Directionality in Nkore-Kiga sibilant harmony: arbitrary or emergent?*

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1 Introduction

The purpose of this paper is to discuss a problem related to directionality in the theory of Agreement By Correspondence, and propose a simple solution: the problem does not actually arise in the known case that motivates it.

The puzzle we focus on relates to sibilant harmony in Nkore-Kiga, a Bantu language spoken primarily in Uganda. Previous work on Nkore-Kiga reports three generalisations:

(1) (a) Anteriority in sibilants is normally allophonic, conditioned by the following vowel
   i. { s z } before [i]
   ii. { ʃ ʒ } elsewhere
   (b) Sibilants deviate from the normal allophonic pattern due to harmony within the stem
   (c) Harmony operates strictly right-to-left: the rightmost sibilant in the stem is conditioned in the normal way, and other, preceding, sibilants assimilate to match it.

These three generalisations, taken together, yield a pattern of consonant harmony that defies explanation both in an Agreement By Correspondence

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framework (Hansson 2001; Rose & Walker 2004) – and more generally in frameworks where assimilation is driven by a need to have agreement or avoid disagreement (Smolensky 1993; Baković 2000; Pulleyblank 2002).

In §2, we present the puzzle in more detail, and show how the pattern described in previous work cannot be derived with straightforward agreement-based harmony constraints - even when directionality is hard-wired into the constraint definitions (following, for example, Walker (2001) or Hansson (2001)). In §3, we consider the Nkore-Kiga data in closer detail, showing that the range of data which actually evidences the problem is at best scant. The solution we suggest is that the problem doesn't actually arise. We find that the observed facts can be explained in a straightforward way by appealing to morphology, without building extra stipulations about the direction of assimilation into the theory of consonant harmony.

2 Nkore-Kiga background and the problem

Nkore-Kiga is a family of closely related dialects spoken primarily in Uganda, classified as E.13-14, in the Inter-lacustrine group, within the Bantu language family. We follow Taylor's (1985) convention of referring to Runankore and Rukiga together as Nkore-Kiga, and the generalisations and data reported in previous work are generally not attributed more specifically within this group.

The phonemic consonant inventory of Nkore-Kiga is given in (2) (Taylor 1985).[2]

(2) Consonants of Nkore-Kiga

labial	dental alveolar	post-alveolar	velar	glottal
p b	t d	tʃ dʒ	k g	
f v	s z	ʃ ʒ		h
m	n	ɲ	ŋ	
w	ɹ	j		

[2]Taylor analyzes [tʃ] and [dʒ] as palatalisation of /k g/ before high vowels, and [d] as an allophone of /r/ after /n/. Taylor does not give /ts/ as a segment in his inventory, nor does Poletto (1998), but it is attested in examples given by both.

Previous work (Hyman 2003, Hansson 2001) reports that the anteriority of sibilants is conditioned by the following vowel, in a fashion that seems to reverse expected "naturalness": [+anterior] sibilants [s z] occur before [i], while their [−anterior] counterparts [ʃ ʒ] occur before all other vowels (sibilants may not occur before consonants other than [w] and [j], which behave like the high vowels). The pattern is schematised in (3), and the examples in (4) are representative of this situation.

(3) Allophonic distribution

si zi	ʃu ʒu	Anterior sibilants {s, z} only before [i]
ʃe ʒe	ʃo ʒo	Non-anterior {ʃ, ʒ} everywhere else
ʃa ʒa		

(4) Sibilant allophones

	[s∼ʃ]		[z∼ʒ]	
__ [i]	kù-sìn-à	'scold'	kù-zìr-à	'forbid'
__ [e]	kù-ʃèk-à	'laugh'	kù-ʒèŋg-à	'become sodden'
__ [a]	kù-ʃàmb-à	'kick'	kù-ʒáb-à	'lap'
__ [o]	kù-ʃòm-à	'read'	èt͡ʃì-ʒòg-à	'large water pot'
__ [u]	kù-ʃùŋg-à	'flatter'	kù-ʒùb-à	'get wet'

Within the stem - consisting of the root and suffixes, to the exclusion of prefixes - sibilant harmony is reported. Given the allophonic distribution of the sibilants, however, two cases must be distinguished. In the first, (5), the two sibilants agree but this is consistent with both the allophonic requirements and any harmonic requirement.

(5) Distributional harmony

	[s, z]			
a.	òbù-sìisì	'sin(s), evil'	èt͡ʃì-zìzì	'phlegm'
	[ʃ, ʒ]			
b.	è-ʃèʃè	'dysentery'	kù-ʒènʒèèk-à	'tie loosely'
c.	òmù-ʃàʃà	'(African) long hair'	kù-ʒááʒààb-à	'to nurse'
d.	kù-ʃòʃòòr-à	'pull out'	èn-ʒòʒò	'elephants'
e.	kù-ʃùʃ-à	'seem, look'	èbì-ʒúʒù	'tsetse flies'

In the examples of (6), however, the requirements of allophony and harmony conflict. In such cases, harmony overrides allophonic expectations (6).

(6) Sibilant harmony overrides allophonic distribution

	Expected by allophony	Attested (R-L harm.)	Unattested (L-R harm.)	
a.	*-siʃa	-ʃíʃà	*-sisa	‘be fat’
b.	*-siiʃa	-ʃîiʃà	*-siisa	‘ear of millet’
c.	*-siiʒa	-ʃì̗iʒà	*-siiza	‘serve (used of cattle)’
d.	*-siʃwa	ʃíʃwà	*-siswa	‘shrink from’
e.	*-ʃaasire	-sààsì̗rè	*-ʃaaʃire	‘be in pain (perf.)’
f.	*-ʃasi	-sàsì̗	*-ʃaʃi	‘porch’
g.	*-ʃasi	-sásì̗	*-ʃaʃi	‘bullet’
h.	*-ʃaazi	-sáàzì̗	*-ʃaaʒi	‘space outside a kraal’

On the basis of the normal sibilant allophony patterns, we would expect forms like *-*siʃa* and *-*ʃaasire*, rather than the observed forms -*ʃíʃà* and -*sààsìrè*. This effect is the evidence for sibilant harmony: sibilants deviate from the normal allophonic pattern in order to achieve anteriority agreement in the stem.[3]

Crucially, in these Nkore-Kiga examples, the harmony is controlled by the sibilant on the right. That is, the rightmost sibilant follows the expected C-V distributional pattern; the preceding sibilants deviate from the expected allophony in order to agree with it.

The generalisation implied here is a pattern of strictly directional harmony. The rightmost sibilant is always the one that controls the result of agreement, irrespective of its quality. The [±anterior] value of the sibilant doesn't determine the direction of agreement.

The combination of allophonic conditioning and strict directionality makes such a pattern problematic for theories of consonant harmony framed in OT, such as Agreement By Correspondence. To illustrate, we treat the allophony constraints as *ʃi and *s, and take the harmony constraints to be Corr·[+sibilant] and CC·Ident-[anterior], all defined in (7).[4]

[3]Agreement does not extend beyond the stem domain, into prefixes: [z-a-iʒa] ‘they (cl.10) have arrived’ (Taylor 1985, p.122; tones not given). This bounding parallels sibilant harmony in other Bantu languages, such as Kinyarwanda (Kimenyi 1979, Bennett 2013), and can be handled in the same way in as those cases, by imposing appropriate domain specifications on the relevant constraints.

[4]These specific definitions of the allophony constraints are not essential to the problem. For example, instead of *ʃi ≫ *s, we could have *sa,se,so,su ≫ *ʃ, and the puzzle arises

(7) Basic constraint definitions

(a) CORR·[+sibilant]: 'Sibilants correspond with each other'
Dfn.: For each distinct pair of output consonants X and Y, assign a violation if:

i. X and Y are both [+sibilant]

ii. X and Y are not in the same surface correspondence class

(b) CC·IDENT-[anterior]: 'Correspondents agree for anteriority'
Dfn.: For each distinct pair of output consonants X and Y, assign a violation if:

i. X and Y are in the same surface correspondence class

ii. X is [+anterior]

iii. Y is [−anterior]

(c) *ʃi: 'no [ʃi] or [ʒi] sequences'
Dfn.: one violation for each [−anterior] sibilant followed by [i] in the output.

(d) *s: 'no [s] or [z]'
Dfn.: one violation for each [+anterior] sibilant in the output.

In order for harmony to force sibilants to deviate from the usual allophonic pattern, the constraints responsible for allophony must be dominated by the constraints that drive harmony. But, in order for the sibilant constraints to produce an allophonic pattern, they must both dominate faithfulness for anteriority, IDENT-[anterior], and must be crucially ranked relative to one another.

The problem is that this ranking does not produce strictly directional harmony. The harmony constraints are satisfied by any sequence of corresponding and agreeing sibilants: they have no preference between [ʃ...ʃ] and [s...s] candidates. Each of the allophony constraints *does* have a preference between these forms, though. If the choice between these options gets passed down to the allophony constraints, the result will be a value-dominant harmony pattern.

The tableaux in (8) and (9) illustrate the problem. Assuming for illustration that *ʃi dominates *s, the choice between different harmonised candidates

in the same way.

will be made based on which one yields fewer [ʃi] sequences - a pattern where [+anterior] is the dominant value. This means harmony will be right-to-left in forms that end in /...si/, as in (8). But, in forms that end in another vowel, harmony can operate from left-to-right (9). If *ʃi is what makes the decision, then the directionality of harmony won't be strictly deterministic: the direction of assimilation will change to suit the preferred form of agreement. The result is harmony that systematically favours [+anterior] or [−anterior], rather than favouring assimilation in one particular direction. (The candidate in (9a) is the winner favoured by the ranking; the candidate in (9b) is the expected form based on the descriptions of the pattern, indicated with a frowning face because it loses.)

(8) *ʃi favours right-to-left harmony in forms ending in /...si/:

	Input: /-ʃasi/	Corr·[+sib]	CC·Ident-[ant]	*ʃi	*s
→ a.	$s_x a s_x i$ (R to L harm)				2
b.	$ʃ_x a ʃ_x i$ (L to R harm)			W 1!	L
c.	$ʃ_x a s_x i$ (corr, no harm)		W 1!		L 1
d.	$ʃ_x a s_y i$ (no corr)	W 1!			L 1

(9) In forms ending in /...ʃa/, *ʃi favours left-to-right harmony:

	Input: /-siʃa/	Corr·[+sib]	CC·Ident-[ant]	*ʃi	*s
→ a.	$s_x i s_x a$ (L to R harm)				2
☹ b.	$ʃ_x i ʃ_x a$ (R to L harm)			W 1!	L
c.	$s_x i ʃ_x a$ (corr, no harm)		W 1!		L 1
d.	$s_x i ʃ_y a$ (no corr)	W 1!			L 1

We know of no straightforward way to ensure uniformly right to left harmony without radical adjustments to all of the constraints involved. Even if we assume that surface correspondence is a non-symmetric relation (following Walker 2000b, Hansson 2001, c.f. Bennett 2013, Walker 2000a), which allows for CC·Ident constraints to be direction-specific, we still don't get the right result. Consider a $C_R C_L$·Ident constraint as in (10) that favours agreement only asymmetrically.

(10) $C_R C_L$·Ident-[anterior]: 'Preceding correspondents agree for anteriority'
Dfn.: For each distinct pair of output consonants X and Y, assign a violation if:

i. Y is a correspondent of X

ii. Y precedes X

iii. X is [+anterior]

iv. Y is [−anterior]

This constraint differs from the simpler, symmetric, CC·IDENT in (7) above in that it penalises disagreement in one direction, i.e. [ʃ...s], while permitting sequences in the other order, [s...ʃ]. But, even building this directional asymmetry into the constraint doesn't have the desired consequences for directionality in assimilation. Forbidden [ʃ...s] sequences can be repaired to either [s...s] or [ʃ...ʃ], both of which satisfy the constraint because both have full agreement. Output-oriented agreement constraints like CC·IDENT cannot control *how* agreement is achieved; they can only restrict where it's necessary. The choice between [s...s] and [ʃ...ʃ] is fundamentally a question of what faithfulness constraints are violated. The difference is faithfulness, not markedness: both achieve agreement, but one does so by being unfaithful for [+anterior], while the other does so by being unfaithful for [−anterior].[5]

Leaving the choice of how to resolve agreement to general markedness constraints results in a value-dominant pattern. If the decision between [ʃ...ʃ] and [s...s] candidate types is passed down from the agreement constraints to general markedness constraints like *ʃi and *s, then harmony will favour whichever harmonised option is a better fit for the general allophony pattern.

Letting faithfulness constraints make the determination between the agreeing candidates also doesn't produce strict directionality. Bennett (2013) proposes positional faithfulness as a general means of deriving strictly right-to-left harmony: a constraint CC·ANCHOR-R, which demands faithfulness for the rightmost member of a surface correspondence group, can produce systems where agreement happens systematically from right to left in order to avoid changing the rightmost correspondent. But in the reported Nkore-Kiga pattern, the rightmost sibilant – the one that should be controlling harmony – is determined allophonically, it isn't necessarily faithful. If the rightmost sibilant is neutralised, then a faithfulness constraint that protects it will not make it control harmony.

[5]Hansson's (2001/2010) analysis works around this by using targeted markedness constraints, which ostensibly hard-wire a particular kind of faithfulness violation into the agreement (and the allophony) as a necessary requisite for avoiding violations of markedness.

The result, then, is that Nkore-Kiga seems to have harmony which is strictly and arbitrarily right-to-left. The generalisation that the rightmost sibilant controls harmony – irrespective of both its surface quality and its underlying value – can't be derived in a theory of harmony like ABC, based on achieving agreement on the surface. So, the Nkore-Kiga case would seem to be a counterexample for this general approach to harmony.

How can we resolve this problem? One approach would be to abandon the ABC theory in favour of a more process-driven approach, where harmony isn't driven by the need for agreement (along the lines of Nevins (2004), for instance). We suggest, however, that the Nkore-Kiga data does not lead us to that conclusion. The problem isn't that the theory is necessarily wrong; it's that the facts of Nkore-Kiga don't actually support the combination of generalisations that seemed to lead us to the problem.

3 Re-evaluating the data: a problem that isn't

3.1 The empirical basis for allophony

Earlier descriptions of the Nkore-Kiga sibilant patterns come from Hyman (2003) and Hansson (2001), and the original source data comes from a dictionary and grammar by Taylor (1959, 1985). A search of Taylor's grammar turns up numerous examples that undermine the premise that sibilants in Nkore-Kiga are in allophonic distribution. This evidence comes in several forms. First, a few minimal pairs, and an abundance of near-minimal pairs (11) suggest that the distinction between [+anterior] and [−anterior] sibilants is actually contrastive.

(11) Minimal and near-minimal pairs

a.	kw-àsà	‘chop’
b.	kw-àʃà	‘strike (of lightning)’
c.	kw-ìzà	‘ease, darken’
d.	kw-ìʒà	‘come’
e.	kù-ʃìʃà	‘spoil, do wrong, sin’
f.	kù-sîsà	‘ask for meat’
g.	kù-sòòmà	‘do a stamping dance’
h.	kù-ʃòmà	‘read, attend church’
i.	òmù-zìŋgà	‘swarm, bee-hive’
j.	òmù-ʒìɲà	‘ambition’
k.	kù-zêŋgà	‘wander, be dying’
l.	kù-ʒèŋgà	‘become sodden’
m.	òrù-sà	‘permission’
n.	(ò)bù-ʃà	‘in vain’
o.	òrú-sjà	‘new’

Additionally, the analysis whereby the distribution of [s] and [ʃ] is completely rule-governed predicts that morphemes will alternate under appropriate affixation. This is correct in some instances, for example, -gàʃ-à ‘useful’ vs. -gàs-ìrè ‘useful (perf.)’. In other cases, however, morphemes are strictly non-alternating, as in (12).

(12) Nonalternating forms

a. -báàs-à ∼ -báás-ìk-à ‘able to’/‘possible’
(-baas- ∼ *-baaʃ-; cf. -gas- ∼ -gaʃ- above)

b.	(è)zàndʒè	‘its (cl.10, poss. cl.9)’
c.	èzò	‘that (cl.10)’
d.	èzì	‘this (cl.10)’

(class 10 prefix invariably has [z], never *[ʒ])

e.	-r-îs-à	‘pasture; cause to eat’
f.	-r-iis-ibw-a	‘cause to be eaten’

(‘long’ causative suffix invariably has [s])

Both Hyman (2003) and Hansson (2010) note that [s] may occur before vowels other than /i/ at least as the result of a covert ‘short’ causative suffix

/-j/; we consider this in section 3.2. But, it is worth noting that many of the instances of /s/ and /z/ before vowels other than [i] are not explained in this way. For example, it is possible - if unintuitive - to posit such a causative suffix with the [s] in (11m) [òrù-sà] 'permission' (perhaps then derived from the root /-ʃà/ 'in vain'). However, a short causative analysis is not plausible for other forms like [kù-sòòmà] 'do a stamping dance', where the sibilant is not root-final; and [èzò] 'that (cl.10)', which is a demonstrative; and in the 'long' causative suffix /-iis/, which would then need to be analysed as a double causative in all instances. It also doesn't explain the three-way contrast seen in (11m–o), where [ʃ] and [s] contrast not just with each other, but also with [sj].[6]

We also used the set of stems from Taylor's (1959) dictionary to calculate observed/expected ratios for all combinations of sibilants and vowels (affricates and the glide [j] were included as well). These values are presented in the table in (13). The cases under consideration are those where the appearance of a particular consonant-vowel sequence is not motivated by harmony. That is, apparent violations of the conditions given above on allophony are not due to a consonant being harmonic. In this table, an O/E ratio of 1.0 indicates that a given combination occurs as often as expected on the basis of the frequencies of each sound. Ratios below 1 indicate that a given combination is under-represented, and ratios greater than 1 mean a combination is over-represented. Cells where the O/E ratio is under 0.5 or more than 1.5 are highlighted.

[6]Larry Hyman (p.c.) points out to us that in many of the minimal and near-minimal pairs, verbs with counter-allophonic [s] and [z] often have transitive meanings (e.g. [kw-àsà] 'chop'), and that this is expected if those verbs were historically causatives, even if not obviously interpretable as such on the basis of the synchronic forms and Taylor's glosses. Additionally, he notes that the long vowel in [kù-sòòmà] 'do a stamping dance' is likely a reflex of a historical *io sequence, so counter-allophonic sibilants in long vowel contexts do have a historical basis. Our aim here is not to seek out possible flaws in the previous characterisation of the Kiga pattern, which is highly insightful; we only want to point out that straightforward allophony doesn't seem to explain the observed synchronic pattern, and this has crucial implications for the analysis of the harmony system. It would be extremely interesting to establish what exactly the properties of directionality were at a stage where the Nkore-Kiga sibilant distribution was transparent.

(13) Observed/Expected ratios for sibilant-vowel combinations from Taylor's (1959) dictionary

	i	e	a	o	u	j
s	0.9	**0.3**	**1.6**	1.0	**0.1**	**1.9**
z	1.1	**0.2**	1.4	1.1	**0.0**	0.7
ʃ	**0.1**	**1.6**	**1.5**	**1.8**	**3.4**	**0.0**
ʒ	**0.0**	0.7	1.3	**2.6**	**6.4**	**0.0**
t͡s	0.9	**0.5**	0.6	**0.4**	**0.0**	**8.8**
t͡ʃ	1.4	**1.7**	**0.1**	0.7	1.4	**0.1**

Several key trends are evident in this data. First, although [s] is reported to occur only before /i/, we can see that it is actually attested before all of the other vowels as well, although there are very few examples before [u]. The same is true of [z], modulo a complete gap before [u]. Three things seem quite clear. First, [s z] aren't under-represented before [a o] at all and there are a fair number of examples before [e]. Second, they are not over-represented before [i]. Third, the under-representation before [u] – complete for [z], incomplete for [s] – may motivate a constraint against the sequences [su] and [zu], a constraint we will represent as *su. Certainly the distribution is not indicative of an allophonic distribution like the one noted earlier. Turning to the non-anterior sibilants, we find that [ʃ] and [ʒ] are under-represented before [i] in a manner comparable to the under-representation of [s] and [z] before [u]. Moreover, this under-representation extends to [j] as well. Again, this points more towards neutralisation rather than allophony. That is, in general Nkore-Kiga exhibits a contrast between anterior and nonanterior sibilants. This contrast is neutralised to [s] and [z] before [i] (*ʃi) and neutralised to [ʃ] and [ʒ] before [u] (*su). This neutralisation has a handful of exceptions. Additional possible restrictions on the distribution of [s] and [z] before other vowels constitute merely a tendency; they do not define gaps in the inventory of the language's surface sequences.

Interestingly, the affricates, which don't participate in sibilant harmony, also show parallel distributional patterns to the sibilants. The [+anterior] affricate [ts] is under-represented before all vowels, but especially so before [a e o u]; [−anterior] [tʃ], on the other hand, is over-represented before [i], but under-represented before [a o]. Taken together with the sibilant O/E values, this points to a gradient lexical tendency, and not to a pattern of active allophony in the phonology of the language.

3.2 Lack of allophony changes the problem

If the sibilants don't actually follow a genuine allophonic distribution pattern, it puts a much different slant on the problem. If there is neutralisation of /ʃi/ and /si/ to [si], but no change (allophonic or neutralising) of /sa/ and /ʃa/ to [ʃa], then some cases of agreement can be explained without invoking anything direction-specific about harmony. To illustrate this, consider a hypothetical disharmonic input like /saʃi/ and imagine a (direction-free) value-dominant harmony pattern where [ʃ] is preserved over [s], all else being equal. In such a case, appropriate perhaps for a case like -ʃààʃà/-sààsìrè 'be in pain (perf.)' (6e)), the surface pattern [...ʃ...ʃ...] could be directly attributed to value-dominant harmony, while the surface pattern [...s...s...] could be attributed to a non-harmonic restriction of the occurrence of [ʃ] (namely, *ʃi) and the accidental appearance of a preceding [s]. Hence, the correct surface form in a case like [sasi] (/saʃi/) – with the rightmost sibilant's phonotactic profile dictating whether surface agreement is harmony induced or accidental – falls out simply from neutralisation, even without the harmony constraints playing a role. This is shown in (14).

(14) In some disharmonic inputs, harmony falls out from neutralisation

	Input: /saʃi/	Corr·[+sibilant]	CC·Ident-[ant]	*ʃi	*su	Ident-[ant]	*s
→ a.	$s_x a s_x i$ (s∼s corr)					1	2
b.	$ʃ_x a ʃ_x i$ (ʃ∼ʃ corr)			W 1!		e 1	L
c.	$s_x a ʃ_x i$ (corr, no harm)		W 1!	W 1!		L	L 1
d.	$s_x a ʃ_y i$ (no corr)	W 1!		W 1!		L	L 1

The point here is that a subset of situations where harmony might appear to be strictly directional actually fall out from having asymmetric neutralisation rather than proper allophony. The same outcome arises when we consider forms like hypothetical /-ʃisa/: neutralisation of /ʃi/ to [si] together with faithful retention of /sa/ results in a disharmonic /ʃ...s/ sequence surfacing as [s...s], irrespective of harmony. This is shown in (15).

(15) Faithful emergence of the rightmost sibilant can look like right-to-left harmony

	Input: /-ʃisa/	Corr·[+sibilant]	CC·Ident-[ant]	*ʃi	*su	Ident-[ant]	*s
→ a.	$s_x i s_x a$ (s∼s corr)					1	2
b.	$ʃ_x i ʃ_x a$ (ʃ∼ʃ corr)			W 1!		e 1	L
c.	$ʃ_x i s_x a$ (corr, no harm)		W 1!	W 1!		L	L 1
d.	$ʃ_x i s_y a$ (no corr)	W 1!		W 1!		L	L 1

So, the lack of allophony means that some kinds of mappings necessitated by the agreement pattern are explained without invoking harmony, and therefore don't support the problem we framed above. We can narrow the scope of the problem further by considering explanations based on CC·Anchor-R (Bennett 2013). In harmonising forms where the rightmost sibilant is faithful, right-to-left harmony can be handled using this positional faithfulness constraint, to nail down the rightmost sibilant and prevent it from assimilating – or undergoing neutralisation. This means that disharmonic inputs like /siʃa/ can be explained without stipulations about directionality beyond invoking anchoring. This is shown in (16): CC·Anchor-R favours the harmonic candidate that doesn't change the rightmost sibilant, which is by nature the one where other sibilants change to match – a right-to-left assimilation pattern.

(16) CC·Anchor can produce R-to-L harmony when the rightmost sibilant is faithful

	Input: /-siʃa/	Corr·[+sibilant]	CC·Ident-[ant]	CC·Anchor-R	*ʃi	*su	Ident-[ant]
→ a.	$ʃ_x i ʃ_x a$ (ʃ∼ʃ corr)				1		1
b.	$s_x i s_x a$ (s∼s corr)			W 1!	L		e 1
c.	$s_x i ʃ_x a$ (corr, no harm)		W 1!		L		L
d.	$s_x i ʃ_y a$ (no corr)	W 1!			L		L

Between the cases where harmony follows automatically from the one-way neutralisation of ʃ to *s* (but not in the other direction), and the cases where the rightmost sibilant is faithful, and right-to-left harmony can therefore be derived using CC·Anchor-R, the vast majority of potentially relevant inputs are explained. The table in (17) illustrates this. If we consider inputs with two sibilants, for all permutations of [+anterior] and [−anterior] on each, followed either by [i] (the neutralisation context) or [a] (representing a non-neutralising context), there are 16 possibilities (abstracting away from the voicing distinction between s/ʃ and z/ʒ).[7] Of these 16 possibilities, 15 fall out from either basic faithfulness and neutralisation, or from faithful protection of the rightmost correspondent (or both).

(17) Inputs and explanatory coverage

	Input	Output	Agreement follows from /ʃ/ → [s] neutralisation	R to L harmony follows from rightmost faithfulness (CC·Anchor-R)
a.	ʃiʃi	sisi	✓	
b.	ʃiʃa	ʃiʃa		✓
c.	ʃaʃi	sasi	☹	☹
d.	ʃaʃa	ʃaʃa	✓	✓
e.	ʃisi	sisi	✓	✓
f.	ʃisa	sisa	✓	✓
g.	ʃasi	sasi		✓
h.	ʃasa	sasa	✓	✓
i.	siʃi	sisi	✓	
j.	siʃa	ʃiʃa		✓
k.	saʃi	sasi	✓	
l.	saʃa	ʃaʃa		✓
m.	sisi	sisi	✓	✓
n.	sisa	sisa	✓	✓
o.	sasi	sasi	✓	✓
p.	sasa	sasa	✓	✓

What remains, then, in accounting for the Kiga pattern, are the forms where (i) the rightmost sibilant is unfaithful, (ii) the unfaithful sibilant controls

[7] We also abstract away from the effect of *su. In table (17), 'Ca' represents Ce, Ca, Co. Factoring in sequences involving *u* would change some details of the point being made, but not the central point.

harmony, and (iii) harmony forces a sibilant to the left to be unfaithful as well. These are only inputs of the form /ʃa...ʃi/, surfacing as [sa...si], with neutralisation of /ʃi/ leading to harmony for another /ʃ/ which should not otherwise neutralise. These are a subset of forms like those in (6) above, the examples given in previous work as evidence for allophony and harmony.

We suggest that the correct explanation for these remaining forms lies in the morphology. Evidence that points to /ʃ/ becoming [s] before [i] comes overwhelmingly from combinations of roots with three morphemes: the perfective suffix /-ire/, the agentive nominaliser suffix /-i/, and the causative suffix /-j/. This same collection of morphemes is responsible for a broad array of consonant mutations in various eastern Bantu languages[8], and Nkore-Kiga is no exception here. These suffixes systematically cause various alternations in root-final consonants; these include affrication of stops, assibilation of /r/ and /h/, and – importantly – shifting of /ʃ ʒ/ to [s z]. Some examples are given in (18) (from Taylor 1985, Poletto 1998; see also Hyman 2003).

(18) Consonant mutations caused by certain suffixes with /-i/

	-ʃíʃà	→ -sisire	'be fat'
Perfective	-îtà	→ -itsire	'kill'
/-ire/	-dʒèndà	→ -dʒènzìrè	'go'
	-béíʒa	→ -béízire	'carve'
	-kórà	→ -kozire	'do, make'
	-ʃèèʃà	→ òmù-sèèsì	'pull down (house)' / 'puller-downer'
Nominaliser	-rìndà	→ òmù-rìnzì	'protect' / '(a) guard'
/-i/	-ʃààʃà	→ òbù-sààsì	'be in pain' / 'trouble, pain'
	-zòòrà	→ òmù-zòòzì	'discover' / 'discoverer'
	-rwârà	→ -rwâzà	'be ill' / 'make ill, nurse'
Causative	-tààhà	→ -tààsjà	'enter' / 'take in, invite'
/-j/	-hìkà	→ -hìtsjà	'reach, arrive' / 'bring along'
	-hààtà	→ -hààsjà	'peel' / 'cause to peel'

These alternations are not systematically conditioned by the vowel /i/; rather, they are specific to certain morphemes. Other suffixes with initial /i/ can be seen not to cause the same mutations, as in (19).[9]

[8]These include Kinyarwanda (Kimenyi 1979, Walker *et al.* 2008), as well as Kinande, Haya, Bemba, and others (Hyman 2003).

[9]Some applicative forms do seem to have at least the [−anterior] to [+anterior] shift for sibilants. For instance, Taylor's (1959) dictionary gives the form [-gàʃ-ìr-à] as in (19),

(19) Not all suffixes with /-i/ cause systematic mutations

Applicative /-ir/	kù-gàʃ-à	'be useful'	kù-gàʃ-ìr-à	'be of use to'
	kù-ráʃ-à	'shoot'	kù-ráʃ-ìr-à	'shoot at, pulsate'
Stative /-ik/	-jata	'spill'	-jat-ik-a	'get spilt'

The mutations in (18) have an important consequence for sibilant harmony: in forms where the rightmost sibilant is mutated from /ʃ/ to [s], the sibilants are not on equal footing. In roots like /-ʃààʃà/ ∼ [-sààsìrè] 'be in pain (perf.)', the rightmost sibilant in the perfective form has its anteriority conditioned by the morphology, whereas the preceding sibilant does not. Consequently, right-to-left harmony in such forms is readily interpretable as the result of the morphologically-conditioned sibilant taking priority. This is a straightforward control-type interaction, quite akin to the positional faithfulness interaction seen with CC·Anchor, but where the factor that imparts control of harmony onto one sibilant is defined on the basis of morphological changes rather than simply position.

If the consonant mutations are taken to be a crucial part of the realisation of this group of suffixes, then we can understand a failure to implement them as violating a constraint on morpheme realisation, call it MorphReal (in the same spirit as Kurisu's (2001) RealizeMorpheme). In favouring a particular form for the rightmost sibilant, this constraint has the effect of disambiguating between the harmonised candidates, and favouring the one where the expected form for the rightmost sibilant determines the result of agreement.

but in Taylor's (1985) grammar, the form [-gàs-ìr-à] can be found as well, along with a few other such examples (e.g. izira 'come for/to'). Taken together with the non-mutated forms in (19), it appears that these are not systematic changes, and this is corroborated by the lack of mutation for other consonants.

(20) MorphReal breaks the directionality tie like CC·Anchor

	Input: /-ʃaʃ-ire/	MorphReal	Corr·[+sibilant]	CC·Ident-[ant]	CC·Anchor-R	*ʃi	Ident-[ant]
→ a.	$s_x as_x$-ire				1		2
b.	$ʃ_x a ʃ_x$-ire	W 1!			L	W 1	L
c.	$ʃ_x as_x$-ire			W 1!	L		L 1
d.	$ʃ_x as_y$-ire		W 1!		L		L 1

Is there a principled reason why these consonant mutations can be considered an integral part of these particular morphemes? In the case of the short causative /-j-/, the answer seems to be a definite yes. In many cases, the mutations induced by this morpheme are its only exponence. This is illustrated clearly by pairs of related stems like those in (21).

(21) Short causative /-j-/ may be expressed solely through mutations

a. -kora 'work'
   -koza 'make (X) work'

b. -funda 'be narrow'
   -funza 'restrict'

c. -taaha 'enter'
   -taasja 'take in'

What about the other suffixes that cause mutations? Here, the situation is a bit murkier. However, it is worth noting that the vowels in these suffixes were historically super-high vowels (Hyman 2003).[10] The high vs. super-high distinction was morphologically significant in proto-Bantu; so, historically, it would have played a crucial role in morpheme disambiguation (e.g. between the applicative *-id- and the perfective -i̪d-e). As the high vs. super-high distinction was lost in Kiga, it's not unreasonable that the spirantisation induced by super-high vowels (but not by regular high vowels) would have become a crucial factor for identifying these morphemes.

[10]Including the short causative, which is represented by some other authors as -y- or -i̪-.

Clearly the exact properties of MorphReal need to be defined and several factors are involved. The selectional requirements of the relevant morphemes are *local* – affecting strictly the consonant preceding the mutation-inducing suffix. The effects all involve anterior coronal outputs although the input consonants may belong to several places and manners. The short causative may or may not involve a segmental realisation that is independent of the mutation per se. While the treatment of these properties is both important and interesting, it would take us well beyond the needs of this paper.[11] For directionality, the crucial point here is simply that there is a demonstrably morphological source to the observed directionality of Nkore-Kiga.

4 Conclusion

The aim of this paper has been to show that Nkore-Kiga seems to raise an interesting conundrum for how directionality needs to be handled in Agreement By Correspondence (and in agreement-based theories of harmony more generally), but to show that it raises this problem in a possible world other than our own. The facts on the ground show that the right-to-left directionality observed in Kiga can be handled as an emergent phenomenon, and doesn't provide solid motivation for deviating from a simpler ABC theory where correspondence and agreement constraints are symmetric. Where the rightmost sibilant in a stem is faithful, right-to-left harmony can be derived by positional faithfulness, using the constraint CC·Anchor-R. Cases where the rightmost sibilant is unfaithful break down into two groups. Those where the neutralisation of /ʃ/ to [s] happens to yield anteriority agreement don't require further explanation (e.g. inputs like /ʃi...sa/); they have only vacuous harmony. The cases where the rightmost sibilant is unfaithful, and still crucially *does* control harmony, reduce to a very specific and localised set of morphological effects. As long as the mechanism responsible for stem-final consonant mutations (e.g. MorphReal) takes precedence over the factors that bear on the direction of harmony (e.g. CC·Anchor-R, and *ʃi), the direction of assimilation will respect the morphological conditioning of root-final sibilants. So, when the rightmost sibilant isn't faithful, right to left

[11] The particular approach that we are currently exploring is that proposed in recent work by Archangeli & Pulleyblank (2012, in press, to appear a, to appear b). In the approach taken there, choosing between allomorphs is central to the theory, with allomorph choice dictated by general phonotactics in some cases and by morpheme-specific selectional requirements in others. For the cases governed here by MorphReal, the appropriate patterns would be ensured by morpheme selection.

harmony still follows, either from the morphology tipping the balance, or from the basic phonotactics making agreement independent of harmony.

The broader point at issue here is the role of directionality in ABC. We've tried to show here that while the particular case of Nkore-Kiga points to an interesting potential problem for a theory that doesn't allow parametric control over the direction of assimilation, the problem isn't empirically borne out. A theory with symmetric correspondence and non-directional CC·IDENT constraints (à la Bennett 2013) is compatible with the right-to-left pattern we find in Nkore-Kiga. This case intuitively seems like one of the best lines of evidence for building directionality into Surface Correspondence theory, but doesn't hold up as such. We speculate that some other cases of strict directionality might be handled in similar ways, without needing to adjust the core of the theory of harmony.

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