Co-occurrence restrictions in the vocalic patterns of Afroasiatic plurals

This paper examines the vocalic patterns in the plural forms of four languages in Afroasiatic. Focus is made on the co-occurrence restrictions that the vowels obey in these forms; particularly it is shown that plurals in which high vowels co-occur are excluded. This restriction is argued to follow form the active role of the well-known Obligatory Contour Principle, which prohibits identical elements in the same domain. Then it is proposed that the same principle underlies the organization of the apophonic path à la Guerssel & Lowenstamm (1996).

It is a well-known fact in Semitic morphophonology that items undergo a set of structural and distributional restrictions which prohibit the co-occurrence of identical elements within the same domain (*cf.* among others Greenberg 1950, McCarthy 1981 and 1986 for prohibited identical or homorganic segments in the same root in Semitic). Compelling arguments show that such restrictions follow a general principle, called the *Obligatory Contour Principle* "henceforth OCP" (*cf.* Leben 1973, Goldsmith 1976 and McCarthy 1981), which prohibits identical elements in the same domain. Numerous studies in the last decades have shown the relevance of such a device in accounting for the distribution of melodies, usually tones (Leben 1973, Goldsmith 1976, Odden 1986) and consonants (McCarthy 1981, 1986, Yip 1988). However, a few scholars such as Kurylowicz (1962: 21) and Cohen & Taine-Cheikh (2000: 298) have pointed out that in Semitic and Berber certain vowels are incompatible within the same word, but for the most part there has been little attention paid to constraints on vowels.

This paper examines the co-occurrence restrictions that vocalic patterns undergo in Afroasiatic plurals. It is shown that plurals in which high vowels co-occur are excluded. Then, it is argued that these restrictions underlie the organization of the apophonic path as stated in Guerssel & Lowenstamm (1996) and Ségéral (1995). In Section 1, I briefly survey the role of the OCP in accounting for the distributional restrictions that segments, tones and features undergo. Constraints on the vocalic patterns in Tashlhiyt Berber, Classical Arabic, Afar and Hausa are examined in section 2. Section 3 introduces the apophonic theory and discusses it in the light of OCP. Section 4 concludes the paper.

1. Consonants, tones, features

One of the turning-points in the development of phonological theory was the introduction of autosegmental theory (Goldsmith 1976). Initiated in the early seventies with research in tonology, the theory offered a comprehensive alternative to the transformational rules in classical theory, claiming that several tonal phenomena such as contour tones, tone preservation and tone shift are better understood by means of multi-tiered phonological representations where segments and tones lie on separate levels. It is, for instance, proposed that contour tones, which raise a serious challenge to the linear model of phonology, are combinations of multiple tones linked to one vowel (an overview of the phenomenon is provided in Kenstowicz 1992: 312 and Odden 1996: 444).

In the late seventies and early eighties, McCarthy (1979, 1981) extended the proposal to Semitic languages. He showed that the wide variety of non-concatenative morphological operations that these languages use result in a natural way from the association of consonantal roots with vocalic melodies to prosodic templates. He indeed proposed that the verbal forms *kataba* "he wrote", *kattaba* "he made write", *kaataba* "he corresponded", etc. are obtained by mapping the root consonants *ktb* and the vowel melody *a* into the templates *CVCVC*,

CVCCVC, *CVVCVC*, etc., the mapping being governed, as in tone languages, by the well-formedness condition and the association conventions first stated in Goldsmith (1976).

The other proposal that evolved from the study of tone languages is the OCP. Originally due to Leben (1973) to account for the absence in Mende of HHL and LLH tonal patterns, the proposal is explicitly formulated in Goldsmith (1976) as "*at the melodic level of the grammar, any two adjacent tonemes must be distinct*" (*cf.* Odden 1986 for a detailed review of the problem). The principle is then extended in McCarthy (1986: 208) to segments and features: "*at the melodic level, adjacent identical elements are prohibited*".

In Classical Arabic phonology, the OCP functions as a structural constraint that prohibits adjacent identical or homorganic consonants in the root. Roots of the form *√ʕʕC, *√CʔʔC, *√Cħħ are thus excluded. In addition, verbal forms such as *samam* and *madad* are analyzed as the result of the association from left to right of a biconsonantal root to a prosodic template that contains three consonantal slots.

Several other works, including McCarthy (1986), Itô & Mester (1986), Borowsky (1986) and Yip (1988), present the OCP not only as a passive constraint on the structure of morphemes but also as an active constraint in the course of the derivation, determining the segmental content of the output. Several phonological processes such as dissimilation and epenthesis are thus analyzed as repairing strategies that languages use to avoid adjacent identical elements in the output.

One noticeable argument for the role of the OCP in the course of the derivation is provided with cases of syncope in Afar. In this Cushitic language, syncope that normally triggers the penultimate non-stressed vowel (e.g. *ʕagára* (accusative) > *ʕagrí* (nominative) "scabies") fails to apply if the last two consonants are identical (e.g. *xararé* > **xarré* "he burned"). The failure of syncope in the latter case is attributed to the OCP which, according to McCarthy (1986: 220), prevents the rule from creating clusters of identical consonants. In English, on the other hand, the OCP causes the epenthesis of the vowel [ɪ] to avoid adjacent coronal sibilants: e.g. *brushes*, *taxes*, *matches*, *judges*. Yip (1988: 67) reviews additional arguments for the active role of the OCP in the course of the derivation.

Within distinctive feature theories, several cases of dissimilation are attributed to the OCP. Clements & Hume (1996: 263) thus noticed that the co-occurrence of certain consonantal features in the same form is prohibited: for instance, the root **dbt* is disallowed, since the feature [coronal] occurs twice. If such sequences arise in the course of the derivation, phonological processes such as dissimilation take place. In Tashlhiyt Berber, for instance, the reciprocal morpheme /m/ dissimilates to [n] whenever it is prefixed to a stem that contains a labial consonant: e.g. /*m-gibil*/ "face each other" surfaces as [*ngibil*] whereas /m-ħidi/ "be side by side" remains unchanged (cf. among others Alderete & Frisch 2006, Elmedlaoui 1992, Lahrouchi 2003).

In sum, the universal character of the OCP lies on arguments from tonal and consonantal phenomena.[1] However, little attention has been paid to constraints on the distribution of vowels. The next section examines the co-occurrence restrictions that the vocalic patterns undergo in the internal plurals of Afroasiatic.

2. Vowels

Early in the sixties, Kurylowicz (1962: 21) reported the incompatibility of the high vowels *u* and *i* in the same form in Semitic. So did McCarthy (1986: 18) claiming that "the high glides *w* and *y* may also be subject to co-occurrence restrictions". If for some morphological reasons these vocalic segments came to co-occur in the same form, then

[1] Counterexamples to the OCP are found in Odden (1986, 1996), among others.

assimilation turns *u-i* and *i-u* sequences into [uu] or [ii] (see also Brame 1969, where various rules assimilating adjacent vocoids are postulated). The examples in (1) illustrate the situation in Classical Arabic:

(1) **mudu<u>ui</u>run* > *mudiirun* "director"
**qu<u>ui</u>la* > *qiila* "say- passive-3 p ms"
jawm (sg), **aj<u>w</u>aam* > *ajjaam* (pl) "day"

The prohibited (underlined) sequences, *ui* in the first two examples and *jw* in the remaining example, turn into [ii] and [jj], respectively. The OCP seems to cause the assimilation of these adjacent vocoids that share the feature high.[2]

Data from one variety of Berber spoken in Zenaga (Mauritania) show another type of constraints on the vocalic patterns. Cohen & Taine-Cheikh (2000: 298) have noticed a tendency for vowels to contrast on the basis of their height: in the verbal conjugation, the Preterit forms display the vowel *a* while their Aorist counterparts use a "*non-a*" vowel. The underlined vowels in the examples in (2) show the phenomenon:

(2)	*Aorist*	*Preterit*
"close"	ja-zˤm<u>u</u>d	ju-zˤm<u>a</u>d
"squeeze"	ja-zˤm<u>i</u>	ju-zˤm<u>a</u>
"plait"	ja-zzˤ<u>i</u>	ju-zzˤ<u>a</u>
"decrease"	je-fn<u>u</u>zˤ	ju-fn<u>a</u>zˤ

Also, the vocalic material of the prefix shows a regular alternation whereby the vowel *a* in the Aorist alternates with *u* in the Preterit, except the last form where *e* alternates with *u*. We will return to this propriety later in section 3.

The vowel height contrast just described is found in the plural formation of many Afroasiatic languages. Data from Tashlhiyt Berber, Classical Arabic, Afar and Hausa, presented in the reminder of this section, show this phenomenon.

2.1 Tashlhiyt Berber

The data in (3) are sorted into three classes with respect to the vocalism they display in the plural: forms in (3a) display the vocalism *u-a*, forms in (3b) the vocalism *i-a*, and the remaining forms the vocalism *a-u*.

(3)		*singular*	*plural*	*plural vocalism*
a.	"room"	aħanu	iħuna	*u-a*
	"pipe"	asaru	isura	
	"torch"	asafu	isufa	
	"fortress"	agadir	igudar	
	"first"	amzwaru	imzwura	
	"head"	agajju	igʷjja	
b.	"country"	tamazirt	timizar	*i-a*
	"fortress"	agadir	igidar	
	"pear"	tafirast	tifiras	
	"tomato"	tamitˤaʃt	timitˤaʃ	
	"help"	talilt	tilila	

[2] It is worth recalling that in McCarthy's autosegmental analysis of Arabic, vowels and consonants appear on different tiers. For instance, in the verb *kabur* "grow up" the consonants *kbr* and the vowel melody *au* appear on separate tiers.

	"house"	tigmmi	tig^{w}mma	
c.	"heart"	ul	ulawn	*a-u* > *[aw]*[3]
	"skin"	ilm	ilmawn	
	"soul"	ixf	ixfawn	
	"face"	udm	udmawn	
	"mouth"	imi	imawn	
	"peeling"	almmuʃ	ilmʃawn	

The initial vowel in the forms in (3a) and (3b) is a thematic vowel prefixed to the stem. It undergoes a regular alternation: singular *a-* alternates with plural *i-*. The initial *t-* that precedes this prefix in certain forms is the feminine marker (each feminine form begins and ends with a *t*). In addition, there is a sizeable amount of nouns, such as in (3c), whose initial vowel remains unchanged (Dell & Jebbour 1991 provide a detailed analysis on this topic). The remaining vowels in the form show a regular alternation. Moreover, their arrangement in the singular is inverted in the plural: *a-u* in the singular becomes *u-a* in the plural in (3a) and *a-i* becomes *i-a* in (3b). The examples in (3c) form their plural by suffixing *–awn* to their singular. They are traditionally analysed as external plurals, compared with the vocalic alternation internal to the stem that the plurals in (3a) and (3b) display. Taken altogether, the forms in (3) show a regular *height contrast condition* in their vocalic patterns: they use one of the following vocalic patterns: *a-u*, *u-a*, *a-i*, *i-a* where each high vowel contrasts with a low vowel. This is comparable to what Kurylowicz (1962) noticed in Semitic.

2.2 Classical Arabic

The same phenomenon arises from the Classical Arabic data given in (4):

(4)		*singular*	*plural*	*plural vocalism*
a.	"worker"	ʕaamil	ʕummaal	*u-a*
	"student"	tˤaalib	tˤullaab	
	"inhabitant"	saakin	sukkaan	
	"passenger"	raakib	rukkaab	
	"old, ancient"	qadiim	qudamaaʔ	
	"ambassador"	safiir	sufaraaʔ	
b.	"sea"	baħr	biħaar	*i-a*
	"spear"	rumħ	rimaaħ	
	"beast of prey"	sabuʕ	sibaaʕ	
	"man"	raʒul	riʒaal	
	"generous"	kariim	kiraam	
	"camel"	ʒamal	ʒimaal	
c.	"book"	kitaab	kutub	*u*
	"boat"	safiina	sufun	
	"meat"	laħm	luħuum	
	"circumstance"	dˤarf	dˤuruuf	

[3] In Berber, any high vowel preceded or followed by another vowel surfaces as a glide, e.g. *zri* (aorist) vs. *zray* (imperfective) "pass", *sli* (aorist) vs. *slay* (imperfective) "touch", "the land has been sold" *inza wakal* (cf. Guerssel 1986 on this topic).

“treasure”	kanz	kunuuz
“arrow”	sahm	suhuum

These forms exemplify one of the best studied aspects of the Classical Arabic morphology. Well before McCarthy’s work (1979, 1982, 1990), which formalizes the templatic and prosodic properties of the plural forms in this language, traditional Arab linguists looked into the problem. They distinguished plurals as in (4), which involve morphological operations internal to the stem, from plurals that are formed by simple suffixation (e.g. “traveller” *musaafir* (sg) > *musaafiruun* (pl)). The majority of Classical Arabic plurals belong to the first type, termed “broken” plurals opposed to “sound” plurals (the various shapes that the plurals display in Classical Arabic are provided in Wright 2004).

The data in (4) also show that the arrangement of the vowels in the plural obeys the height contrast condition: the vocalic patterns combine, as in the Tashlhiyt Berber data in (3), high vowels with low vowels (*u-a* in the examples in (4a) and *i-a* in those in (4b)). The forms in (4c) are not counterexamples to the above statement. Rather, they are analysed in the non-linear tradition of phonology as internal plurals where one single vowel spreads into more than one vocalic slot. Counterexamples to the height contrast would be those plurals where the high vowels *i* and *u* co-occur, but forms of this type are not attested.

It is noticed, in addition, that many of the forms in (4) involve a regular vocalic ablaut whereby singular *i* alternates with plural *a*, and singular *a* alternates with plural *u* (e.g. *ʕaami<u>l</u>* (sg) > *ʕummaal* (pl)). Section 3 discusses the phenomenon in light of the apophonic theory provided in Guerssel & Lowenstamm (1996).

The height contrast condition raised with the above data is found in other formations in Classical Arabic such as the *diminutive*. The examples in (5) illustrate the phenomenon:

(5)		*noun*	*diminutive*	*vocalism*
a.	“man”	raʒul	ruʒajl	*u-a*
	“dog”	kalb	kulajb	
	“slave”	ʕabd	ʕubajd	
	“mountain”	ʒabal	ʒubajl	
b.	“book”	kitaab	kutajjib	*u-a-i*
	“poet”	ʃaaʕir	ʃuwajʕir	
	“expert”	ʕaalim	ʕuwajlim	
	“mosque”	masʒid	musajʒid	

The vocalism of the diminutive is *u-a* in (5a) and *u-a-i* in (5b). The difference between the two groups is probably due to templatic constraints: the use of a three-vowel melody in the second group, in contrast with the two-vowel melody in the first group, reflects the number of the vocalic slots that the template contains. According to McCarthy (1979: 195), “we can isolate just one diminutive melody *u-a-i*” for both groups. The absence of the vowel *i* in the diminutive forms in (5a) is attributed to the lack of a third vocalic slot in the template. On the other hand, we notice that the height contrast condition applies to the diminutives in (5b): the high vowels that this melody contains are not adjacent in the vocalic tier; a low vowel stands between them.

In sum, the morphological formations we have examined so far in Tashlhiyt Berber and Classical Arabic display regular vowel melodies that contrast in height. One may still object that certain morphological formations in these languages contradict this statement. One noticeable counterexample arises with the passive perfective formation in Classical Arabic,

whose vowel melody show adjacent high vowels *u-i* (e.g. *kutib* “it has been written”). This vocalism that apparently contradicts the height contrast condition is however analysed as bi-morphemic, composed of two markers: *u* being the mode (passive) marker and *i* the aspect (perfective) marker. In the autosegmental phonology tradition, this is rendered by means of multi-tiered representations where *u* and *i* stand in different morphemic tiers. Evidence for the bi-morphemic analysis of the passive perfective vowel melody is provided with the alternation that the aspect marker *i* undergoes, but not the mode marker *u*: *i* alternates with *a* in the imperfective while the passive marker *u* remains unchanged (e.g. *kutib* (passive perfective) vs. *yuktab* (passive imperfective)).

The next two subsections examine data from two other Afroasiatic languages: one is Cushitic (Afar) and the other Chadic (Hausa). The data prove essential to the analysis, as the vowel systems of these languages are richer than those of Berber and Semitic languages. In addition, Hausa has a tonal system that the plural formation uses in a specific way. We shall see that tones and vowels are sensitive to the height contrast in the plural.

2.3. Afar

The vowel system of Afar is depicted in (6) (cf. Parker & Hayward 1985). It has one aperture more than in Tashlhiyt Berber or in Classical Arabic. Moreover, each short vowel has its long counterpart.

(6) i/ii u/uu
e/ee o/oo
a/aa

The data in (7) exemplify the vowel combinations that the plural forms display in Afar:

(7)		*singular*	*plural*	*plural vocalism* *(last 2 syllables)*
a.	“vein”	ramád	ramoodá	*o-a*
	“grave”	magáʕ	magooʕá	
	“skin”	aráb	aroobá	
	“half”	garáb	garoobá	
	“head”	amó	amoomá	
	“elder brother”	sáʕal	saʕoóla	
b.	“hand”	gabá	gaboobí	*o-i*
	“tradition”	qaadá	qadoodí	
	“bone”	lafá	lafoofí	
	“moon”	alsá	alsoosí	
	“can”	birassó	birassosí	
	“generation”	aadó	aadoodí	
c.	“mother”	iná	inaaní	*a-i*
	“donkey”	okló	oklaalí	
	“hill”	koomá	koomaamí	
	“hiding-place”	goná	gonaaní	
	“back”	guddá	guddaadí	
	“fire, weapon”	girá	giraarí	

d.	"milk container"	ajní	ajniiná	*i-a*
	"ear"	ajtí	ajtiitá	
	"eye"	intí	intiitá	
	"substitute"	fidá	fidiidá	
e.	"quantity"	gide	gideeda	*e-a*
	"froth"	girre	girreera	
	"insane person"	ħabulé	ħabuleela	
	"middle"	gudé	gudeedá	
	"revenge"	ħané	ħaneená	
	"wound"	dalé	daleelá	

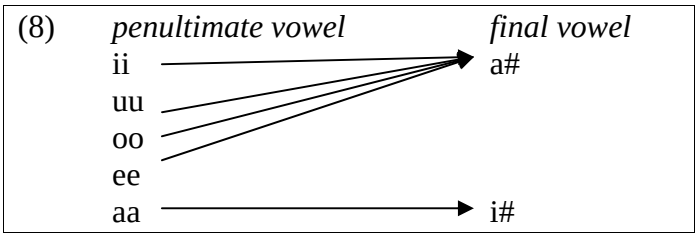
The templatic character of the morphology of Cushitic is not as well established as it is in Semitic, in spite of important studies including Bendjaballah (2003), Barillot & Bendjaballah (2005) and Rucart (2006a, 2006b), which show that many aspects of the morphology of these languages are better analysed in terms of templatic mechanisms.

The examples in (7) are sorted into five groups with respect to the vowel melody in the last two syllables of the plural form. The morphological operations they use are indeed limited to these two syllables. The plural formation thus consists of (i) lengthening the second vowel in the singular form (its quality changes in certain cases, e.g. *gabá* > *gaboobí* in (7c)), (ii) reduplicating the second consonant in the case where the singular form contains less than three consonants, and (iii) suffixing the vowel *a* or *i*. In any case, the first syllable in the singular form remains unchanged in the plural.

The morphological operations just described refer to the well-known internal plurals in Afroasiatic: the lengthened vowel, though varying qualitatively, corresponds to the internal *a* in other branches such as in Semitic (see examples from Classical Arabic in (4)). The reduplicated consonant compensates for the lack of a third consonant in the stem, just as in the Classical Arabic biconsonantal roots (e.g. "dam" *sadd* (sg) > *suduud* (pl)).

The examination of the vowel melody in the last two syllables in the plural forms in (7) leads to the following observations. Firstly, the final and penultimate vowels are systematically of different types (see also Rucart 2006b: 147). Secondly, while the penultimate vowel can be mid, low or high (*e, o, a* or *i*), the final vowel is either *a* or *i*. The use of one or the other of these vowels seems to depend on the quality of the preceding vowel: *a* is suffixed if the preceding vowel is *i*, *o* or *e*, and *i* if the preceding vowel is *a*. The distribution of the vowels in the last two syllables of the plural forms is schematized in the table in (8):

(8)



The last two vowels systematically differ in height: if the penultimate vowel is low, then the final vowel is high, and if the penultimate is high, then the final is low[4]. The quality

[4] On the basis of Element Theory, the mid vowels *e* and *o* are taken to be a combination of high elements with low elements: (A, I) > [e], (A, U) > [o], the underlined element being the head and the other the operator (for details about this theory, the reader will refer to Kaye, Lowenstamm & Vergnaud 1990).

of the final vowel is thus entirely predictable on the basis of the penultimate vowel. The height contrast is the only condition that this vowel should obey with respect to the preceding vowel. This suggests that the OCP governs the distribution of the last two vowels in the plural in an active way. A similar phenomenon in Hausa confirms this observation.

2.4 Hausa

Hausa, a Western Chadic language, has five short vowels /i, e, a, o, u/ with their long counterparts, and 3 tones: high, low and falling. The data given in (9) exemplify some of the 46 classes of plurals in the language (for a thorough analysis of the plural formation in this language, *cf*. Newman (2000) and Jaggar (2001) among others). They are part of the so-called "suffix system", as opposed to the "semantic system", the oldest system, which involves changes in tonal and vocalic patterns and the "prosodic system" which is transitional (*cf*. Hellwig & Mcintyre (2000)).

(9)		*singular*	*plural*	*tone pattern (plural)*	*plural vocalism (last 2 syllables)*[5]
a.	"house"	gídáa	gídàayée	*HLH*	*a-e*
	"earth"	kásáa	kásàashée		
	" rat trap"	ɓúrmáa	ɓúràamée		
	"grass bracelet"	tàfáa	táfàafée		
	"old cow"	gúzúmáa	gúzàarée		
	"white"	fárii	fáràarée		
b.	"cripple"	gúrgùu	gúràagúu	*HLH*	*a-u*
	"member"	gáɓàa	gáɓàaɓúu		
	"stone"	dúutsèe	dúwàatsúu		
	"jungle"	kúrmìi	kúràamúu		
	"hollow place"	gúrbìi	gúràabúu		
	"den, lair"	kúrfìi	kúràafúu		
c.	"bicycle"	kèekée	kéekúnàa	*HHL*	*u-a*
	"dog"	kàrée	kárnúkàa		
	"stream"	ràafìi	ráafúkàa		
	"pit"	ràamìi	ráamúkàa		
	"spoon"	cóokàlìi	cóokúlàa		
	"axis"	gàatárii	gáatúràa		

The examples are sorted into three groups with respect to the vocalic and tonal patterns that the plural forms display. The plural formation involves the following operations:

- The insertion of a long *a* between the last two consonants in the stem.
- The reduplication of the second stem consonant or the insertion of a default consonant (*k, n* or *y*) in the case where the stem contains less than three consonants.
- The suffixation of a long vowel (*ee* in the forms in (9a), *uu* in (9b) and *aa* in (9c)).

[5] The last two syllables in the plural refer to the morphologically active portion of the word. This portion is filled by means of reduplication or suffixation.

In addition, the examples in (9c) illustrate the case where the internal *a* changes to *u* in reaction to the neighboring velar consonant, e.g. *kéekúnàa* and not * *kéekánàa* or * *kéekánée*. We will return to this point soon.

On the other hand, the careful reader will have noticed that there is a regular correlation between the vowel height and the tone values in the last two syllables in the plural. A high vowel has a high tone whereas a low tone is assigned to a low vowel. The issue, raised first in Pilszczikowa-Chodak (1972) has been challenged in Newman (1975), bringing several counter-examples to the above generalization. Without going into detail about this issue, the crucial point about the data in (9) is that the last two vowels in the plural forms as well as their tones systematically contrast in height. Moreover, the final vowel is probably a phonotactic vowel[6], whose height is determined by that of the preceding vowel: if the penultimate vowel is hight, then the final vowel is low, and if the penultimate is low, then the final is high. The behavior of the penultimate vowel in (9c) further argues for the height contrast condition that the last two vowels obey. That is, when the penultimate *a* changes into *u* because of the neighbouring velar consonant, not only its tone changes to high but also the following vowel becomes *a* and its tone changes to low.

In summary, the facts described throughout this section show a systematic vowel height contrast in the internal plurals of Tashlhiyt Berber, Classical Arabic, Afar and Hausa. This reinforces the active role of the OCP in regulating the distribution of vowels.

In the next section, we present the apophonic theory as stated in Guerssel & Lowenstamm (1996). Then, we examine the structure of the apophonic path in light of the OCP and the height contrast condition.

3. Apophony and OCP

Apophony (or ablaut) refers to sound alternations within forms of a word that convey grammatical information (*sing* > *sang* > *sung* illustrates the phenomenon in English). Many of the forms examined so far in this paper show regular vocalic alternations: e.g. Tashlhiyt Berber: *agadir* (sg) > *igudar* (pl), *tamazirt* (sg) > *timizar* (pl), *tigmmi* > *tig*^{w}*mma*; Classical Arabic: *saakin* (sg) > *sukkaan* (pl), *raakib* (sg) > *rukkaab* (pl), *kanz* (sg) > *kunuuz* (pl); Afar: *ramád* (sg) > *ramoodá* (pl), *aráb* > *aroobá*, *gabá* > *gaboobî*. Guerssel & Lowenstamm (1996) is an attempt to handle similar facts in the verbal conjugation of Classical Arabic. The section below outlines the main proposals made therein.

3.1. The apophonic path

The apophonic theory à la Guerssel & Lowenstamm (1996) was originally stated to account for the regularities that vocalic alternations in Classical Arabic show between Perfective and Imperfective conjugations. The examples in (10) illustrate these alternations:

(10)	*Perfective*	*Imperfective*	
« dress »	lab**i**s	ya-lb**a**s	i ⇨ a
« write »	kat**a**b	ya-kt**u**b	a ⇨ u
« hit »	d^{ˤ}ar**a**b	ya-d^{ˤ}r**i**b	ø ⇨ i
« be great »	kab**u**r	ya-kb**u**r	u ⇨ u

The authors propose that such vocalic alternations "*are organized in terms of a comprehensive network of sound correspondences*". They are regular as they follow a unique path where each output vowel of an apophony is the input to another. The apophonic path is given in (11):

[6] Newman (2000: 400) has already noticed that in Hausa "common nouns tend to end in a long final vowel".

(11) Apophonic path **ø ⇨ i ⇨ a ⇨ u ⇨ u**

This path allows predicting the nature of the vowel that appears between the last two consonants in the Imperfective on the basis of its counterpart in the Perfective: Perfective *lab**i**s* yields Imperfective *ya-lb**a**s*; *kat**a**b* yields *ya-kt**u**b* and *kab**u**r* → *ya-kb**u**r*. However, the vowel *a* that appears between the last two consonants in *dˤar**a**b* behaves differently from the one that appears in the same position in *kat**a**b*: wile the latter alternates with *u* in the Imperfective, the first alternates with *i*. This case of opacity is analyzed in Guressel & Lowenstamm (1996) as follows: the second vowel in *dˤar**a**b* is a copy of the preceding vowel whereas in *katab* it is a lexical vowel. In other words, the second V slot is lexically empty in *dˤar**a**b* while in *katab* it hosts a lexical *a*. On the other hand, the first step **ø ⇨ i** in the path formalizes the status of the unmarked vowel attributed to *i* in the phonological theory (see Underspecification and Markedness in Steridade (1996)) and the fact that it is used as a "default epenthetic vowel"[7].

The apophonic theory is then generalized to many other Afroasiatic and non-Afroasiatic languages, including Ge'ez, Akkadian (cf. Ségéral 1996 and 2000), Kabyle Berber (cf. Bendjaballah 1995 and 2001) and German (cf. Ségéral 1995 and Ségéral & Scheer 1998). In all these languages, the apophonic path is argued to govern grammatically-motivated alternations. Except for one noticeable case, the apophonic path provides a default vocalism in onomatopoeia and word games. Examples follow in (12):

(12) *a. Onomatopoeia*:
French: b**i**m b**a**m b**ou**m, p**i**f p**a**f p**ou**f, d**in**g d**an**g d**on**g... ;
German: r**i**r**a**r**u**tsch, p**i**mp**a**mp**u**m, der B**i**-B**a**-B**u**tzemann
Spanish: p**i**mp**a**mp**u**m

b. Taqjmit, a Berber secret language spoken in the south-west of Morocco:

	Tashlhiyt Berber	*Taqjmit*
"enter"	kʃm	t**i**kk**a**ʃmj**u**ʃm
"be happy"	frħ	t**i**ff**a**rħj**u**rħ
proper noun	xadiʒ	t**i**xx**a**dʒj**u**dʒ
proper noun	mbark	t**i**bb**a**rkj**u**rk
"plough"	krz	t**i**kk**a**rzj**u**rz

3.2. The OCP and the structure of the apophonic path

The apophonic path thus functions as a vowel melody generator, providing a default vocalism in word games and onomatopoeia. In the examples in (12), the three vowels part of the apophonic path appear in the expected order: *i-a-u*[8]. The question that arises then is: is there any external motivation for the apophonic path to be structured in such a way? That is,

- Why does *u* follow *a* and not *i*?

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[7] *i* is indeed the default epenthetic vowel in Yokuts and Yoruba (Pulleyblanck 1988), in Hebrew (e.g. ʃəmor *vs.* ʃimrii), in Tigrinya (Angoujard & Denais 1989 : 136) and in Akkadian (Ségéral 2000 : 280). It is also the case in Vulgar Latin where the same vowel precedes initial #sC clusters (e.g. schola > ischola), and in Classical Arabic where it is inserted before #CC clusters (e.g. ʔinkasara, ʔistaqbala).

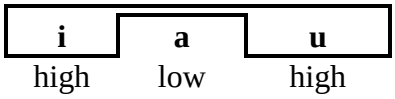
[8] In other cases, only portions of the apophonic path may appear, such as in French *t**i**c-t**a**c, z**i**gz**a**g, prêch**i** prêch**a**, z**a**z**ou**, c**a**c**ou**;* German *fl**i**ckfl**a**ck, m**i**schm**a**sch,r**i**psr**a**ps, w**i**rrw**a**rr;* English *t**i**ck t**a**ck, h**ee**h**a**w, s**ee**s**a**w, j**i**mj**a**ms, j**i**ngle-j**a**ngle;* Spanish *ch**i**sch**á**s, c**a**tapl**u**n*.

- Why does the apophonic path involve the portion *i→a→u* and not **a→i→u, a→u→i* or *u→a→i*, etc.?

- Why do the formations in (12) use the vocalism *i-a-u* and not **a-i-u*,**a-u-i* or **u-a-i*, etc.?

Following the general principle discussed in this paper, namely the OCP, the reason why *i* and *u* are not adjacent in the vocalism used in onomatopoeia and word games is that they share the feature *high*. Therefore, *a* intervenes between *i* and *u* to avoid adjacent high vowels so that we have the situation depicted in (13):

(13)



One could still ask that if the OCP were the only principle that governs the arrangement of vowels in onomatopoeia, word games or any similar formation, we might expect to find forms with the vocalism *u-a-i*, as well. Diminutives in Classical Arabic use such a vocalism. The examples given in (5b) are repeated in (14) for convenience:

(14)	*Noun*	*Diminutive*
"book"	kitaab	k**u**t**a**jj**i**b
"poet"	ʃaaʕir	ʃ**u**w**a**jʕ**i**r
"expert"	ʕaalim	ʕ**u**wajl**i**m
"scorpion"	ʕaqrab	ʕ**u**q**a**jr**i**b
"mosque"	masʒid	m**u**s**a**jʒ**i**d

Interestingly, the OCP accounts for the arrangement of vowels in onomatopoeia and word games of the type in (12) as weel as in the diminutives such as in (14).

4. Conclusion

The prohibited co-occurrence of high vowels in Afroasiatic plurals is analyzed as a direct consequence of the active role of the OCP. This principle is claimed to govern the distribution of vowels not only in the plural forms but also in the diminutives, in onomatopoeia and word games, as well. The vocalism used in onomatopoeia and word games is discussed on the grounds of the apophonic theory à la Guerssel & Lowenstamm (1996). Then, it is proposed that the arrangement of vowels in the apophonic path obey the OCP.

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