sigma}$

This ranking prioritizes closed syllables in Tarifit, meaning that syllables necessitate a coda consonant as favored by ALIGN-Cs. If this is not feasible, the alignment constraint ALIGN-Vσ permits full vowels to occupy the syllable. Finally, the last alignment constraint, *ALIGN-ə] Ơ, prevents any occurrence of schwa in open syllables:

Table 6:schwa in open syllables is prohibited= ALIGN-Cơ >> ALIGN-Vơ >> *ALIGN Ə] Ơ

INPUT : /ny/	ALIGN-Cσ	ALIGN-Vσ	*ALIGN ə] σ
a. nyə	*		*
b. ☞ nəy		*	

1.1.Complex Segments Controls Schwa Alignment:

In Tarifit, complex prosodic segments are licensed [3] at the beginning of a word, whose prosodic licensing effects of a complex segment can then be implemented as alignment constraints. The constraint required for this case is the following:

(5) *"All complex segments can be found at the left edge of the prosodic word, i.e., in the initial position. Violations are evaluated for each segment that occurs between the complex segment and the left edge of the word."* *(Zoll, 1997, p. 267).*

In Tarifit, following prosodic licensing theory, complex segments at the root edges may be governed by alignment constraints. These constraints mandate that the word's periphery must either begin or end with a complex segment since complex segments are authorized at word edges. This constraint can be expressed as an alignment constraint formula, as outlined below:

(6) ***ALIGN-L (Complex segment, PrWd): Complex segments are initial.***

Formally:

"∀complex segments ∃prosodic word as a complex segment Coincides with the leftmost segment of the prosodic word." (Zoll, 1997, p. 267)

This constraint mandates that all complex segments must be positioned at the word's initial position, which is the left edge of the prosodic word. It assesses any violations for each segment occurring between the complex segment and the word's left edge. The reverse constraint can be expressed as follows:

(7) ***ALIGN-R* (Complex Segment, PrWd):**

Complex segments are final in the word.

Formally

∀ Complex segments ∃ Prosodic word such as a complex segment Coincides with the rightmost segment of the prosodic word.

The constraints in (6) and (7) must be outranked by *Complex, which restricts complex margins. This aligns with the pattern observed in Tarifit, where complex margins are permissible but necessitate the rearrangement of non-underlying affix materials.

Let's see how these constraints interact in the following table:

Table 7:Absence of a complex segment: /ʒiwn/

Input /ʒiwn/	ALIGN-R (Segment Complex, PrWd)	ALIGN-L (Segment Complex, PrWd)	*ə] σ
1. ☞ ʒiwən	*	*	
2. ʒiwn		*	
3. ʒwən	*		

Table 8:The presence of a complex segment (verb]#): /bdd/

Input : /bdd/	ALIGN-R (Complex Segment, PrWd)	ALIGN-L (Complex Segment, PrWd)	*ə]σ
a. ☞ bədd		*	
b. bdəd	*		
c. bəddə	*	*	

Table 9: A complex segment at the left edge: the exampleof /s+bdd/

Input : /s+bdd/	ALIGN-R (Segment Complex, PrWd)	ALIGN-L (Segment Complex, PrWd)	*ə]σ
a. ☞ sbədd			
b. səbədd	*		
c. səbdədə	*	*	*

An alternative alignment approach, suggested by (Karim Bensoukas & Abdelaziz Boudlal, 2012), aims to insert schwa before the final consonant in CCC roots. To achieve this, they introduce an alignment constraint called Align-R-σ-Maj, which mandates that the right edge of the root aligns with the right edge of a major syllable. The relevant constraints for accommodating epenthesis in CCC roots and their hierarchies are provided below:

(8) "MAX, PARSE-SEG, *COMPLEX, ALIGN-R-σ-MAJ> DEP > *MIN-σ > NO-CODA."

Karim Bensoukas; Abdelaziz Boudlal (2012)

Bensoukas & Boudlal (2012) propose that a constraint called "Align-R-σ-Maj" takes priority over a constraint called "DEP" in Tarifit. This forces schwa to be inserted between the last two consonants of three-consonant words. They argue that prioritizing "DEP" ensures schwa doesn't appear in open syllables (like *Cə.CəC), while allowing forms like C.CəC (with a minor syllable on the first consonant). However, this solution violates another constraint.

Boudlal (2001) offers a contrasting view for Moroccan Arabic. He argues that schwa appears before the third consonant (C3) in CCC roots, not the second (C2). This, according to Boudlal, is due to a preference for an "iambic radical structure" (think alternating stressed and unstressed syllables). Instead of "Align-R-s-Maj," Boudlal proposes "Align-R-," which aligns the schwa syllable to the right of the word stem and places the minor syllable at the beginning, as seen in words like [c.məz] ("scratch"). In Tarifit CCC clusters, the optimal placement, according to Boudlal, features a minor syllable at the word's left edge.

*Table 10: the example of /fsr/= Align-R- ơ-Maj >*Complex, DEP, *Min-ơ, *Coda.*

Input : /fsr/	**Complexe*	*Align-R-ơ-Maj*	**Min-ơ*	**Coda*
a. *fəs.r^{u}*		*!	*	*
b. ☞ *f.sər*			*	*
c. *fsər*	!			*
d. *fəsr*	!			*

We have noticed in this table that schwa cannot be in an open syllable since this violates the Align-R-ơ-Maj constraint. In this sense, the Align-R-ơ-Maj constraint not only ensures the correct epenthesis of the schwa in CCC roots, but also prevents this epenthesis from taking place after the final consonant of the stem. Note again that schwa in open syllables could be excluded for violating another constraint prohibiting schwa in open syllables *ə] ơ, which prevents outputs like:"*fsere «spread» , *nqebe «pecking.»

The alignment constraint responsible for complex segments like *fser* which **fs*, **nq*could have many extensions, these extensions can be formulated as follows:

(9)

1. Align- R-CC|	2. Align-L-|CC-
ALIGN-R (Segment Complex, PrWd) = Align (CC|, R, Root, R) ➔ *A root must end in a complex segment.*	*ALIGN-L (Segment Complex, PrWd)* = ALIGN (CC, L, Root, L) ➔ *The verb stem begins with a complex segment.*

According to the effects of alignment in (9), complex segments are initialized in the radical /ssn/ in (table 10), the complex segment #ss- is optimized in the initial position of the verb [ssən] as shown in (table 10) and (table 11):

Table 11: Align-L-|CC- >> Align- R-CC|: the example of /ssn/

/ssn/	*Align-R-CC|*	*Align-L-|CC-*
a. ☞ ssən	**!*	
b. səsn		*!*

Table 12: Align- R-CC| >> Align-L-|CC- : the example of / ɣẓẓ/

/ɣẓẓ/	*Align-R-CC|*	*Align-L-|CC-*
a. ☞ *ɣəẓẓ*		**!*
b. ɣẓəẓ	**!*	

In this context, we should stress that constraints such as Align (σ,L,C,L) and Align (σ,R,C,R) are constraints applied only to syllables, but we need another constraint that specifies the nature of the word on which the alignment has effects, therefore, other relevant constraints should be incorporated into a Tarifit grammar.

To derive the correct output, we have introduced the following constraints:

(10) **<u>Constraints for the imperative verb /bdd/ :</u>**

- ✓ ***FINAL-C*** : *The word in Tarifit ends in a consonant.*
- ✓ ***ALIGN-L (#|CC-, L, PrWd, L):*** *The left edge of the verb*^{CCC} *starts with a Complex Onset* #dd-.
- ✓ ***ALIGN-R (-CC|#, R, PrWd, R):*** *The word ends with a complex coda* ***dd***.
- ✓ ****PARSE:*** *Block the schwa epenthesis to avoid splitting geminates in words like [bədd].*

Let's have a look at the following table:

*Table 13:ALIGN-R-COMPLEX-SEGMENTS- >> ALIGN-L - *COMPLEX-SEGMENTS: the example of /bdd/*

<table>
<tr><th>Input : /bdd/</th><th>ALIGN-R (-CC|#, R, PrWd, R):</th><th>ALIGN-L (#|CC-, L, PrWd, L):</th><th>Align (σ,L,C,L) = Onset</th><th>Align (σ,R,C,R) = coda</th><th>*complex Onset[4] = *Verb [CCons</th><th>*complex coda = *CC] verb</th><th>FINAL-C</th><th>*PARSE</th><th>PARSE-C</th></tr>
<tr><td>a. bəd<d></td><td>*</td><td>*</td><td></td><td></td><td></td><td>*</td><td></td><td></td><td>!</td></tr>
<tr><td>b. ☞ bədd</td><td></td><td>*</td><td></td><td></td><td></td><td>*</td><td></td><td></td><td></td></tr>
<tr><td>c. bdəd</td><td>*!</td><td></td><td></td><td></td><td>*!</td><td></td><td>*</td><td>*!</td><td></td></tr>
</table>

A distinction is made in Tarifit between verbs containing true geminates (they are contiguous, inseparable by the constraint of contiguity) and false geminates (they are separable by the insertion of schwa) of the pattern: biconsonantal (CC:) and triconsonantal (CCC), for example:

Table 14: True and False geminates

A. True Geminates		**B. False Geminates**	
məll	*"disgust"*	**mrər**	"white"
ɣəẓẓ	*"to eat hardly."*	**zded**	"thin
bedd	*"to stand up"*	**fsəs**	"light"
bəʃʃ	*"to urinate*	**lɣəɣ**	*"don't be harsh"*

In the examples in the table 14 the schwa splits the false geminate (table 13-C), while the true geminates are ignored (14-b). This is because the schwa insertion skips the place occupied by a true geminate. In the table 14 schwa does not split true geminates in the table 14-A, but in 14-b schwa does not split geminates but it is inserted into two consonants of the same type.

11 The epenthesis preserves the alignment, not the sonority:

In Tarifit, schwa epenthesis functions to maintain the structural integrity of morphological units, a concept emphasized by Kager (1999, p. 110). These units serve as prime locations for the insertion of an epenthetic segment, often found at morpheme boundaries. McCarthy and Prince (1993b, p. 2) have proposed alignment constraints to elucidate this phenomenon. These constraints ensure that a specific edge of each Cat1 prosodic or morphological constituent aligns with a designated edge of some Cat2 prosodic or morphological constituent. Such constraints are pivotal in preserving the organizational coherence of Tarifit, enabling the smooth incorporation of epenthetic segments within morphological confines:

(11)

a. **Align-Right:** **Align (Root, R, σ, R)**
"The right edge of the radical coincides with the right edge of a syllable" ➔ (end of PrWd)".

b. **Align-left:** ***Align (Root, L, σ, L)***
"The left edge of the radical coincides with the left edge of a syllable" ➔ (initial of PrWd)."

Consider the following example:

Table 15: the example of /n-bda/

input	*Insertining a schwa*	*Translation*
/n-bda/	*[nəb.da]*	*"We begin'.*
/n-fsr/	[nəf.sar]	"We exhibit'.
/n-ʃana/	[nəʃ.na]	"We are nice'.

This can also be explained by the requirement of Onset, i.e., a syllable containing schwa requires an Onset (no initial schwa without Onset):

*Table 16:Align-L > *ə [s =the example of / n-ɣza/*

/n-ɣza/	*Align-L*	*ə[σ*
a- ☞ [/nəɣ.za		
b- [ə/nɣ.za	*!	*

The above evaluative table in (16) shows that violating a Sound constraint is preferable for ensuring the success of the hierarchical Align-L and for ensuring an Onset for schwa. In other words, the epenthesis respects the alignment constraint and not the soundness, which enforces the optimality of (16-a).

12 Contiguity Controls the Alignment Of Schwa :

The restriction against placing schwa at the very end of a word is enforced by a generalized alignment constraint proposed by (John J. McCarthy, Alan S. Prince, 1993). This constraint necessitates aligning the right edge of the morphological word with the right edge of the prosodic word. This alignment rule ensures the preservation of the morphological word's integrity by preventing epenthesis at word edges. The constraint is expressed as follows:

(12)Align **(PrWd, R; *PrWd*, R):** *"∀x∃ y such that x is a morphological word and y is a prosodic word, in which the rightmost edge of x coincides with y."*

'coincide' requires that the final segments which have morphological affiliation overlap with the final segment dominated by the prosodic word. This implies that epenthesis will result in a violation of the alignment of (MWd[5] , R), as the epenthetic segment will 'intervene' between the edge of what constitutes the morphological word and the edge of the prosodic word. This constraint, in practical terms, is the same as that of Edge integrity1 ((Kang, 2002, p. 52) :

(13) EDGE INTEGRITY (*MCAT*, PCAT):

A segment at the edge of a morphological constituent (M^{CAT}) should be at the edge of a prosodic constituent (P^{CAT}), whose edges may be left, right, or both.

Based on our data, the Align constraint (MWd, R; PrWd, R) restricts schwa epenthesis at the word's end but not within the word. The evidence presented in this section indicates that *ə]σ was primarily employed to prevent epenthesis in the final position in Tarifit.

Table 17:Align (MWd, R; PrWd, R): the example of /ns/

input: /ns/	***Align (MWd, R; PrWd, R)***
a. ☞ *nəs*	
*b. *nsə*	***!**

The Align constraint (MWd, R; PrWd, R) supports candidate (table 17-a) and accommodates schwa epenthesis through cyclic parsing. This suggests a potential replacement of *ə]σ. The constraint likely governs the right epenthesis site, potentially outweighing the restriction on schwa in open syllables. Our article emphasizes the prohibition of schwa at word boundaries in Tarifit.

(20) ALIGN: *The edges of each word are not subject to change.*

The alignment is sufficiently hierarchical with that of Parse-C which will block the deletion of consonants at the end of the word. To illustrate this, I will present the following table to simplify this effect of alignment on schwa:

Table 18:The ranking: ALIGN, PARSE-C : the example /qbr/

input /qbr/	*ALIGN*	*CONTIGUE*	*PARSE-C*
a. *x.ba. <r>*	*!		*
b. *<.ba. <r>*	**	**	**!
c. *q<b>a.r*		*!	*
d. *qə.ba.r*		*	
e. ☞ *q.bar*			

We observe in (table 18-a) that the edge (r) is deleted, altering the right edge. However, in (table 18-b), neither edge is altered, making it the winning candidate. Meanwhile, candidate (table 18-c) violates alignment by introducing a new segment at the word's right edge. For further exploration of this topic, we consider a new constraint in the last table, referred to as "contiguity":

(14)**CONTIGUITY**:

> *"Contiguous segments in the lexical representation of a morpheme are contiguous in the output. In other words, if /...xy.../ are contiguous in the lexical structure, [...xay...] should be avoided in the prosodic structure, where [a] is either [■] (epenthetic material) or <a> (subanalytic content)."*

Contiguity gives preference to [nəɣ] over [nə<ɣ>] and forbids the division or omission of adjacent segments within the base form. We can delve deeper into this premise using the subsequent table.

Table 19: the example/nɣ/

Input: /nɣ/	ALIGN	PARSE-C
a. .nə. <ɣ>	*!	*
b. ☞ .nəɣ.		
c. .nə.ɣə	!*	

In Tarifit phonology, non-syllabic consonants are preserved through vowel epenthesis, with the prioritization of Parse-σ over FILL to prohibit deletion (■). This hierarchy ensures that epenthesis protects non-associated consonants from deletion, but it doesn't specify the location of the epenthetic vowel association.

Table 20: PARSE-σ >> FILL = the example /ʃnf/

Input : /ʃnf/	PARSE-σ	FILL
a. ☞ ʃ.nəf		*
b. <ʃ> nəf	*!	

Given the discussion on word alignment and boundaries, Tarifit employs schwa epenthesis to maintain stray consonants (those not associated), prioritizing constraints that prevent unassociated or non-syllabic consonants (Parse-C) over those that avoid epenthesis (Fill). However, the positioning of the epenthetic vowel in Tarifit is also influenced by additional constraints. Certainly, as demonstrated by the data in (15), a schwa occupies the void (empty slot) between the morphemes.

(15)

/C C +C^{123} / → [C C^{12} əC^{3}] (i.e., [*ddəz*]):

|***CC is*** *a geminate at the left edge of the root.*

In Tarifit, vowel placement is reliably determined by alignment constraints, while contiguity helps identify the spaces between consonants where Align inserts a schwa. Essentially, the uncertainty in syllabification of stray consonants (whether they function as Onsets or Codas) hinges on their association with either the first or second morpheme:

- If the stray consonant (C2) is affiliated with the first morpheme (C1), a schwa (ə) is added after C1, creating a new compound consonant (C1 ə C2).

- If the stray consonant C3 belongs to the second morpheme C2, a schwa is inserted before C2, resulting in C2 ə C3. This insertion takes place within the morpheme gap, assuming contiguity governs segment ordering across all morphemes, irrespective of lexical specifications.

Consequently, regarding word boundaries, contiguity predicts that the inserted schwa must appear at the word's edge, as observed in examples like #əCC and əžžu 'prick' and əẓẓu# 'plant'.

Moreover, the selection between #CəC and #əCC is influenced by syllable marking constraints such as Onset ("prefer syllables with onsets") or No-Coda ("avoid syllables with codas"). These constraints dictate whether the schwa is placed within the initial consonant cluster or not. For instance, bi-consonantal roots like "eat" and "leave" compel the schwa to the word's initial edge, thus satisfying the constraint *Onset while violating the constraint *Coda.

Table 21: the exampleof /CC/ templates

Input /CC/	*Onset*	**Coda*
a. ☞ *əʃ.ʃ*	*	*
b. ʃəʃ		*

If Contiguity takes precedence in Parse-C, the Onset constraint alone cannot ensure the preference for #CəC over #əCC as illustrated in the table 22.

Table22: the example /mnɣ/

Input : /Mnɣ/	*ALIGN*	*ONSET*	*CONTIGUITY*	*PARSE-C*	*FILL*
a. mənəɣ			*!		*
b. ☞ *<m> nəɣ*	*!			*	
c. əmnəɣ	*	*		✓	*

The input /mnɣ/ results in [mənəɣ] (22 -a), [<m> nəɣ] (22 -b), and [əmnəɣ] (22 -c). In [mneɣ], the initial consonant meets Onset and Contiguity constraints, but in [məneɣ], Contiguity is violated, making candidate (Table 22 -b) optimal.

13 Epenthesis Of Schwa and The Alignment Of Word Edges:

When analyzing word boundaries, Contiguity implies that the epenthetic schwa should be positioned at the edge of the word, evidenced by *#ƏCC and *CCƏ#. However, Tarifit deviates from this prediction, disallowing the occurrence of schwa at either edge (neither left nor right) of the word. This deviation corresponds with constraints that mandate the alignment of prosodic and morphological edges, where alignment denotes the coincidence of these edges:

(16)

"An edge E1 of a category C1 coincides with edge E2 of category C2, if E1=E2 and feature F1 dominated by E1, a feature F2 dominated by E2, such that E1=E2 and dominated by E2, F1 dominated by E1, such that F1=F2."

In our analysis, we find strong evidence that phonological word edges in Tarifit rarely undergo vowel epenthesis, as processes like this never introduce a schwa vowel at the word's edge. This suggests the presence of an alignment constraint on word edges in Tarifit, where two edges coincide if they are identical. For example, the preference for #CƏC over #ƏCC aligns with expectations regarding syllable marking. Constraints like Onset and No-Coda compel the schwa inside the initial consonant group.

(17)

/fss/ ➔ [fsəs] but not ➔ [fəsəs]

/nqb/ ➔ [nqəb] but not ➔ [nəqəb]

In summary, Tarifit's insertion of schwa is guided by Contiguity, placing the schwa between morphemes, and Alignment, which positions it within a cluster of initial consonants [[6]].

(18)

a. a.mən.ɣi "the fight”
b. am.nəɣ.i “the fight”

In the example (18-a), the preferred syllabification of the VCCCV form is V. CƏC.CV, while in the second example (18-b), VC. CƏC.V is favored. However, Tarifit speakers reject the latter and accept the former, indicating a preference for inserting the schwa between the first and second consonants. This choice is optimal as the schwa naturally seeks out an available space between consonants, facilitating smoother pronunciation. Tarifit speakers consistently favor CƏCC over CCƏC, suggesting that when a word ends in a cluster, the schwa typically finds its place between the second and third elements. This tendency ensures that complex segments are anchored to the right edge of monosyllabic words, a pattern supported by alignment constraints. Nevertheless, alignment constraints do not preclude schwa insertion within initial or final consonant clusters, allowing its presence at word edges. Additionally, in Tarifit, a fidelity constraint mandates that the initial phoneme of the input form matches that of the output form, ensuring alignment between lexical and prosodic structures.

14 The placement of the epenthetic element on the left or right

The contrast between the directional correspondence of the templates, on the one hand, and these alignment constraints, on the other, is interesting. The leftward template match places the epenthetic vowel between the first and second elements of the tri-consonantal group. The rightward template match predicts the opposite, as follows:

(19)

A. **RIGHT-TO-LEFT :**

- amrqi➔ amr [qi]➔ a[mƏr][qi] ➔ [a][mƏr][qi]

- CCC ➔ C[CC] ➔ [C][C■C]

B. **FROM LEFT TO RIGHT :**

- Amrqi➔ [am]rqi➔ [am][rƏ]qi➔ [am][rƏ][qi]

- CCC➔ [C■C]C➔ [CC][C]

As a rule, Tarifit prevents consonants from clustering in Onset and Syllable Codas. Indeed, if they are followed by a vowel, the clustering in #CCC# roots are presented as a sequence of Coda plus Onset.

15 *Align in verbs of the template #__CC # :*

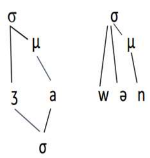
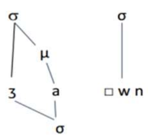
Another pattern we need to examine is the foot initial in the case where a schwa appears in the syllable penultime (in the position after the initial position, the second Position), for example in /rqf/ of the template /CCC/ there are triconsonantal sequences which must be broken somewhere. Thus, /rqf/ is a #CCC# template where the epenthetic vowel is located between the final consonants of the word.

This vowel is inserted inside the root, thus preserving the alignment. In the sequence /ʒawn/ 'assuage' we have a complex segment at the end that needs to be analyzed, so an epenthetic vowel should be between #___w_n# thus preserving the alignment of the template because the end of the syllable is 'n':

Figure 3: The syllable of the penultimate schwa: the example of /ʒawn/

the closed syllable shares space with the following Onset:

Table 23:the example of /ʒawn/

Candidate	Template	Aligne-T (T=trait)
The Output Template **(The optimal output)** ☞		
The Output Template		*!

In this case, there is a way to satisfy all the constraints mentioned. We can insert a schwa into the core; in word-end position, this schwa should be inserted at the end of the template, thus violating the alignment, but in word-initial position, the schwa is inserted after the consonant so that the alignment is not violated.

The fact that the edges of prosodic words in Tarifit remain unsyllabic that consonants are placed in a degenerate syllable at the end of a word. This explains the distribution of 'superheavy' syllables in the Tarifit, which occur only and in most cases at the end of some word.

The epenthetic vowel can always be predicted from the alignment constraint in interaction with PARSE and FILL [7] .

(20)

a. **PARSE:** *Avoid removing root nodes (segments).*

b. **FILL :** *avoid epenthesis.*

16 *Alignment through the MINOR syllable (σ^{min}):*

A mora is a phonological unit that defines syllable weight. A syllable with one mora is light (minor), while one with two is heavy (major). This distinction is governed by two specific alignment constraints.

(21)

a. **Align (root, R, σ, R):**
The right edge of the root should be aligned with the right edge of the syllable.

b. **Align-R- σ-MINOR [8]** :
The right edge of the radical aligns with the right edge of the minor syllable.

Let's look at the prosodic representation of the word *rqəf* :

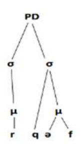
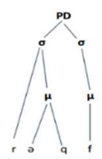
a.PrWd	***b.PrWd***
	

Figure 4: /rqf/

The observation that Tarifit prevents the schwa from bearing a Mora is well-established and supported by alignment constraints (for further information, refer to Bensoukas, 2006). This constraint arises from the inability of the schwa to carry or attract accentuation within a syllable containing it. Consequently, syllables containing the schwa vowel are considered light, contrasting with full vowels which are heavy. Let's examine this perspective further through the following table:

*Table 24:*COMPLEX, ALIGN-R-s -Min, ALIGN (ROOT, R,σ,R)>> *s -Min, DEP-IO the example od /rqf/*

Input : /rqf/	**Complex*	*Align (Root,R, σ,R)*	*Align-R-σ-Min*	*DEP-IO*	** σ-Min*
a. ☞ r^{μ} .$q\text{ə}f^{\mu}$	√	√		*	*
b. req^{μ} .f^{μ}	√	*!	*!	*	
c. *rqəf*	*!	√	*!	*	
d. *rqf*	*!	*!	*!		*!

Another pattern we need to examine for the initial foot is when a schwa appears in the peninitial syllable, including loanwords.

17 The insertion of the penultimate schwa and its alignment:

18 Loan Words :

The examples of TN cited here in (22-a), show that the last CC clusters in #CaCC# loans attract schwa insertion:

(22)

/εayn/	➔	*[εa.yən]*	*"Wait".*
/εawd/.	➔	*[εa.wəd]*	*"Narrate".*
/qadʃ/.	➔	*[qa.dəʃ]*	*"To be combed"*
/εawn/.	➔	*[εawən]*	*"Help".*
/samḥ/.	➔	*[saməḥ]*	*"Forgiv"*
/dafε/.	➔	*[dafəε]*	*"Defend".*
/εand/.	➔	*[εanəd]*	*"Insist".*
/farq/.	➔	*[farəq]*	*"Divide and conquer"*

We observe that in the verb εanəd for example, the schwa is inserted between the last consonants -CC# of the stem, thus resolving the appearance of complex segments and all this is due to the general principle of the correct formation of the template structure in Tarifit.

19 Penultimate in the imperative-causative verbs:

The examples in (23) also show that the last /-CC#/ group in Tarifit attracts emphasis in the #sicc# and #SIC:C# template:

(23)

/sidf/	[sidəf]	"Getting into".
/sidf/	[siwəl]	"Talking"
/siry/	[sirəy]	"Bringing it up"
/sizzl/	[sizzəl]	"Liquidate".
/sigg^{w}j/	[sigg^w əj]	"Distancing"

To evaluate the effect of alignment in these exemples, the following relevant constraints in (24) can interact to produce the best and most correct candidate according to the Tarifit of Nador:

(24)

a) ***əµ:**		The syllable in schwa is without Mora and cannot contribute to the weight of the syllable by Mora.
b) *µ/a, *µ/u,*µ/i :		Full vowels are prohibited from having a Mora.
c) **Align-R-C^µ:**		The right edge must be a moraic consonant.
d) **Align-Right -V (σ, V):**		The constraint Align-Right-V (σ ,V) is widely decoded as "NOCODA", which requires that a syllable be aligned to the right of a vowel (i.e. be open), this requirement does not mean that every syllable must end in a vowel, but that every vowel must end in a syllable and that this requirement is violated by every diphthong and by every long vowel.
e) **ALIGN-Left-C (Onset):**		Requires each syllable to be aligned to the left, with a consonant (have an Onset), it is violated by any complex Onset (as well as by codas, whether simple or complex).

To assess the interplay of these constraints in (24), let's analyse the word /*sizzl*/d within the context of the following hierarchical constraints.

*Table 25:*əµ , Align-R-Cµ , DEP-C >> Align-R-V, Align-L-C, *µ/a,*µ/u,*µ/i = the example of / sizzl/*

INPUT: /sizzl/	*$ə^{\mu}$	Align-R-C $^{\mu}$	DEP-C	ALIGN-L- C	*µ/a,*µ/u,*µ/i	ALIGN-R-V
a) $siz^{\mu}.əl^{\mu\mu}$	*!		* !	*!	√	*
b) ☞$si.z^{\mu.\mu}.zəl^{\mu}$	√	√	√	√	*	**!
c) $siz^{\mu}.zə\ l^{\mu\mu}$	*!	√	√	√	√	**
d) $siz^{\mu}.zə^{\mu}$	*!	*!	*	*!	√	*

This table focuses on two-syllable words (σσ) with a full vowel (/i/) in the first syllable and an epenthetic schwa ([ə]) on the second syllable. Candidate (25-b) emerges as the optimal choice because it satisfies three key constraints: (1) *No Moraic Schwa (*əµ): This constraint prohibits schwa from carrying a mora. (2) *Align Moraic consonant Right (Align-R-Cµ): This constraint aligns moraic consonants (consonants contributing to syllable weight) to the right edge of the word or stem. And (3) Faithfulness (DEP-C): This constraint prioritizes maintaining the input consonants without deletion.

These constraints working together to prevent constraints like "Align Left Consonant (Align-L-C)" or constraints against moraic full vowels (*µ/a, *µ/u, *µ/i) from taking precedence. The concept of moraic alignment helps to identify the optimal candidate by prioritizing constraints that keep schwa away from the word's edges, ensuring it aligns correctly within the syllable structure.

*Table 26:*əµ , Align-R-Cµ , DEP-C >> Align-R-V, *µ/a,*µ/u,*µ/I, DEP-C= the example of /bʃʃ/*

Input : /bʃʃ/	Align-R (imperative, R, $ə^{\sigma}$, R)	*PARSE	*GEM	MAX-GEM
a) ☞ bəʃʃ	*		*	
b) Bʃəʃ		*		*

As we can see in Table 26 the same ranking in *Table 26* gives us the optimal candidate in (*Table 26*-b), since verbs with the template (#SiCC#) such as the verb '*sidəf*' 'to bring in' containing two syllables (##), the first one is initial and it is open because it ends with a vowel and the second one is closed and it has a schwa as syllable nucleus. Moreover, it ends with a consonant and consequently the candidate (*Table 26*-b) is the optimal one, since it satisfies the ranking **ə^µ^, Align-R-C^µ^ , DEP-C >> Align-R-V, *µ/a,*µ/u,*µ/I, DEP-C*. This ranking is therefore a powerful tool in the Tarifit because the optimal candidate always satisfies this ranking.

20 Geminates (C: #) and alignment in the imperative forms:

In the imperative forms, with final geminate groups, the schwa is between the CC#:

(25)

/bdd/	=>	[bəd.d]	"Stand up, stop »
/bʃʃ/	=>	[bəʃ.ʃ]	"Urinating »
/fss/	=>	[fəs.s]	"Be faster".
/ɛss/	=>	[ɛəs.s]	"Be careful"
/ẓmm/	=>	[ẓəm.m]	"Writing, taking notes. »
/ʃdd/	=>	[ʃəd.d]	"Catch. »
/qss/	=>	[qəs.s]	"Cut, divide »

Imperative verbs with final geminates, as shown in (25), resist geminate splitting at the right boundary, contravening the alignment constraint Align-R (imperative, R, əσ, R). Consequently, verbs like /bdd/ are syllabified as [bəd.d] and /ɛss/ as [ɛəs.s], wherein the alignment is breached by preventing -dd# from accepting [ə] as an inserted segment. However, due to the lower ranking of Align-R (imperative, R, əσ, R), any /CCC/ is syllabified as [CəC.C], featuring a CVC pattern at the left rather than the right edge of the foot. The interaction will be elucidated in the forthcoming table.

Table 27:the example of /sidf/

Input: $si^{\mu}d\partial^{\mu}f$	**ə^µ^*	*Align- R-C^µ^*	*DEP-C*	*Align-R-V*	*Align-L -C*	**µ/a,*µ/u,*µ/i*
a) *$si^{\mu}.\partial^{\mu}f^{\mu}$*	* !	*	*	*	*	*
b) ☞ *$si^{\mu}.d\partial f^{\mu}$*		*	√	*	√	*
c) *$si^{\mu}.d\partial^{\mu}f^{\mu}$*	*	*	√	*	*	*
d) *$si^{\mu}.d\partial^{\mu}$*	*!	*!	*!	√	*	*

For words like CCC without geminates, we assign a CVCV template to each unsyllabified CC sequence from right to left (note that V is interpreted as a schwa):

21 the choice is between the rightmost groups of -cc#, (i.e., the right cc is not a geminate):

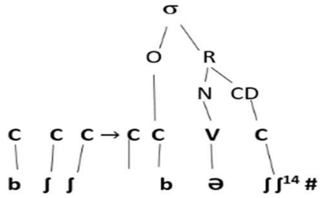


Figure 5: the example of /nqb/

22 the schwa is between the leftmost cc# groups (i.e., the right cc# is a geminate):

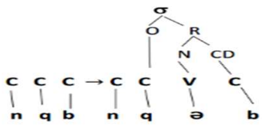


Figure 6:: the example of /nqb/

The scheme in (figure-6) without geminate consonants can perhaps be represented in the following constraint interaction (table 28) [9] :

*Table 28: Without (*C:): Align /rqf/= Align-R (imperative, R), Align-R- min-σ, *Complex >> Dep-IO, * σ-Min, *CODAthe example of /rqf*

Input : /rqf/	*Align-R (Imperative, R, $ə^σ$, R)*	*Align-R, σ-min*	**Complexe*	*DEP-IO*	** σ-Min*	**CODA*
a. ☞ *r.qəf^μ*				*	*	*
b. *rəq.f^μ*	*!	*!		*	*	*
c. reqf	*!		*!	*		*

23 Geminate final consonants and schwa alignment:

Geminate consonants in Tarifit are generally marked structures, they may function as a distinctive segment that contributes to a lexical contrast (*lexical geminates*), or they may be derived through phonological derivation (*assimilative geminates*), or they may be morphological geminates:

24 Lexical contrast: with geminate consonants

At the level of lexical representation, geminates are underlying, and they are also well present at the level of the lexical repertoire:

/bdd/	bedd	'Stop'.
/ɣẓẓ/	ɣezz	'Chewing'
/fẓẓ/	feẓẓ	'Chew'

25 Gemintes that are morphologically derived:

This is the case of the simple - geminate alternation in the 'aorist' and 'inacc':

[nqəb]	[nəqqəb]	'Click on'
[ʒbəd]	[ʒəbbəd]	'Drag'
[ʃməz]	[ʃəmməz]	'Scratch'

What is important in these examples is that schwa is attracted to geminates, so other constraints may be applicable in the geminate's literature, like:

(26)

a. MAX-GEM: the input length and its corresponding output length must be identical.

b. *GEM: Geminates consonants are not allowed.

In Tarifit, geminates predominantly occur at the intervocalic level, particularly with schwa as the preferred vowel preceding them (Saib, 1976). This contextual hierarchy underscores the identical representation of geminates at the representational level, as they are linked with two root nodes:

Table 29: the example of /bcc/

Input : /bʃ/	*MAX-GEM*	**GEM*
a. *bəʃ*	*!	
b. ☞ *bəʃʃ*		*

In Tarifit, the fundamental component of a syllable is its vowels rather than its consonants. Reflecting this prosodic characteristic, numerous constraints governing the appropriate output form must be considered, as outlined in (27):

(27)

a. *Empty Headed[s2] *A syllable must have a nucleus*

b. *μ/C[h] **:** *A consonant should not be the head[3] of a syllable.*

c. *μ/ə: *schwas are not moraic.*

The constraints described in (27) are designed to guarantee the presence of a vowel element within a syllable. However, this vowel element, typically represented by schwa, is characterized by its lack of a mora. Consequently, schwa is considered the prime candidate for the nucleus or head of a syllable, thereby prohibiting consonants from occupying this position. The classification of this phenomenon is assessed in (Table-30):

*Table 30: * Empty Headed, Max-Gem, *M/ə, Dep> *M/Ch= the example of /CC/*

Candidat : /cc/	*MAX-GEM*	**GEM*	**EMPTY HEADED*[s]	**m/C*$_h$	**μ/ə*	*DEP*

a. ɣẓ^μ	**!		*			*
b. ☞ ɣəẓ^μ .ẓ		*		*		
c. ^μ ɣəẓ^μ .	*			*	*	*

Candidate (Table 30-b) emerges as the optimal choice as it adheres to the criteria of *EMPTY-HEADED and preserves gemination without contravening Max-Gem. Thus, it is selected based on its fulfillment of the *EMPTY-HEADED, Max-Gem, *μ/ə, Dep >> *μ/C_h constraints.

26 Schwa alignment and type of geminates:

In OT analyses, the process of schwa epenthesis in /CCC/ verb templates is most adequately described by alignment constraints.

(28)

Align (σ, L, C, L) = Onset σ [	Align-V (σ, R, V, R) = No-coda
Left aligned with C	*Right aligned with C*

The ranking of these constraints is illustrated in the following table (31):

*Table 31: Real Geminates: Align-R, *Complex, *Break, Parse-C, Max-Gem >> Align-L, Fill= the example of /ɣẓẓ/*

Candidat : /ɣẓẓ/	***ALIGN-C (σ, L, C, L) = Onset σ[Align left by C***	***ALIGN-V (σ, R, V, R) = No-coda Align right by V***	***PARSE-SEG (without complex seg)***	***NO-SPLITTING[4] (prohibits the epenthesis between two CC)***	***FILL[5] (avoid epenthesis)***	***MAX-GEM***	****COMPLEX***
a. ☞ ɣəẓ.ẓ		*			*		
b. ɣəẓ<ẓ>		*	*		*		!
c. ɣ.ẓə	*!				*	**!	
d. <ɣ>zeẓ				*		*!	

As we can see, *FILL-SEG* triggers the epenthesis of the schwa at the expense of *DEP*-Ə, but the constraint against the dissociation of geminates MAX-GEM is not violated, since this is the case for true geminates. Thus, the constraint *ALIGN-V (s , R, V, R)* is violated, since schwa never occurs in open syllables.

In contrast, the alignment constraint ALIGN-C (s , R, C, R) satisfies the requirement that syllables end in consonants, and hence it corresponds to the constraint that schwas never occur in open syllables, which is ensured by *ə]^{s} . Therefore, candidate (31-a) is the winner.

Another example can be tested and evaluated as in (32):

Table 32: False geminates: PARSE-C, ALIGN-L (Imperative, ə]σ), EMPTY-HEADED >> DEP-Ə, ALIGN-R-σ.= the example of the verbe /fss/ «hurry up»

Input: /fss/ VB	***NO-SPLITTING***	***ALIGN-L (imperative, ə]$^{\sigma}$***	***ALIGN-R-σ***	***PARSE-C***	***DEP-ə***	**** EMPTY HEADED $^{\sigma}$***
A. fəs.s		*	*		*	
B. ☞ *fsəs*	* !			*	*	
C. Fss		*	*!			*!

Such a case is problematic in terms of alignment, since both forms [fsəs] and [fəss] are widely attested in the everyday communication of an aboriginal speaker from Tarifit, but we can see from the table that the faithful CCC candidate fails due to the lack of syllabic structure,

Furthermore, candidate (table 32-b) is the optimal candidate, since Tarifit speakers consider it a well-formed word with a schwa in the -CC# groups at the end of the word, satisfying the constraint against the geminate Breeze.

Here again, we think that the relevant geminate-splitting constraint should override *Align-R (Root, R; σ, R),* so that the problem comes from words with final geminates that have epenthesized a schwa between the first and second part of the geminates.

The *Align-R* constraint *(VB, σ$^{\mu}$*) is a suitable constraint that can fix the correct location of the schwa epenthesis as shown in example (table 33):

Table 33: the example of /bdd/

Input: /bdd/ ^{vb}	***Align-R (imperative, σ$^{\mu}$)***
a. ☞ *b.dəd$^{\mu}$*	
b. *bəd$^{\mu}$ .d*	*!

27 Conclusion :

Indeed, the insertion of schwa in Tarifit is intricately tied to the syllabic, prosodic, and morphological structure, particularly at word boundaries. This process is governed by the interplay of alignment constraints with faithful constraints that regulate segment insertion. Understanding the multifaceted nature of schwa in Tarifit requires an exploration of its prosodic, phonetic, phonological, and morphological dimensions. Leveraging modern technologies can provide valuable insights into the challenges associated with schwa insertion and aid in resolving them effectively.

Notes:

[1] This example has sparked extensive discussion among linguists. Some linguists argue for inserting the schwa after the consonant (n), even if it violates the sonority scale. However, in the case of Tashlhiyt, there is no requirement for an epenthetic schwa because the language permits the consonant to occupy the nucleus position due to the presence of a high-rank sonority constraint.
[2] the *Complex constraint has been widely used by Prince and Smolensky, 1993.
[3] Prosodic dismissal is widely used by (Itô, 1989) and (Junko Itô, Armin Mester and Jaye Padgett, 1995) It means that certain segments are only allowed to appear in a string if they are prosodically constrained.
[4] Prince is Smolensky, 1993, McCarthy is Prince, 1993
[5] Morphological word
[6] Tarifit prefers performances in which the Coda of the closed syllable shares space with the following attack.
[7] To this end, we have chosen to represent schwa as an empty mora (unspecified vowel), which allows us to rely on the family of constraints that accompany empty structures.
[8] The exact definitions of major and minor syllables vary from language to language, but in general, a major syllable is a heavy surface syllable (μμ) and a minor syllable is a light surface syllable (μ).
[9] For the convenience of our analyses, we have ignored *Bris in this example since it does not contain a geminate.

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