PHONOLOGICAL AND MORPHOLOGICAL ISSUES AND SCHWA EPENTHESIS IN BERBER

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1) INTRODUCTION

This paper deals with some phonological and morphological factors that condition the insertion ofschwa in Berber. These include sonority, gemination, extraprosodicity and output-output correspondence relationships existing between a derived form and a base.

In the present paper, we will provide a constraint-based analysis of the phenomenon of Berber schwa epenthesis. Underlying the account are the assumptions of Optimality Theory (Prince & Smolensky 1993; McCarthy & Prince 1993, 1995,1999; Kager 1999; Bensoukas 2003,2004 and related works).

It should be specified that the vocalic inventory of Berber contains three underlying vowels / a,u, i */*[1]*. When the lexicon yields vowelless forms, a schwa (trascribed throughout this paper as **e**) is epenthesised to syllabify consonants that fail to belong to a syllable (Saib 1976; Chtatou 1982, 1991; Dell &Tangi 1992; MacBride 1996...etc.).*

In the following paragraphs, each factor is treated in a separate section. The data[2] *presented here is taken from the Ayt Wirra Tamazight Berber (AWTB) (Hdouch 2004; Oussikoum 1995).*

2) SONORITY

The insertion of schwa is largely dependent on the sonority of input consonants. This vowel is epenthesised before the most sonorous consonant in a string. Consider the following items:

1)

-a- C_1 C_2 Clusters		**$/C_1/ < /C_2/$**	
	/gn/	**[j e n]**	**'sleep'**
	/_r/	**[_er]**	**'call'**
-b- C_1 C_2 Clusters		**$/C_1/ > /C_2/$**	
	/nz/	**[enz]**	**'sell'**
	/rz/	**[erz]**	**'break'**
-c- C_1 C_2 C_3 Clusters		**$/C_2/ \geq /C_3/$**	
	/srs/	**[sers]**	**'put down'**
	/fst/	**[fes_]**	**'shut up'**

In the items above, schwa is contingent on the sonority of the first and second consonants of biconsonantal roots; it is also dependent on the sonority of the second and third consonants of triconsonantal roots. Schwa is epenthesised before the most sonorous consonant in the string. In addition, The fact that schwa appears in different positions shows that it is epenthetic.

The sonority requirements are given expression in the present constraint-based analysis. First, we point out that schwa is moraless on its own and that it acquires a moraic status only in combination with a following consonant in the same syllable (Zec 1988; Boudlal 2001; Bensoukas 2003,2004). This assumption explains why schwas are banned from occurring in open syllables (this point is further developed below). To express this sonority-based insertion, we make use of Clements'(1988) Dispersion Principle which states that :

2)The Dispersion Principle (DP)

a) The preferred initial demisyllable maximizes sonority dispersion

b) The preferred final demisyllable maximizes sonority dispersion

Initial and final demisyllables stand for onset-peak and peak-coda positions of the syllable. What is of interest here are the final demisyllables, which Clements rank as follows:

3) V>VG>VL>VN>VO

(V= vowel; G= glide; L= liquid; N= nasal; O= obstruent

In Northern Berber dialects, demisyllables of the shape V are not allowed if V is a schwa (see below). In addition, it is necessary to deconstruct the class of obstruents into voiced fricatives (VF), voiceless fricatives (-VF) and stops. In AWTB all underlying stops become fricatives except / q /. We also assume that a ranking should be established to the effect that (VF) dominate (-VF). Furthermore, based on phonotactic restrictions, we also assume that liquids should dominate glides. The reason for this is that in a glide-liquid cluster, schwa is inserted before the liquid(e.g.: [er. wel]'run away'(dots stand for syllable breaks). With hindsight, the Berber final schwa demisyllables can be stated as follows:

4) Berber Final Schwa Demisyllables

eL > eG >eN > eVF> e-VF> eS

This harmony hierarchy can be turned into a Sonority Markedness hierarchy-viz.,:

5) SONORITY MARKEDNESS HIERARCHY

***u >>*u >> *u >> *u >> *u >> *u**

e S e -VF e VF e N e G e L

(In the text these constraints are represented as *u(eS)>>*u(e-VF)...etc.).

The evaluation of candidate outputs fed against the Sonority constraints can be exemplified by the following constraint tableau for the input /nz/.

6*) *u eVF>>*u(eN)*

/nz/	*u eVF	*u(eN)
a) .nez.	*!	
☛b).enz.		*

The tableau above shows that candidate (6b) is optimal since it does not violate the higher-ranked constraint *u(eVF). *In OT, violation of a lower-ranked constraint like* *u(eN) *is not fatal as far as this constraint is dominated.*

The SONORITY constraints determine the site of schwa epenthesis. In Hdouch (2004), we argue that the faithfulness constraints MAX-IO (McCarthy and Prince 1995) and PARSE (Prince & Smolensky 1993) force epenthesis in totally vowelless forms. The two constraints can be stated as follows(after McCarthy & Prince 1995; Prince & Smolensky 1993, respectively).

7) a) MAX-IO

Every segment in the input has a correspondent in the output

b) PARSE

Segments must belong to syllables

The combined effect of the two faithfulness constraints and SONORITY is to parse consonants into syllables. Consider the parsing of the word /hrwl/ *'stroll'. We point out that the three constraints are not ranked vis-à-vis each other.*

8) MAX-IO, PARSE, SONORITY

/hrwl/	MAX-IO	PARSE	SONORITY
☛a) her.wel.			
b).her.wl		*!	
c).ehr.	**!		*

The tableau above shows that SONORITY is decisive in choosing the candidate in(8a) is the most optimal. While MAX-IO and PARSE force epenthesis, SONORITY determine its site. Candidate (8b) incurs one violation of PARSE as two consonants fail to associate to any syllable. Finally, candidate (8c) violates MAX-IO as two input segments have no correspondents in the output. This candidate is also ruled out by SONORITY as the schwa vowel occurs before the less sonorous [h].

However, a scrutinisation of the data shows that SONORITY can be violated when dominated by superordinate constraints. Consider the examples below:

9)

/n-bda/	**[neb.da]**	**'we started'**
/y-xdm/	**[yex.ðem]**	**'he worked'**
/ t-qwa/	**[θeq.wa]**	**'it is strong'**

The forms in (9) consist of a string of four consonants. They are syllabified in the way an input CCCC is (see **[her.wel/** *above). In the word* [neb.da]*, schwa is inserted before the voiced fricative* [b]*. Given that* [n] *is more sonorous than* [b], *we do expect schwa to be inserted before the nasal. The question to ask is the following: How can the violation of SONORITY be accounted for? First of all, this violation occurs at the initial position of the prosodic word (PrWd). Such cases were treated by McCarthy & Prince (1993) in their account of the impossibility of prothesis (i.e.*

initial epenthesis) in Tashlhit. In their analysis of why the onset requirement is lifted stem-initially in languages like Berber and Axininca Campa, they argue that the failure of epenthesis is attributed to an alignment constraint. This is Align(Stem, L, PrWd, L) formulated (after McCarthy & Prince 1993) as in (10):

10) Align(Stem,L,PrWd,L)
Align-L [Stem= [PrWd

*All the forms in (9) abide by Align-L. This amounts to saying that the violation of the sonority requirements is due to the superordinate Align-L . This is a typical constraint conflict situation. SONORITY requires a schwa to be inserted before the most sonorous consonant in a string. Align-L, on the other hand, bans epenthesis in this position, because doing so would lead to the dealignment of the stem and the prosodic word. Since a schwa appears before the voiced fricative,we deduce that ALIGN-L should dominate SONORITY. Consider the following tableau for /n-bda/.(Focus is on the sequence /*n-b*/; / and [stand for stem and PrWd's edges, respectively).*

11) **Align-L>> *u e(VF)>> *u e(N)**

/n-bda/	Align-L	*u e(VF)	*u e(N)
☛a)[/neb.da.		*	
b) [e/nb.da.	*!		*

The constraint tableau above shows that it is better to violate a SONORITY constraint to secure success on the higher-ranked Align-L. This explains the optimality of (11a).

Related to the issue of sonority is the fact that schwa never occurs in an open syllable. Unlike full vowels, which occur freely in all positions, schwa is banned from occurring in open syllables (Saib 1976; Guerssel 1976; Chtatou 1982; Dell & Tangi 1992 and related works). The constraint against the occurrence of schwa in open syllables is formulated by MacBride (ibid.,p8) as follows:

12) **$*e[_\sigma$**

Schwa is not allowed in an open syllable

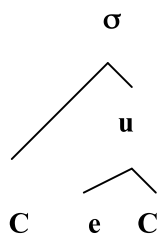
Bensoukas (2004) argues that the reason why schwa is prohibited in this position lies in its not being mora-bearing. This assumption is encoded in the following constraint:

13) **Constraint on schwa association to a mora (Bensoukas ibid. p6)**

***u**
|
e

Making appeal to the precepts of Moraic Theory (Zec 1988; Hayes 1989;Rosenthall 1994, among others),he argues that schwa, being epenthetic, can not bear a mora. This sets it apart from the full vowels, which are underlyingly mora-bearing. This assumption is corroborated by weight-sensitive phenomena. In fact, unlike syllables with full vowels, syllables with schwa as a nucleus are treated by stress phenomena as light (Faizi 2002; Hdouch 2004). This means that closed schwa syllables are monomoraic. In other words, a schwa shares a mora with the following consonant. This is represented as follows:

14) **Closed syllable with schwa: mora-sharing**



(From Bensoukas ibid.p6)

Another prosodic-morphological process lends more support to the constraint in (13). This concerns the perfective formation, where an /a/ *vowel is epenthesised before the last stem consonant. A schwa vowel is never inserted in this position.(See Bensoukas1994 ,2001,2003a-b and the references cited therein). The following data exemplify this situation:*

15) **Unmarked Stem**	**Perfective Stem**
/gn/	**[eg.gan] *[eggen] ‘sleep’**
/bddl/	**[beddal] *[beddel] ‘change’**

The examples above show that schwa is never inserted before the last radical consonant. This simply means that schwa, being moraless, fails to make the last syllable heavy.

With hindsight, the inclusion of the constraint in (13) in the grammar of Berber accounts for why schwa is absent in open syllables. Of course, this constraint combines with other faithfulness constraints to account for the syllabification of forms like /mlil/ *‘be white’. Of relevance here are the following: *COMPLEX^{ONS} ,DEP-IO and ONS formulated as in (16):*

16)

a) *COMPLEX^{ONS}

$*[_{\sigma}$CC (Onsets are simple) (Kager 1999,p97)

b) DEP-IO

Output segments must have input correspondents (no epenthesis)

(Kager 1999,p101)

c) ONS

Syllables must have onsets (Prince & Smolensky 1993)

The fact that the output form is [em.lil] means that *u/e and *COMPLEX^{ONS} outrank DEP-IO. This is schematised below:

17) *u/e, *COMPLEX^{ONS} >> DEP-IO

/mlil/	*u/e	*COMPLEX^{ONS}	DEP-IO
☛a) em.lil.			*
b) me.lil.	*!		*
c) .mlil.		*!	

Candidate (17b) is eliminated because it has a schwa in an open syllable, a fatal violation of *u/e. Candidate (17c) is also ruled out as two consonants are parsed in the onset, thus incurring a *COMPLEX^{ONS} mark. Finally, the candidate in (17a) is optimal as satisfies the two higher-ranked constraints at the detriment of DEP-IO. In the spirit of OT, violation of a lower-ranked constraint is not serious as far as the requirements of the dominating constraints are met.

The optimality of candidate is also computed on the basis of the interaction of the three constraints and ONS. First, it should be specified that ONS dominates DEP-IO. The reason for this is that when the lexicon yields two contiguous vowels, an unrounded glide is inserted to break the resulting hiatus(e.g.: [er.bu.yas] from underlying /rbu-as/ 'carry for him'). The insertion of [y] satisfies ONS and violates DEP-IO. As for the interaction of ONS with *u/e and *COMPLEX^{ONS} ,the last two constraints should be ranked higher. This is due to the fact that in the output [em.lil], the first syllable is onsetless. This means that *u/e and *COMPLEX^{ONS} are satisfied. Consider the tableau below:

18) *u/e, *COMPLEX^{ONS} >>*ONS* >> DEP-IO

/mlil/	*u/e	*COMPLEX^{ONS}	ONS	DEP-IO
☛a)em.lil.			*	*
b)me.lil.	*!			
c).mlil.		*!		

The tableau above shows that candidate (18a) will always be the winner as it satisfies the superordinate *u/e and *COMPLEX^{ONS} . Violation of ONS is not fatal as far as this constraint is dominated.

The next factor that interacts with schwa epenthesis is gemination. This is treated below.

6) GEMINATION

It is a well-known fact that geminates can not be split up by epenthesis(Guerssel 1976;Hayes 1986; Sherer 1994; MacBride 1996...etc.). In Berber, geminates are of two kinds: underlying and derived. The latter are the result of assimilation, which is triggered by a restriction against the cooccurrence of similar consonants on the surface. Coronal as well as noncoronal segments assimilate. Consider the following data:

19)	**Input**	**Output**	
	n-lxudrt	**ell.xu.δ erθ**	**'of the vegetbles'**
	ad-t-ddu	**at.ted.du**	**'she will go'**
	t-xdm-m	**θex. δ em**	**'she worked'**

For Two coronals to assimilate, they should share the same features for a) Place of Articulation, b) Stridency and c) Sonorancy (Sonorancy refers to the distinction between obstruents and sonorants). In the examples above, the assimilating consonants have the three features.

*To express the resistance of geminates to schwa epenthesis, we adopt MacBride's constraint *SIMILAR & LOCAL which he formulates as in (20):*

20) *SIMILAR & LOCAL (*SIM&LOC)

Consonants with the same features for place, stridency and sonorancy are not local

This constraint is violated when two similar segments are adjacent or separated by schwa. Since geminates are never broken by epenthesis, this constraint is to be ranked higher in the constraint hierarchy. In fact, it dominates Align-L as well as ONS. On its turn, Align-L dominates ONS. This is the right ranking if we are to account for the violations of ONS phrase-initially (e.g.:[ar.jaz]*'man'). The following tableau is provided to show the interaction of the three constraints.*

21) ***SIMILAR & LOCAL >> Align-L >>ONS**

/n-lxudrt/	*SIMILAR& LOCAL	Align-L	ONS
☛a) .ell.xu.δ erθ		*	*
b) .lel.xu.δerθ	*!		

*The optimal output (18a) violates both Align-L and ONS, since the left edges of the prosodic word and the stem are dealigned and the first syllable is onsetless. This violation is not serious as long as the higher-ranked *SIM&LOC is satisfied.*

The next subsection deals with the issue of extraprosodicity.

4) EXTRAPROSODICITY

Berber contains a large body of forms with three consonants word-finally contributed by the feminine suffix /t/, *the second chunk of the second person pronoun* /d/, *the third masc./fem. object clitics* /t/ *and* /tt/ *and the orientation index* /d/. *Illustrative examples are presented below:*

22) a) The feminine suffix

θin_θ **'ankel'**

θi_e_tt **'she-goat'**

b) The 2nd person pronoun

eθçerzδ **'you ploughed'**

θezzenδ **'you sold'**

c) The 3rd person masc./fem. object clitics /t/ and /tt/

ssird-t **essirtt** **'wash it (masc.)'**

ssird-tt **essirtt** **'wash it (fem.)'**

srs-t **sersθ** **'put it (masc.) down'**

srs-tt **serstt** **'put it (fem.) down'**

d) The orientation index

dda-n-t-d **eddandd** **they came here'**

umz-n-t-d **umzendd** **they held'**

*The suffixes/ clitics above give rise to triconsonantal clusters word-finally. These can not be parsed in the coda, since the dialect allows only two consonants in this subsyllabic position (Hdouch 2004). On this account, these segments are parsed under an appendix. Under the OT model adopted here, appendixal consonants are analysed in a Push-Pull fashion (Prince & Smolensky 1993). There is a constraint against appendices in opposition to the faithfulness constraints MAX-IO and DEP-IO and the structural constraint *COMPLEX^{COD} . The constraint against appendices is formulated (after Sherer 1994) as in (23):*

23) *APPENDIX (*APP)

Appendix consonants are banned

*At this stage, it should be specified that the extraprosodic/ appendixal consonants are moraless. This is so for two reasons. First, they are stress-inert. That is, they fail to make the last syllable heavy (i.e. bimoraic). In Hdouch (2004), we showed that nouns like [*θim.δiθ*] have main stress on the first syllable [*θím.δiθ*]. This result is possible only if the feminine suffix is parsed under the appendix. The same holds true for the other extraprosodic clitics. A review of the stress patterns of nouns and verbs is beyond the scope of this paper.(See Hdouch 2004).*

Second, we argued above that schwa is epenthesised to the effect that it shares a mora with the following consonant. The fact that schwa does not appear before these extraprosodic segments is due to the latter's moralessness.

*Correspondingly, if a consonant is parsed as appendixal, then it incurs a violation of *APP. To explain, if *APP is ranked above MAX-IO and DEP-IO, the language in question will lack appendixal consonants. On the other hand, if *APP is ranked below both faithfulness constraints and*COMPLEX^{COD} , the language will have appendices.*

*Since AWTB keeps its consonants to the surface, *APP is dominated by MAX-IO and DEP-IO. It should be specified This is due to the fact that Berber prefers epenthesis (a violation of DEP-IO) to deletion of input segments. Consider the following tableau for the input* /tin_t/.

24) MAX-IO >>DEP-IO>>*APP

/tin_t/	MAX-IO	DEP-IO	*APP
☛a) .θin_.θ			*
b) .θin_.	*!		
c) .θin._eθ		*!	

*The tableau above demonstrates that the candidate in (24) , where the suffix is appendixal, is preferred to the others. Violation of a lower constraint is not important. Since no consonant is deleted, MAX-IO is satisfied. Likewise, since no schwa appears before the suffix, this candidate spares a DEP-IO mark. Candidate (24b) is suboptimal as an input consonant has no correspondent in the output, a MAX-IO violation. Finally, candidate (24c) is eliminated as it incurs a DEP-IO violation. In fact, a schwa is inserted before the suffix. This satisfies the lower-ranked *APP at the detriment of the superordinate DEP-IO. To sum up, the candidate with an appendix emerges as the most optimal output, a result predicted by the the ranking established for the three constraints.*

*However, another candidate was not considered in the tableau above. This candidate has the suffix parsed in the coda of the last syllable -namely [*θin_θ**].** *Such a candidate would be eliminated.This is due to the fact that the adjunction of the extraprosodic suffix to the coda will make the latter more complex. The constraint militating against complex codas, *COMPLEX^{COD}, is formulated (after Prince & Smolensky 1993) as in (25):*

25) *COMPLEX^{COD}

Complex codas are not allowed.

*This constraint should dominate *APP as complex codas never occur word-internally. Consider the following tableau for [*θin_θ] fed against the constraint subhierarchy **COMPLEX^{COD}* >>*APP.

26) *COMPLEX^{COD} >>*APP

/tin_t/	***COMPLEX^{COD}**	***APP**
☛**a)θin_θ**	****!**	
b)θin_.θ	*	*

In the tableau above, the candidate in (26a) incurs two violations of the dominating *COMPLEX^{COD}*, and as such it is ruled out. Candidate (26b) incurs only one. It should be pointed out that this constraint is gradient. That is, it assesses only simple vs complex codas (i.e. 1 vs 2,3,4...etc.).* *COMPLEX^{COD} *says nothing about the the first consonant in the coda (i.e. [_]. This consonant incurs a –COD violation, the constraint banning consonants from occurring in this subsyllabic position. For this reason, output (26b) is optimal.*

The same argument holds true for the verbal clitics. The syllabification of an input like

/srs-t/ *is given below. The faithfulness constraints PARSE is included in the constraint hierarchy as the input is voelless. It should be specified that PARSE , MAX-IO and DEP-IO should dominate* *COMPLEX^{COD} *,since the latter does not force the deletion of an input consonant or the epenthesis of a schwa.*

27) PARSE, MAX-IO>> DEP-IO >>*COMPLEX^{COD} >>*APP

/srs-t/	PARSE	MAX-IO	DEP-IO	*COMPLEX^{COD}	*APP
☛a) .sers.θ			*	*	*
b) .ser.seθ			**!		
c). sersθ.			*	**!	
d) .sers.		*!			

The output in (27a) is optimal since the higher-ranked constraints PARSE and MAX-IO are satisfied. This candidate shows that the clitic should be parsed into the appaendix. The other candidates are ruled out as they incur violations of the superordinate constraints. Candidate (27b) incurs two violations of DEP-IO. Candidate (27c) has three consonants in the coda, and as such violates ***COMPLEX^{COD}** *twice. Finally, candidate (27d) has the suffix deleted , a fatal violation of MAX-IO. Therefore, the candidate in (27a) emerges as the optimal output. To sum up, the assignment of the suffix / clitic to an appendix could be seen as a case of the emergence of the unmarked.(See McCarthy 2000).*

This section has shown that extraprosodicity is another factor that conditions the insertion of schwa.

The next subsection deals with output-output correspondence constraints conditioning the distribution of schwa.

5*) Morphologically-Conditioned Schwa Epenthesis*

The next factor conditioning the epenthesis of schwa in Berber is morphological. Specifically, verbal forms of the shape VC_1C_2- C_3 where V is a full vowel and C_3 is a suffix, end in a consonant that is more sonorous than the suffixal consonant. Consider the past (perfective) conjucation of the verb /amz/:

28) Unmarked Stem /amz/

Perfective Stem

umzex	**‘ I held’**
θumzδ	**‘ you held’**
yumz	**‘ he held’**
θumz	**‘she held’**
numz	**‘ we held’**
θumzem	**‘you (pl./masc.) held’**
θumzemθ	**‘you (pl./fem.) held’**
umzen	**‘they (pl./masc.) held’**
umzenθ	**‘they (pl./fem.held’**

The root consonants in (28) form a contiguous string throughout the perfect paradigm. We propose that it is this fact that causes a schwa to be inserted between the stem-final consonant and the suffix [umzex]. *The clusters allow the contiguity relationship which is present in the unmarked stem to be maintained throughout the perfect paradigm.*

Our claim is that the perfect stem is in correspondence with the unmarked stem and that a constraint demanding contiguity relationship be identical between strings in correspondence forces schwa to be epenthesised before the suffix /x/ This is what McCarthy & Prince (1995) refer to as Output-Output Correspondence (see Basri et al 1998).

Thus, the output [umzex] *could be derived comparing it to the simple base (itself a surface form)* [amz]. *This can be schematised as follows:*

29)

[amz] O/B –O-Identity

I-O **[umzex]**

/amz/

The O-O Correspondence constraint we propose for the syllabification of [umzex] is NO-INTRUSION *(after MacBride 1996). This is given below:*

30) **NO-INTRUSION**

The portion of the unmarked stem standing in correspondence forms a contiguous string

This constraint conflicts with SONORITY. Consider the constraint tableau for the output [umzex] *fed against the constraint subhierarchy* NO-INTRUSION>>* u(e-VF)>> *u(eVF). *(We ignore the change of* a *into* u*)*

***31)* NO-INTRUSION>> *u(e-VF)>>*u(eVF)**

Input /amz/ Base [amz]	NO-INTRUSION	*u(e-VF)	*u(eVF)
☛a)um.zex.		*	
b) u.mezx.	*!		*

The constraint tableau above shows that candidate (31a) is optimal because it satisfies the superordinate NO-INTRUSION. The reason for this is that [m] *and* [z]*, the portion of the unmarked stem standing in correspondence, are contiguous to each other in the perfect form. If the reverse ranking were the correct one, we would expect the candidate in (31b) to be the optimal output.*

4) CONCLUSION

*The present paper has shed light on some phonological and morphological issues that condition the distribution of schwa in Berber. We have argued that while faithfulness constraints force the epenthesis of this vowel, the sonority constraints determine its site. However, this sonority-based insertion is blocked when dominated by higher-ranked constraints.These include constraints such as *SIM &LOC, the constraint banning a schwa from splitting a geminate,* *u/e*, the constraint prohibiting schwa-open syllables, faithfulness constraints such as MAX-IO and DEP-IO, the constraints banning the deletion of input material and the insertion of segments lacking input correspondents, respectively. Schwa epenthesis is also blocked in front of extraprosodic suffixes and clitics.This is due to the fact that these segments are moraless. Finally, the O-O Correspondence constraint NO-INTRUSION preserves the contiguity relationship existing between segments of a base and a morphologically-related form.*

6) NOTES

1) *Chtatou (1981,1991) argues that Tarifit Berber contains long vowels as well. These are the result of compensatory lengthening. or an OT analysis of this phenomenon, see Bensoukas (2004).*
2) *The transcription adopted in this paper is that of IPA.*

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