Vowel Harmony

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1. Introduction

Vowel harmony is a renowned and robust phonological process in Bantu languages that has been widely investigated from a descriptive and theoretical perspective, and covering both synchronic and diachronic dimensions (Clements 1991, Beckman 1997, Hyman 1999, 2002, among others). It is essentially an assimilation process, involving usually partial assimilation between vowels with respect to a feature such as vowel height, backness or advanced tongue root (ATR), for example.

This chapter provides an overview of vowel harmony in Bantu languages, evaluating the different types of vowel height harmony systems and the dominance of the root in triggering height harmony. Although height harmony is the most predominant type of harmony found in Bantu languages, ATR harmony also occurs, although this is a more common feature outside of Bantu. While vowel height harmony (VHH) tends to be restricted in its domain of application, targeting verbal bases, ATR harmony usually has a wider span that covers the word. The two types of harmony thus differ with respect to whether prefixes canonically undergo harmony. There are also contrasting patterns in the application of vowel harmony in 5-vowel versus 7-vowel systems. An important crucial factor in VHH, in particular, is the asymmetry between front height harmony and back height harmony. Apart from these two standard types of harmony – VHH and ATR harmony – the chapter will also consider a process of vowel assimilation where total assimilation occurs in some Bantu languages, specifically affecting the final vowel and referred to as vowel copying.

Vowel Harmony has led to a number of proposals with respect to analyses and in particular the contrast between the use of bivalent or monovalent features, on the one hand, and autosegmental representations vs. constraints, on the other. These theoretical analytical issues will only be briefly visited in this chapter. The central aim of the chapter is rather to provide a more descriptive overview of the patterns of vowel harmony in Bantu, highlighting the issues that would need to be considered in developing analyses. The chapter will also showcase the attested variation in Bantu vowel harmony in order to provide an understanding of where particular harmony processes occur within the Bantu area.

2. Vowel Height Harmony

2.1 Five vowel systems

Bantu languages typically have small vowel inventories of 5 or 7 vowels (see Mtenje, this volume). These synchronic systems derive from a diachronic 7-vowel system reconstructed for Proto-Bantu (PB) (Guthrie 1967-71, Meeussen 1967, Meinhof and van Warmelo 1932) as shown in (1) below.[1] Five-vowel systems are the result of the

[1] The two degrees of high vowels is also represented in the Bantu langauge literature as /į - i/ and /ų - u / with the highest vowels, also referred to as “super-closed”, marked with a cedilla. Thus, in terms of

merger of the two degrees of high vowels reconstructed for PB as shown in (1) below. In 5-vowel languages (e.g. Ila (M63), Bemba (M42), Swahili (G42)) the mid-vowels may also be lax in some languages (and even perhaps predominantly so) but they tend to be represented with the tense /e, o/ symbols, since there is no contrast in the mid vowels. Languages that have synchronically maintained 7 vowels result into two types of systems, one that collapses the two degrees of height for the front and back high vowels, i.e. /i, ɪ, ʊ u/, and instead expand the mid-vowel degrees to have tense and lax mid vowels. The other 7-vowel system maintains the two degrees of high (front and back) vowels with only one set of mid lax vowels. This latter variety of 7-vowel system (e.g. as in Kikuyu (E51), Setswana (S31), Kaonde (L40), Matengo (N13)), with two degrees of mid vowels, is much more common that those with two degrees of high vowels such as Kinyamwezi (F22), Kimatuumbi (P13). The Proto-Bantu system and the three emerging synchronic systems are shown in (1).

(1) Proto-Bantu vowel system: *i *ɪ *e *a *o *ʊ *u

Five vowel system: i e a o u

Seven vowel system (i): i ɛ e a ɔ o u

Seven vowel system (ii): i ɪ ɛ a ɔ ʊ u

For the purpose of the discussion to follow and to delineate the domain of vowel harmony, we recap the structure of the Bantu verb in (2) below, where prefixes are treated as an outer domain to the verbal base that contains the verb root and suffixes, as standardly assumed in the Bantu literature.

(2) [Prefixes [[Verb-root]- suffixes]$_{\text{Verbal Base}}$-FV]$_{\text{Verb Stem}}$

The verb root in (2), usually of CVC shape shows vowel contrasts that allows all vowels in a language to contrast in this position. This differs from suffixes, which show diminished contrasts with only the high vowels /i, u/ and low /a/ occurring. This difference between roots and suffixes is what determines the dominance relation of vowel harmony, with the root being dominant and therefore acting as the trigger, while suffixes are the targets and undergoers of harmony. Bantu VHH thus involves a lowering process triggered by mid vowels in the root that require high vowels in suffixes to assimilate to the triggers by lowering their height from high to mid vowels. The canonical domain of VHH is thus the root + suffixes to the exclusion of the final vowel (FV).[2] A number of suffixes that lexically have high vowels thus have two

degrees of height {ị ụ} are first degree vowels; {i u} are second degree vowels; the mid vowels {ɛ ɔ} are third degree vowles and /a/ is the fourth degree vowel. Loss of first degree vowels by merger has resulted in spirantization in many 5-vowel systems as discussed in Schadeberg (1995) and Bennett, this voulme.

[2] Hyman (1999: 240) though points out some cases including Koyo (C24) and some B30 languages where the final vowel may harmonise by being raised. These are discussed in section 2.3.

allophones in e.g. the applicative, causative, stative, passive, and reversive/separative. Consider the process as illustrated with Ila (M63) examples from Greenberg (1951: 813) using the applicative *-il-*.

(3) Ila (M63)

a.	amb-a	'to speak'	→	amb-il-a	'to speak to'
b.	ik-a	'to cook'	→	ik-il-a	'to cook for'
c.	fund-a	'to cut up'	→	fund-il-a	'to cut up for'
d.	bez-a	'to carve'	→	bez-el-a	'to carve for'
e.	bomb-a	'to submit'	→	bomb-el-a	'to submit to'

In Ila (M63) suffixes which contain /a/, such as the reciprocal *-an-* show no variation and in this case /a/ can be said to not participate in the VHH process. The process in this case would involve raising, rather than lowering, and we will see presently that this is an option that some Bantu languages use.

We see a similar pattern to Ila (M63) in Swahili (G42) in (4) below where the suffix vowel of the applicative *-i-* is lowered to /e/ after the mid vowels {e, o} in the root, while the suffix vowel of the separative suffix *-u-* is lowered to /o/ only following an /o/ and not after an /e/. As in Ila (M63), suffixes with /a/ show no vowel harmony. Data are from Kula (2002: 45).

(4)

	verb			applicative	
a.	pit-a	'pass'	→	pit-i-a	'pass for'
b.	fung-a	'close'	→	fung-i-a	'close for'
c.	kat-a	'cut'	→	kat-i-a	'cut for'
d.	let-a	'bring'	→	let-e-a	'bring for'
e.	som-a	'read'	→	som-e-a	'read for'

(5)

	verb			separative		
a.	zib-a	'plug'	→	zib-u-a	'unplug'	
b.	fung-a	'close'	→	fung-u-a	'open'	
c.	pak-a	'load'	→	pak-u-a	'unload'	
d.	teg-a	'set trap'	→	teg-u-a	'set off trap'	*teg-o-a
e.	song-a	'press'	→	song-o-a	'squeeze out'	

The data in (4a-c) show no change in the applicative suffix, while (4d-e) show a change from /i/ to /e/. In the data in (5) by contrast, only the mid vowel /o/ triggers harmony when the suffix is *-u-*, while /e/ in (5d) does not. The harmony process is in this sense *asymmetric* because in the case of suffixes containing /u/, the mid vowel /e/ fails to trigger the processes. Hyman (1999) shows that this is a pervasive feature of Bantu VHH and that this is the cannonical type of VHH in Bantu (Ibid 1999: 236ff). This VHH pattern is the most widely discussed in the litearture. Hyman (ibid) further dicusses some variation in vowel harmony, recapped in a comparison of five 5-vowel

Bantu languages in Nichols (2018: 8) as in Table 1 below, where three non-canonical patterns can be seen.

Shona		**S. Kongo**		**Pende**		**Punu**		**Lozi**	
i.i	i.u	i.i	i.u	i.i	i.u	i.i	i.u	i.i/e	i.u
u.i	u.u	u.i	u.u	u.i	u.u	u.i	u.u	u.i/e	u.u
e.e	e.u	**e.e**	**e.o**	**e.e**	e.u	e.i	e.u	e.i/e	e.u
o.e	**o.o**	**o.e**	**o.o**	**o.e**	**o.o**	o.i	o.u	o.i/e	**o.o**
a.i	a.u	a.i	a.u	**a.e**	a.u	a.i	a.u	a.i/e	a.u

Table 1: Canonical vs. non-canonical VHH in 5 Bantu languages

For each language each column shows the vowel in the root followed by the vowel in the suffix, contrasting a high front suffix in the first column and a high back suffix in the second column. Pairs in bold show where VHH applies. Shona (S12) is the standard asymmetric VH we have seen thus far, where in the first column both /e, o/ harmonise /i/ to /e/ and in the second column only /o/ harmonises /u/ to /o/ while /e/ fails to do so, and as such the suffix surfaces with /u/. This canonical asymmetric pattern is predominantly found in Central, Eastern and Southern Bantu languages, such as for example, Kisa (E32), Runyankore (E13), Shambaa (G22), Cokwe (K11), Bemba (M42) and Tonga (M64).[3] The Bemba (M42) examples below in (6) show that the asymmetric nature of VHH means that /u/ of the stative *-uk-* acts as a blocker even if there is a possible target following, in this case, the applicative *-il-* with malefactive interpretation here. Thus in (6a-b) no harmony applies in contrast to (6c-d) where /o/ is the trigger and harmonises the two suffixes.[4] (6c-d) also illustrates the unbounded nature of VHH. Data are from Kula (2002: 46).

(6) Bemba asymmetric unbounded VHH

a. pen-uk-il-a	→	pen-uk-il-a	‘fall back on’
b. lep-uk-il-a	→	lep-uk-il-a	‘become torn on’
c. sok-uk-il-a	→	sok-ok-el-a	‘become unstuck on’
d. kont-uk-il-a	→	kont-ok-el-a	‘become broken on’

Punu (B43) is a rare example of a Bantu language that does not have VHH such that the mid vowels have no effect on either /i/ or /u/ in the suffix. Languages with no VHH tend to be 5-vowel languages as also seen in Lengola (D12), Suku (H32), Mbala (H41) and Ruund (L53).

Pende (C11) is like Shona in terms of being asymmetric with respect to front vs. back harmony but differs from most systems in having /a/ also able to trigger VH in a high front suffix. This is exemplified with Herero (R31) in (7) below (data from Kula & Marten 2000). The Herero (R31) examples show that /a/ also triggers harmony

[3] Hyman (1999: 238) identifies 46 languages with this system from a data base of 134 Bantu languages.
[4] This stative form *-uk-* in Bemba is now mainly found in fossilised forms as an expansion (Meeussen 1967).

despite Herero having an identical vocalic system to e.g. Swahili (G42) and Shona (S31) where /a/ does not trigger VHH.

(7) Herero (R31) VHH with the applicative *-ir-*

a.	pit-a	'go out'	→	pit-ir-a	'go out for'
b.	tuk-a	'shake'	→	tuk-ir-a	'shake for'
c.	pat-a	'close'	→	pat-er-a	'close for'
d.	vet-a	'hit by throwing'	→	vet-er-a	'hit for'
e.	ror-a	'taste'	→	ror-er-a	'taste for'

As in canonical VHH (in e.g. Shona) the mid vowels in Herero in (7) trigger vowel harmony (7d-e), but in addition, /a/ also lowers the suffix vowel of *-ir-* (7c) to *-er-*. This ability of /a/ to also trigger VHH is a feature predominantly of South-West Bantu, covering mainly zones K and R. Some other examples are Kwangali (K33, see Legere this volume), Mbundu (H11 and R11), Dciriku (K62), Kwanyama (R21) and Ndonga (R22).

S. Kongo (H16a) in Table 1 shows a very rare case of symmetric harmony which is hardly attested outside this zone, where unlike the Shona type of VHH, the mid front vowel /e/ also triggers harmony in a suffix with /u/ turning it to /o/. The H10 Kongo dialects that show symmetrical VHH are mainly 5-vowel languages in the North-West of the Bantu area (Hyman 1999). This pattern is illustrated in (8) below for the reversive/separative suffix *-ul-* with a high back vowel that gets harmonised and lowered to /o/ both after /o/ in (8d) and after /e/ in (8c). Data are from Hyman (1999: 241, glosses here translated into English from the original French).

(8) S. Kongo with separative/reversive *-ul-*

a.	vil-ul-a	'to recall'
b.	bub-ul-a	'corrupt/break'
c.	lemb-ol-a	'to rub out'
d.	tomb-ol-a	'to make/mount'
e.	bang-ul-a	'to violate/make violence'

Finally, Table 1 shows that Lozi (K21) differs from the canonical Shona type of VHH by showing no harmonization at all for suffixes with high front vowels so that for example the causative is *-is-* and the applicative is *-el-* in all contexts, with all preceding vowels. Examples are given in (9) below. Lozi (K21) is thus also non-canonical in having no VHH of high front vowels but having the regular asymmetrical harmony pattern for back high vowels as the separative/reversive *-ulul-* in (10) shows (see also Gowlett 1967). Data are from Fortune (2001) and also confirmed in own field notes (2005).

(9) Lozi (K21) non-harmonising *-is-*

a. lif-is-a ‘to find’
b. fuluh-is-a ‘to help puddle’
c. belek-is-a ‘to give employment’
d. fol-is-a ‘to wait till sunset’
e. bal-is-a ‘to teach to read’

(10) Lozi (K21) with separative/reversive *-ulul-*

a. bip-ulul-a ‘to let fermented grain dry up’
b. lut-ulul-a ‘to unthatch’
c. ez-ulul-a ‘to do for the second time’
d. bof-olol-a ‘to outspan’
e. amb-ulul-a ‘to change one’s mind’

The Lozi (K21) examples, in particular, show that Front VHH and Back VHH behave as independent systems since the absence of one does not preclude the other. Hyman (1999: 244-5) argues that these are also separated diachronically. Examples of Bantu languages with the Lozi harmony pattern are mainly in zones K and S in for example, Luyana (K31), Mbukushu (K33), Makhua (P31), Venda (S21), Tswana (S31), Nguni (S40).

The foregoing discussion shows that as long as suffix combinations are possible, VHH is an unbounded process that applies throughout the verbal base, with the FV excluded at least in canonical VHH, but see the discussion below for cases where FVs may be harmonised.

2.2 Seven vowel systems

As pointed out earlier, some Bantu languages have 7-vowel systems consisting of either the set {i, ɛ, e, a, ɔ, o, u} or one that mirrors PB more closely: {i, ɪ, ɛ, a, ɔ, ʊ, u}, to be discussed presently below. Examples of languages with two degrees of mid vowels are Kikuyu (E51), Matengo (N13), Sukuma (F21), Setswana (S31) and Kaonde (L40). 7-vowel systems provide more scope for complexity or at least variation in VHH than in the 5-vowel systems. Greenberg (1951: 814) notes that in Kikuyu (E51), for example, derivative suffixes occur with tense vowels as *-el-*, *-ol*, *-ek-*, *-ok-* (for the applicative and stative) after /a/, after tense mid-vowels and also after the high (tense) vowels. They however change to their lax counterparts when they occur after lax vowels as in the examples in (11). (11a-e) show the tense allophone *-er-*, while (11f-g) have the lax variant in harmony with the lax vowel of the root. In all cases, vowel duration does not have any additional effect on VHH as (11d) and (11f) show.

(11) Kikuyu (E51) VHH with the applicative *-er-*

a. ak-er-a	'to build for'
b. kin- er-a	'to catch up with'
c. rut-er-a	'to work for'
d. ɣe:r-er-a	'to fetch for'
e. rom-er-a	'to bite for'
f. rɛ:h-ɛr-a	'to read for'
g. ðrɔr-ɔr-a	'to look at'

Similarly, the reversive is *-or-* after /a, i u, e, o/ in the root but surfaces as *-ɔr-* after the vowels /ɛ, ɔ/ (Greenberg, ibid. p.814). This makes Kikuyu (E51) symmetrical with respect to back harmony, see further discussion below, as well as Peng (2000).

Greenberg (ibid. p.815) observes more broadly that 'in PB… vowels of the second level (ɛ, ɔ) may not be followed by vowels of the third level (e, o)'. He notes that an evaluation of PB reconstructed nominal forms (nouns and adjectives) and other parts of speech shows that a mix of the two sets of mid vowels were almost non-existent. This is as such also indicative of lexical VHH, which is also supported by Peng (2000).

In the 7-vowel languages that have two degrees of height for the high vowels i.e. {i, ɪ, ɛ, a, ɔ, ʊ, u}, we see differences in the VHH patterns in contrast to languages like Kikuyu (E51) above. In Kimatumbi (P13), for example, Odden (1996) shows that for the passive and causative suffixes, VHH involves agreement in height with the preceding non-low vowel. The underlying vowel of the passive and causative suffixes is tense /i/ since, Odden explains, this is what occurs after a low vowel (see 12a) that does not participate in the harmony process. Consider the data in (12) from Odden (2015).

(12) Kimatumbi (P13) VHH

	infinitive	passive inf.	causative inf.	Gloss
a.	ʧáag-a	ʧáag-ilw-a	ʧáag-ij-a	'to grind'
b.	ín-a	ín-ilw-a	ín-ij-a	'to dance'
c.	kún-a	kún-ilw-a	kún-ij-a	'to grate coconut'
d.	óʊg-a	óʊg-ɪlw-a	óʊg-ɪj-a	'to bathe'
e.	twíɪk-a	twíɪk-ɪlw-a	twíɪk-ɪj-a	'to lift a load'
f.	bɔ́ɔl-a	bɔ́ɔl-ɛla-a	bɔ́ɔl-ɛj-a	'to tear bark off a tree'
g.	ʧɛ́ɛŋg-a	ʧɛ́ɛŋg-ɛlw-a	ʧɛ́ɛŋg-ɛj-a	'to build'

(12a-c) have the underlying forms of the two suffixes, while (12d-g) show VHH where in (12d-e) the lax counterpart of *-il-* occurs (second degree vowel agreement), and in (12f-g) there is both laxing and lowering in height (third degree vowel

agreement) in line with the root mid-vowel.[5] Kinyamwezi (F22, Maganga and Schadeberg 1992) has the same 7-vowel inventory as Kimatuumbi (P13) but by contrast suffixes have lax vowels underlyingly and only show VHH with the mid vowels where *-ɪl-* of the applicative becomes *-ɛl-*. Consider the examples in (13).

(13) Kinyamwezi (F22) VHH with applicative *-ɪl-*

a. ap-íl-a ‘collect money for’
b. ʃik-ɪl-a ‘arrive for’
c. zug-íl-a ‘cook for’
d. βɪt-íl-a ‘pass for’
e. gʊl-ɪl-a ‘buy for’
f. lɛk-ɛl-a ‘let for’
g. βɔn-él-a ‘see for’

In this case only (13f-g) show VHH. This illustrates the important role of directionality in VHH as earlier discussed. We noted that the verb root is usually the trigger while suffixes are the targets, which results in the VHH process going from left to right. If suffixes could be triggers then we would expect the roots in (13b-c) to be harmonised from right to left. Thus in 7-vowel systems of this type, the shape of the suffix with a tense or lax vowel determines whether VHH will apply at multiple degrees – it does so in Kimatuumbi (P13), which has tense suffixes, but does not in Kinyamwezi (F22), which has lax suffixes, as illustrated above.

In all cases, both in the Kikuyu (E51) type and the Kimatuumbi (P13) type of 7-vowel systems, we see that VHH with high front vowels is symmetrical in that both front and back vowels trigger harmony in a suffix with a front vowel. As we saw with 5-vowel systems, back vowels are, with only a few exceptions, asymmetrical since front mid vowels fail to trigger harmony in suffixes with back high vowels. This same situation also holds in 7-vowel languages with some variation as summarised in Table 2 below. Other 7-vowel languages also showing the asymmetry as noted in Hyman (1999: 237) are Rimi (F32), Kinga (G65), Nyakyusa (M31) Lega (D25) and Holoholo (D28).

Kikuyu		**Matengo**		**Nkundo**		**Kimatuumbi**		**Kinyamwezi**	
V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
a	u	a	u	a	o	a	u	a	ʊ
i	u	i	u	i	o	i	u	i	ʊ
u	u	u	u	u	o	u	u	u	ʊ
e	u*	e	u*	e	o	**ɪ**	**ʊ**	ɪ	ʊ
o	u**	**o**	**o**	o	o	**ʊ**	**ʊ**	ʊ	ʊ
ɛ	**ɔ**	ɛ	u*	ɛ	ɔ	ɛ	u*	ɛ	ʊ*
ɔ	**ɔ**	**ɔ**	**ɔ**	ɔ	ɔ	**ɔ**	**ɔ**	**ɔ**	**ɔ**

[5] For clarity, {i, u} are first degree vowels, {ɪ, ʊ} are second degree vowels and {ɛ, ɔ} third degree vowels in this instance.

Table 2: Back Vowel Height Harmony in 7-vowel systems

The vowels in bold and underlined are cases that show VHH. Apart from Nkundo (C61), all systems are asymmetric with respect to at least one set of front mid vowels not showing harmony. This is indicated by one asterisk. The Kikuyu case with two asterisks is surprising as a back mid vowel fails to trigger back harmony, with this only happening for the lax vowels so that in this case it seems that the harmonising trigger vowel must be a lax vowel.

Matengo (N13, Yoneda 2000) is exactly parallel to a 5-vowel system in that no front mid vowels trigger harmony with back vowels. Data in (14) below from Yoneda (2000) show that only (14e, g) show VHH while the front mid vowels in the roots in (14d, f) fail to trigger harmony.

(14) Matengo back VHH with the stative *-uk-*

a. tab-uk-a ‘separate’
b. ʤím-uk-a ‘wake up’
c. tumb-uk-a ‘start’
d. hjék-uk-a ‘be de-lidded’
e. hóg-ok-a ‘be openable’
f. njɛmb-uk-a ‘be flexible’
g. ʤɔ́m-ɔk-a ‘be over’

Nkundo is an outlier and seems to parallel the Lozi pattern of VHH in front vowels where, for example, the applicative suffix is *-el-* invariantly. Here the separative/reversive is invariantly *-ol-* apart from when it harmonises in (15f-g). Interestingly though, it shows no asymmetry with respect to lax /ɛ/ which also triggers back harmony. This symmetric harmony pattern with respect to back vowels in 7-vowel languages is found in zones A-C (Hyman 1999: 241).

(15) Nkundo non-canonical VHH with the separative/reversive *-ol-*

a. bák-ol-a ‘set’
b. fík-ol-a ‘respect’
c. kund-ol-a ‘bury’
d. bét-ol-a ‘arouse’
e. bomb-ol-a ‘remove’
f. sɛ́k-ɔl-a ‘chop’
g. mɔm-ɔl-a ‘take off’

Kimatuumbi (P13) and Kinyamwezi (F22) contrast only because they differ in the quality of the vowel of the suffix, which is tense in Kimatuumbi and hence shows harmony with high lax vowels, while Kinyamwezi with an underlyingly lax suffix does not. Odden (2015) reports that the Kimatuumbi patterns can also be seen in Kinga (G65), Vwanji (G66) and Lugungu (JE101).

2.3 VHH with prefixes and the FV

In the majority of cases as discussed above, prefixes and the FV are excluded from the domain of VHH. There are nevertheless cases where this happens in some Bantu languages and we discuss these briefly here. Hyman (1999) notes that in those cases where prefixes do harmonise, the target is generally prefixes with high vowels to the exclusion of those with /*a*/. The other distributional fact in cases where prefixes harmonise is that this happens predominantly in 7-vowel languages of mainly zones A and C, although there are also cases in zone E. Example languages are Londo (A11), Bakweri (A22), Nə̀n (A44), Koyo (C24), Mongo (C61), Tetela (C71), Logooli (E41) and Gusii (E42). VHH with prefixes applies more often in languages with ATR harmony, as will be discussed later below for Budu (D35) (with 9 vowels). The appearance of VHH with prefixes may thus be indicative of a transition towards ATR harmony. Examples of VHH with the class 5 prefix *e-* and class 3 prefix *o-* in Koyo (C24) are given in (16) and (17) below, drawn from Hyman (1999: 240). In each case the (b) examples show VHH triggered by stems with lax mid vowels, changing the VHH direction to right-to-left and here still root/nominal stem controlled. The (a) examples show the underlying form of the prefix

(16) Class 5 prefix -*e* harmony in Koyo (C24)

a.	e-símu	‘scream’	b.	ɛ-bɛ	‘thigh’
	e-túsi	‘shoulder’		ɛ-sɛ́gɛ́	‘hoe’
	e-bémbo	‘debt’		ɛ-bɔ́gɔ́	‘arm’
	e-kóró	‘skin’		ɛ-sɔ́gɔ́	‘hip’
	e-lagá	‘promise’			

(17) Class 3 prefix -*o* harmony in Koyo (C24)

a.	o-lingu	‘love’	b.	ɔ-kɛsú	‘stream’
	o-kulí	‘hill’		ɔ-tɛrɔ	‘basket’
	o-yélo	‘morning’		ɔ-nɔgɔ	‘mouth’
	o-kóro	‘clothing’		ɔ-kɔ	‘might’
	o-sanga	‘rope			

In these Koyo (C24) examples we see that both mid vowels /ɛ ɔ/ can trigger harmony of /e/ and of /o/; there is thus in this sense symmetry. The first example in (17b) shows that overall disharmonic stems are possible and that VH still applies from the first vowel of the stem to the prefix in this instance.

The other uncommon feature of VHH is that it may sometimes involve the FV. This has been reported in B30 and a few A and C languages, but is otherwise quite rare, but see the later related discussion of vowel copying. (18b) shows examples of the FV being harmonised in Bakweri (A22) from Hawkinson (1985) in Hyman (ibid).

(18) Bakweri (A22) VHH of the FV

a.	li-sík-a	'to groan'	b.	i-lɛmb-ɛ́	'to laugh'
	li-tút-a	'to sweep'		i-kɔ́m-ɔ	'to beat'
	i-kot-a	'to light'			
	i-vend-á	'to plait'			
	i-fáf-a	'to hit'			

In the (18b) examples we see the final *-a* raised to the mid lax vowels, triggered from left to right. With all the other vowels in (18a) the FV stays in its standard citation form *-a*.

Hyman (1999: 241) reports that in Kongo (H10) and Yaka (H31) there is VHH involving the final vowel only in perfective forms. In Yaka (H31), for example, the perfective suffix is *-idi* (also nasalising to *-ini* after nasals) and is subject to harmony that turns the suffix *-idi-* into *-ele* after the mid vowels /e, o/ in the root. It seems that most languages that extend VHH to the prefix also tend to harmonise the FV (e.g. Mongo (C61), Tetela (C71), Gusii (E42)) so it may be that beginning to harmonise prefixes reflects a broad extension of the VHH domain to include the whole stem/word.

3. ATR Harmony

ATR harmony in Bantu languages is much less common than the VHH discussed above. But there are some cases where the PB vowel inventory has been expanded such that both the high and the mid vowels have tense and lax counterparts, resulting in 9-vowel inventories, such as in Budu/Kibudu (D35) where /a/ does not have a +ATR counterpart or resulting in a 10-vowel system as in Kinande (DJ42) where /a/ has /ə/ as the counterpart vowel. These systems are the type that predominantly show ATR harmony although this has also been reported in smaller systems like Nə̀n (A44, Bancel 1991). Around Cameroon and the Democratic Republic of the Congo (DRC) are the main areas where ATR harmony applies in Bantu. I will discuss Budu (D35) and Kinande (DJ42) in more detail below, as examples of ATR systems.

3.1 ATR Harmony in Budu (D63)

Kutsch Lojenga (1994) discusses Budu (D63) from the DRC as a language demonstrating ATR harmony. ATR harmony is also present in other zone C10-30 DRC languages of the Congo Basin including Bila, Lika, and Ntomba (Leitch 1996).[6] The vowels of Budu (D63) are divided into the ATR and non-ATR sets below.

(19) Budu (D63) vowel inventory (Kutsch Lojenga 1994: 124)

a. +ATR: {i, e, o, u}
b. -ATR: {ɪ, ɛ, a, ɔ, ʊ}

[6] Leitch (1996) also discusses cases where the [RTR] feature is active in a large number of zone C languages.

ATR harmony in this border Bantu language implies that there are co-occurrence restrictions within roots and nominal stems such that vowels must belong to the same ATR set. Kutsch Lojenga (ibid) shows that apart from within roots and nominal stems this Vowel Harmony (VH) is attested in the noun class prefix system, in the verbal FV, in verbal prefixes and in numeral prefixes. The VH is +ATR dominant so that it is -ATR vowels that change to become +ATR. /a/ is transparent to VH and can occur with either vowel type, but if it occurs alone in a root, for example, it takes a -ATR prefix, and for this reason is presented as both transparent and -ATR.[7]

Budu has a reduced Noun Class system with only classes 1-6, 8, 10, 11 and 14 present. Of these, all those with high vowels are subject to ATR harmony with [+ATR] nominal roots triggering harmony in the prefix, so that each prefix shows an alternation between a [+ATR] and a [-ATR] variant. Consider the examples in (20) from Kutsch Lojenga (ibid, p. 130).

(20) ATR Harmony in Budu nominal prefixes

Class	-ATR		+ATR	
1	mʊ-nɔnɔ	'descendant'	mu-nenú	'daughter in Law
3/4	mʊ-tɪmá	'heart'	mu-kpékpé	'seed, grain, kernel'
	mɪ-kaní	'pips of fruit'	mi-tanji	'type of trees'
11	ʊ-kyɛpʊ́	'non alcoholic drink'	u-njiɓo	'type of caterpillar'
	ʊ-mwɛngá	'type of fish'	u-bŭka	'type of sweet potato'

In (20) we see the alternating prefixes depending on the vowel(s) in the stem. The transparency of /a/ is demonstrated by its ability to occur in both [+ATR] and [-ATR] forms without blocking the harmony process. The ATR harmony shown here for nominal prefixes also applies in numerals that take prefixes i.e. the roots for *one*, *two* and *three*. The prefixes for numbers two and three are [+ATR] and trigger [+ATR] harmony in the root. In this case the ATR harmony goes from the prefix to the root: *ɓă-tʊ́* 'Cl.2-three' vs. *ɓĕ-tú* 'Cl.10-three'; *kă-tʊ́* 'Cl.6-three' vs. *fĕ-tú* 'Cl.8-three'.

As we saw earlier in 7-vowel language systems, languages that showed VHH with prefixes, also generally showed harmony with the FV. This is also the case in Budu, where in verbal forms the FV alternates between *-a* and *-o* depending on the preceding vowel in the base being [-ATR] or [+ATR], respectively. Thus, we get forms like *nít-o* 'to pour', *ses-o* 'to send', *tók-o* 'to spit' and *kut-o* 'to close' (Kutsch Lojenga ibid, p.131). All other stems with [-ATR] vowels take *-a*.

Finally, quite exceptionally, object prefixes also show ATR harmony with object markers having two forms depending on whether a verbal form is [-ATR] or [+ATR]. Table 3 shows the different forms of the object markers as presented in Kutsch Lojenga (ibid. p.131).

[7] Another way of representing this is to assume it is underspecified as just [ATR].

		Underlying Form	In [+ATR] contexts
Cl 1	1 sg	-na-	-na-
	2 sg	-na-	-na-
	3 sg	-mʊ-	-mu-
Cl 2	1 pl	-tɪ-	-ti-
	2 pl	-nɪ-	-ni-
	3 pl	-bʊ-	-ɓu-
Cl 3		-ʊ-	-u-
Cl 4		-ɪ-	-i-
Cl 5		-ɪ-	-i-
Cl 6		-kʊ-	-ku-
Cl 8		-dɪ-	-dɪ-
Cl 10		-mʊ-, -ɪ-	-mu-, -i-
Cl 11		-ʊ-	-ʊ-
Cl 14		-bʊ-	-bʊ-

Table 3: Budu (D65) Object Prefixes/Markers

The object markers with /a/ do not alternate due to the neutrality of the low vowel with respect to ATR. All other object markers, apart from classes 11 and 14, alternate. There are no prefixes and objects markers with mid vowels.

3.2 ATR Harmony in Kinande (DJ42)

The vowel system of Kinande (DJ42) has been described in different ways. Mutaka (1995) describes it as having 7 contrastive vowels {i, ɪ, ɛ, a, ɔ, ʊ, u} but with {e, o} as two additional phonetic/non-contrastive vowels that never occur in roots and are the result of ATR harmony. Kinande (DJ42) also has VHH as described above for 7-vowel languages, applying at the stem level and showing the asymmetric pattern with respect to back vowels. VHH and ATR harmony apply in parallel and there is no direct relation between the two. Archangeli and Pulleyblank (2002: 142) treat the two {e, o} as part of the system and also assume a [+ATR] counterpart for /a/ to give the system in (21).[8] They however also assume that only the high vowels have a lexical contrast for ATR.

(21) Kinande vowel system and specifications

Advanced [+ATR]: {i, e, ə, o, u}

Retracted [-ATR]: {ɪ, ɛ, a, ɔ, ʊ}

[8] Mutaka (1995) also says the /a/ vowel in [+ATR] contexts has a different quality to that in [-ATR] contexts and thus seems in agreement with (21). Gick et al. (2006) conduct a phonetic study that supports this and leads to the conclusion that there is a [+ATR] counterpart to /a/, albeit that only surfaces in [+ATR] contexts. See also Kenstowicz (2008).

ATR harmony in Kinande is triggered by [+ATR] high vowels and can be bi-directional with application from right to left from suffixes to roots/stems, as well as from roots/stems to suffixes also being possible. The domain of application is the word although harmony across words is also possible (Mutaka 1995). Although the [-ATR] mid vowels undergo ATR harmony to become [+ATR] they are not themselves triggers. Application of ATR harmony means, as we saw above, that words will have either all [+ATR] or all [-ATR] vowels. The process is illustrated in the examples below from Mukata (1995: 48ff). In the verbal forms below ɛ- is the augment, -rɪ- is the infinitive marker, both with underlying [-ATR] vowels, which are then followed by the verb root, suffixes if present, and the default FV *-a*.[9] The causative suffix *-is-i-* or *-i-* in (22c-f) is underlyingly [+ATR].

(22) Kinande ATR harmony

a.	yir-	'dislike'	e-ri-yi̱r-a	'to dislike'
b.	hum-	'move'	e-ri-hu̱m-a	'to move'
c.	hʊm-	'roar'	e-ri-hum-is-i̱-a	'to make roar'
d.	sɛk-	'laugh'	e-ri-sek-i̱-a	'to make laugh'
e.	sɔk-	'cross'	e-ri-sok-i̱-a	'to make cross'
f.	sak-	'leave'	e-ri-sak-i̱-a	'to leave out something'
g.	yɪr-	'have'	ɛ-rɪ-yɪr-a	'to have'

In (22) we have the underlying forms of roots in the leftmost column and the outputs after prefixation and suffixation in the second Kinande forms, with the [+ATR] harmony triggering vowels underlined. In (22a-b) the trigger is the root vowel that then harmonises the prefix vowels to be [+ATR]. In (22c-e) the roots are [-ATR] but change to [+ATR] under influence of the causative suffix, demonstrating spreading through the root and up to the prefix. (22f) shows that /a/ is transparent with [+ATR] able to spread through it to the prefix. Alternatively, the vowel here has been treated as also changing to [+ATR] as a schwa, as in Archangeli and Pulleyblank (2002), for example. (22g) shows that when there is no [+ATR] trigger in the verb form then all vowels in the word are [-ATR]. These are all cases of right to left spread of [+ATR]. The other instance where we see right-to-left [+ATR] spread is with the agentive suffix *-i* where forms like *ɔ-mʊ-lɪm-i* become *o-mu-lim-i* 'farmer' with ATR harmony from the right to the left edge.

The examples in (23) show that bidirectional spread is also possible with, for example, the purposive suffix *-ɪrɪr-*. Data are from Mutaka (1995: 49).

[9] The presentation of the data is here changed from the original and uses /i, u/ instead of /ị ụ/ as the [+ATR] vowels and /ɪ, ʊ/ instead of /i, u/ as the [-ATR] vowels in the interest of clarity and uniformity with the rest of the chapter. Although not shown in all the Kinande examples cited here following Mutaka's (1995) representation, Kinande has penultimate lengthening which is particuarly important at the phrasal level, but has no effect on VH.

(23) Bidirectional [+ATR] spreading

a.	hum-	'move'	e-ri-hum-irir-a	'to move anyway'
b.	huk-	'cook'	e-ri-huk-irir-a	'to cook anyway'
c.	hʊm-	'roar'	ɛ-rɪ-hʊm-ɪrɪr -a	'to roar anyway'

In (23a-b) [+ATR] spreads from the root rightwards to the suffix and leftwards to the prefix. (23c) shows that both the prefix and suffix are lexically [-ATR] when they occur with a [-ATR] root.

A striking feature of ATR harmony in Kinande is that the targets of rightward and leftward harmony are different. Leftward ATR harmony affects both high and mid vowels, but by contrast rightward [+ATR] spread only affects high vowels. Hyman (1999) treats this as reflecting that anticipatory VH (the former) is more robust than preservative VH (the latter). That rightward ATR harmony only affects high vowels is shown in the data in (24b and d). These also crucially present cases of disharmonic words where the (a) examples have the prefix as [-ATR] but in the (b) examples the same prefix is [+ATR] but with no local source for this. Data are from Mutaka (1995: 49-50). In these forms *-rɪ-* is the noun class 5 prefix that is only homophonous with the infinitive maker. Similarly, in (24c) the [-ATR] nominal stems occur as expected with [-ATR] prefixes but the same stems take [+ATR] prefixes in (24d).

(24) Left to Right ATR VH targets only high vowels

a.	ɛ-rɪ-sʊngʊ	'rat'	b.	e-ri-tɛrɛ	'breast'
	ɛ-rɪ-rɪnda	'seven'		e-ri-takɔ	'buttock'
	ɔ-rɪ-erʊ	'ripe banana'		e-ri-lɔlɔ	'sin'
c.	ɔ-lʊ-sɛkɛ	'big reed'	d.	e-sí-sɛkɛ̀	'reeds'
	ɔ-lʊ́-sakɔ	'tattoo'		e-sí-sakɔ	'tattoos'

Hyman (1999) further identifies three patterns in some unexpected ATR distributional patterns that relate to (24) but are limited to the class 5 prefix /*ɛ-rɪ-*/. The class 5 prefix is [+ATR] when; (i) there is a [+ATR] high vowel in the stem and (ii) when all stem vowels are [-ATR]. And (iii) the class 5 prefix is [-ATR] when the first stem vowel is a [-ATR] high vowel. These patterns are exceptional and elude a uniform analysis given the patterns discussed earlier.

In contrast to VHH, ATR harmony more readily crosses the prefix boundary and is more likely to show variation in directionality. For both processes the Bantu languages show interesting variation predominantly related to the vowel inventory involved.

4. Vowel copying

A final case to consider is vowel copying, which can in some sense be treated as a special kind of vowel harmony involving total rather than partial assimilation as seen thus far. Vowel copying has been described as used to denote near past or anterior

aspect (Nurse 2008).[10] Languages of South-West Bantu, particularly in zone K, such as Dciriku or Rumanyo (K332), Lucazi (K13), Mwenyi or SiMwenyi (K352), Cokwe (K11), Kwangali (K33), most commonly display the process, although it can also be found in Comorian (G44) and in an altered form in Kilimanjaro Bantu languages (Shinagawa 2014). The assimilation process in its canonical form involves a copying of the verb root vowel onto the FV, thereby replacing the canonical final *-a* in particular tenses of the past. Consider the examples below from Dciriku drawn from Möhlig (1967), see also Kula & Marten (2019). In all cases the FV is replaced by the preceding root vowel in (25).

(25) Vowel copying in Dciriku (K332)

a. a-nà-dúy-u
   SM3SG-PAST-row-VCopy
   'S/he rowed'

b. a-nà-m-fíng-i
   SM3SG-PAST-OM3SG-cast_spell-VCopy
   'S/he cast a spell on him/her'

c. a-nà-hór-o
   SM3SG-PAST-love-VCopy
   'S/he loved'

d. a-nà-n-djéd-e
   SM3SG-PAST-OM3SG-seduce-VCopy
   'S/he seduced him/her'

e. a-nà-tang-a
   SM3SG-PAST-kick-VCopy
   'S/he kicked'

These verb forms in other tenses/aspects would take the standard final vowel *-a*. The domain of vowel copying is canonically the root and final vowel as seen also in, for example, Lucazi (K13) and Cokwe (K11) (Fleisch 2000), Kwangali (K33, Legere, this volume) and Comorian (G44, Shinagawa 2014). However, there are cases where vowel copying also applies when extensions are present. In Dciriku, for example, a subset of suffixes trigger vowel copying. The process is seen in particular with the applicative extension and the 'causative 2' extension. In cases where VHH also applies it may be difficult to distinguish VHH that affects the FV and vowel copying. Consider the following examples from SiMwenyi (K352, Kula & Marten 2019) where the applicative and the separative transitive show vowel copying. Furthermore in SiMwenyi, in contrast to Dciriku, there is variation with vowel copying sometimes only happening when there is an overt object/verbal complement present. Consider the examples in (26).

[10] In Möhlig (1967: 28-9, 178-9) it is associated with a recently completed progressive, today's perfect, definite past, and the subsecutive. Importantly, the tenses involved are considered as having a 'definite aspect', i.e. as having a definite temporal restriction or endpoint.

(26) Vowel copying with suffixes in SiMwenyi (K352)

a. ni-na-twal-el-e Sitali
1SG-PST.PERF-take-APPL-VC Sitali
'I have taken for Sitali'

b. ni-na-a-twal-el-e
1SG-PST.PERF-3PLOM-take-APPL-VC
'I have taken for them'

c. ni-na-kam-un-a
1sg- PST.PERF-comb-SEP-FV
'I combed'

d. ni-na-kam-un-u kale
1SG-PST.PERF-comb-SEP-VC already
'I had already combed'

e. ni-na-bind-ulul-a
1SG-PST.PERF-plait-SEP-FV
'I have uplaited'

f. ni-na-bind-ulul-u ŋuki
1SG-PST.PERF-plait-SEP-VC 9hair
'I have unplaited hair'

Like in Lozi (K21) the applicative is invariantly -el- in SiMwenyi. In (26a-b) we see this suffix vowel copied to the FV position in the two tenses. In (26c-d) no vowel copying applies in (26c) but for the same tense when an adverb follows, vowel copying applies. Similarly, in (26e-f) the verb forms/tenses are identical with the only contrast being the presence of the object, which seems to then license the vowel copying process. Kula and Marten (2019) argue that vowel copying, at least in the zone K languages, is associated with expressing an endpoint, which in some languages, like SiMwenyi, must be provided by an overt complement.

The vowel copying process in Kilimanjaro Bantu (Chaga E60)[11] languages is different from this. Shinagawa (2014) shows that in this case it involves lengthening the final vowel, which is usually an inflectional vowel, by adding a *vowel copy clitic*. Like the vowel copying process described above, vowel copying in the Chaga languages is also restricted to occurring in a restricted set of tenses related to the near past and anterior aspect. Consider the pairs of examples in (27)-(29) below from Shinagawa (ibid, p.11, 13-14) for Rwa, a West Kilimanjaro Bantu language.

(27) a. ti-loli-ié
SM1PL-see-FV(STAT)
'We see / We have seen'

b. tí-í-loli-ié=e
SM1PL-PST.IMPF-see-FV(STAT)=POSF
'We saw / We had seen'

[11] The collect of Kilimanjaro Bantu languages/peoples are found on the slopes of Mt. Kilimanjaro in Tanzania and borders the non-Bantu Maa (Nilotic) speaking area in the west, with which there is contact and it may be that this feature is as a result of contact (Shinagawa 2014). To the northeast is the Nyika-Taita group (Bantu) and to the south is Shambaa (G23).

(28) a. ni-ishí
SM1SG-know
'I know'
b. ní-i-ishí=i
SM 1SG -PST .IMPF -know=POSF
'I knew'

(29) a. t-a-ṅ́-loli-a
SM-1PL-PST-ANT-see-FV
'We have seen'
b. t-e-é-ṇ-loli-á=a
SM-1PL-PST-PST.IMPF-ANT-see-FV=POSF
'We had seen'

As can be seen in (27)-(29) in each of the past forms of the (b) examples, the FV is lengthened irrespective of the quality of the vowel. This differs from the case above in Dciriku as this does not involve a replacement of the FV but rather addition of a copy of the FV. It also means that it is not the root vowel that is copied, but like in the cases where the suffix vowel can be copied, it is the FV itself that is copied. Shinagawa (2014) notes that although not widespread, this pattern of vowel copying is found outside the Chaga area in some Forest Bantu languages of the Congo Basin as reported for Bila in Kutsch Lojenga (2003: 469) where it denotes the past of the anterior aspect as shown in (30) below. Data are drawn from Shinagwa (ibid).

(30) a. a-chéch-í (ɗo̰)
SM3SG-run-FV(ANT) (AFF)
'He has run (perfect)'
b. a-chéch-íí ɗo̰
SM3SG-run-FV(R.PST) AFF
'He has run (a long time ago)'

In (30) as also seen above, the remote past is marked by vowel copying of the final inflectional vowel. This latter type of vowel copying process differs from what may be standardly considered vowel harmony since the process involves adding the target but the process is still assimilatory in as far as all its features must derive from the preceding vowel.

5. Vowel Harmony analyses

This section gives a brief commentary on the analytical issues that vowel harmony in Bantu languages raises and the kinds of analyses that have emerged in response to some of the data discussed here. The reader is referred to the references cited here for detailed discussion. Although vowel harmony is a very common and pervasive process cross-linguistically, it raises very crucial questions with respect to contiguity and locality because of its non-local nature, applying across a consonant. This is particularly significant when the same features are used for both consonants and vowels as we must explain why the intervening consonant remains unaffected in any

spreading processes. This has made autosegmental representations (e.g. Clements 1991) highly favoured in dealing with feature spreading, assuming that these features reside on tiers higher than the segments themselves and allow the required adjacency between targets. This also makes it possible to represent the harmonic features as a single feature from the trigger that spreads to all targets in a specified domain.

A crucial issue in most analyses is the nature of the spreading features themselves and whether they are bivalent and have binary oppositions or whether they are monovalent. The majority of work on Bantu languages has favoured bivalent features defining VHH as the spread of [-High] from a mid vowel to a [+High] vowel in the suffix thus changing its specification and turning it into mid (see e.g. Scullen 1992) with this implemented using autosegmental spreading, or through constraint interaction (Archangeli and Pulleyblank 2002, Beckman 1997, Krämer 2003, Mtenje 1985, Nichols 2018), or using strata (e.g. in Mutaka 1995). Monovalent approaches, particularly in Element Theory are offered in Harris (1994), Kula & Marten (2000), Kula (2002) for example, offering spreading analyses which are representation based, and where a monovalent element like |A| spreads from a mid-vowel that is composed of |A I| to a high suffix vowel containing either only |U| or |I| to harmonise these into mid vowels that are structurally complex. In this case there is no element replacement but rather composition. In all approaches to VHH and as Nichols (2018) emphasises, based on the distributional facts discussed in section 2, analyses distinguish Front VHH from Back VHH to account for their asymmetric pattern, which as Hyman (1999) also shows, can be traced back to Proto-Bantu. With respect to ATR harmony, an ATR feature, also usually with binary oppositions, has been used in different approaches, particularly with grounded constraints (Archangeli and Pulleyblank 2002). In element-based approaches this would normally involve some kind of head alignment/agreement since there would be no element spreading in ATR harmony as there is no change in element composition in this case when, for example, /ɪ/ becomes /i/. These analyses have all mainly dealt with canonical vowel harmony including the main variations, and can be extended to capture some of the more idiosyncratic cases discussed here.

6. Conclusion

This chapter has provided an overview of vowel harmony in Bantu. It has looked at VHH and discussed the similarities and differences between how VHH applies in 5-vowel vs. 7-vowel languages. In each language type we have seen variation in the application of VHH and, in particular in 7-vowel languages, we get two types of vowel inventories that lead to different patterns of VHH. The 7-vowel languages can be seen as the bridge to the development of ATR systems, particularly in systems like Kimatuumbi, which then expand the vowel inventories further. VHH and ATR harmony are not exclusive and can apply within the same language as seen in Kinande. A crucial difference between the two types of harmony is the domain of application. VHH applies within the stem and in verb forms is mainly restricted to the verbal base. By contrast, ATR harmony applies in a larger domain that also includes nominal prefixes, as well as TAM markers in verbs, thus applying at the word level.

We have seen that although the domains of vowel harmony generally exclude the FV there is a specific kind of harmony – vowel copying – that only targets the FV. In terms of directionality, due to the root being the trigger in verbal forms in VHH, with suffixes being the targets, VHH generally goes from left-to-right. In ATR Harmony where prefixes are also targets and in addition suffixes can also be triggers, we see both directions being possible, and also have systems where bidirectional spread applies within the same forms. Although vowel harmony is triggered in morphological contexts, it is phonological in applying in a blind unbounded fashion, as long as suitable targets are available.

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