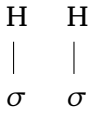
Appendix A: A unified analysis of OCP effects in Shona

In the main paper we showed that Meeussen's rule in Shona is not A-ISL, though it is RSL and A-RSL. However, two related processes analyzed by Myers (1987; 1997) as being motivated by the OCP are in fact A-ISL. Specifically, *tone spread* and *tone slip* find a unified analysis under a logical definition of association.[1]

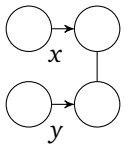
The OCP condition described in Myers (1997) forbids the following configuration, in which two adjacent H tones are associated to adjacent syllables.

(1)


In what follows we will define a couple of predicates to use in the analysis. Importantly, these predicates are defined in terms of the same primitives we have been using throughout and serve only to clarify the connection between the various phenomena under consideration.

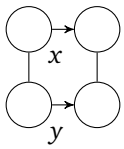
The first of these predicates helps to identify whether a given structure violates the OCP condition represented by (1). This predicate, called $\texttt{next}_A(x, y)$, is defined in (2a). It is true for two positions x and y when the successor of x is associated to the successor of y.

(2) a. $\texttt{next}_A(x, y) \stackrel{\text{def}}{=} A(s(x), s(y))$

b.


Two elements x and y are in an OCP configuration if they satisfy the formula in (3a), which is true if x and y are associated and also satisfy $\texttt{next}_A(x, y)$.

(3) a. $A(x, y) \wedge \texttt{next}_A(x, y)$

b.


Given this tool for identifying OCP-violating structures, we will now see how it factors in two related processes in Shona. First, in tone spread, an underlying tone spreads to the subsequent unspecified TBU across a morphological boundary within a phonological word, as shown in (4).

[1] For the sake of brevity, in this section we assume ARs and put aside the question of how these same processes would be categorized with a string representation.

(4) *Shona* (Niger-Congo; Myers 1987; 1997)

a.	/sadza/	[sadza]	‘porridge’
b.	/í-sadza/	[í-sádza]	‘(it) is porridge’
c.	/ku-verenga/	[ku-verenga]	‘read (inf.)’
d.	/ti-chá-verenga/	[ti-chá-vérenga]	‘we will read’

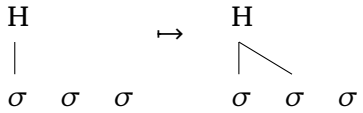
However, the spreading is blocked when there is an H tone associated to the TBU following the target TBU.

(5)

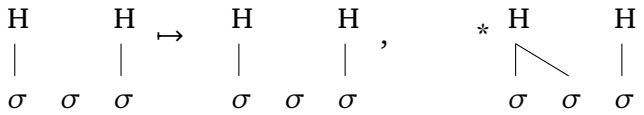
/badzá/	badzá	‘hoe’
/í-badzá/	í-badzá	‘(it) is a hoe’
*í-bádzá		

This can be attributed to tone spread being blocked just in case it creates the configuration in (1). In terms of ARs, the transformations in (4a) and (5) are as below in (6a) and (6b), respectively.

(6) a.



b.



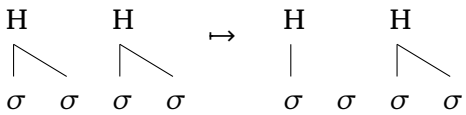
In a related process of tone *slip*, a tone underlyingly associated to multiple TBUs will retract one TBU when immediately preceding another H-tone span.

(7)

/bángá/	[bángá]	‘knife’
/gúrú/	[gúrú]	‘big’
/bángá gúrú/	[bánga gúrú]	‘big knife’

Again, this is to avoid the structure specified in (1). Autosegmentally, the transformation of underlying /bángá gúrú/ ‘big knife’ to [bánga gúrú] is as follows.

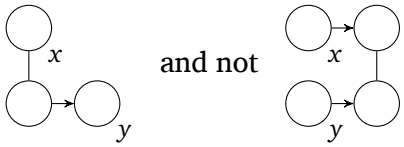
(8)



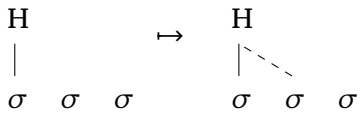
In sum, an underlying H tone spreads unless it creates an OCP violation. Similarly, if there is an underlying association that violates the OCP, the first H tone retracts to avoid the violation on the surface.

A logical definition of output association unifies these two processes. First, in neither case does an association surface when it would create the configuration in (3a). In other words, a tone x is associated to a TBU y in the output if x was associated to y’s *predecessor* in the input (i.e., this is the spreading process in action) *unless* $\texttt{next}_A(x, y)$ is true (i.e., in which case spreading is blocked or tone slip takes place). These conditions are combined in the formula in (9a) using conjunction and negation.

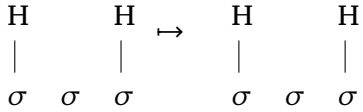
(9) a. $A(x, p(y)) \wedge \neg(\texttt{next}_A(x, y))$

b. 

Note that this formula covers a tone and TBU associated as a result of spreading, as well as a tone and TBU underlyingly associated and not subject to tone slip. Both of these cases are highlighted with dashed lines in the forms in (10), taken from (6) and (8) above.

(10) a. 

(=(6a))

b. 

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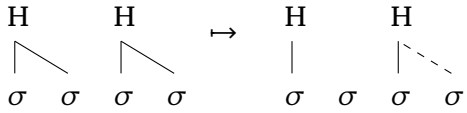
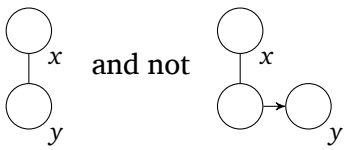
c. 

(=(8))

Conversely, tones and TBUs that are in the OCP configuration, such as the first H and second TBU in both (10b) and (10c), *equally* fail to satisfy (9a), even though the TBU in (10b) is a spreading target and the tone and TBU in (10c) are underlyingly associated. In both cases then the association does not surface. In this way the same formula also covers both the blocking of spreading and the application of tone slip.

Thus with one formula we capture the application and blocking of two processes. However, this formula only includes the dashed association lines in (10); to define the complete output association relation we also need to include the first TBU that each H is associated to. To do this, we define the predicate in (11a), which is true when y is the first TBU associated to a tone x in the input.

(11) a. $\texttt{first}_A(x, y) \stackrel{\text{def}}{=} A(x, y) \wedge \neg A(x, p(y))$

b. 

The statement $A(x, p(y))$ is true when the predecessor of y is associated to x. The full predicate $\texttt{first}_A(x, y)$ is thus true only when $A(x, y)$ and there is no such $p(y)$.

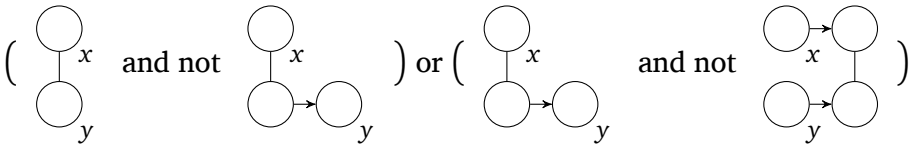
The full output association relation for Shona can thus be defined as the disjunction in (12b). As a reminder the definition of $\texttt{next}_A(x, y)$ is repeated in (12a).[2]

(12) binary tone spread and tone slip (ISL)

[2] Note that (12b) uses both predecessor and successor. Recall (fn. **??**) that the use of both p and s is permitted with ISL.

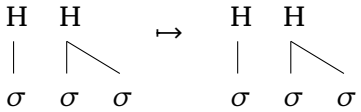
a. $\texttt{next}_A(x,y) \stackrel{\text{def}}{=} A(s(x),s(y))$

b. $A_o(x,y) \stackrel{\text{def}}{=} \texttt{first}_A(x,y) \vee \big(A(x,p(y)) \wedge \neg\texttt{next}_A(x,y)\big)$

c. 

The first disjunct in (12b) copies over an input association from x to y just in case y is the first TBU associated to x in the input. The second disjunct is exactly the formula from (9a), and thus implements tone spread and tone slip such that surface violations of the OCP are avoided. That is, it is true for any x and y such that x is associated to y's predecessor in the input, so long as x and y are not in a potential OCP-violating configuration.

This completes the map except for one case: when an H tone is associated to a single TBU in an OCP violation. In this case, the definition in (12b) maps this configuration faithfully.

(13) 

This is in fact the exact case in which Meeussen's rule applies, as seen in the following examples.

(14) a. /bángá/ [bángá] 'knife'
/í-bángá/ [í-banga] '(it) is a knife'

b. /sékúru/ [sékúru] 'grandfather'
/vá-sékúru/ [vá-sekuru] 'grandfather (hon.)'

The combination of tone spread, tone slip, and the OCP in Shona is necessarily input-oriented, as the assessment of whether a tone can be associated to a TBU depends on context that will be altered in the output. Shona's version of Meeussen's Rule, however, is necessarily A-RSL, as we saw in the main paper. It is beyond the scope of this paper to determine how multiple functions are combined into a complete phonological grammar, or the effect on complexity when functions from different classes are composed. However, the analysis of this portion of Shona points to a mechanism (either ordering via composition or some other operation) by which Meeussen's Rule will apply just in case the tone spread/slip definition leaves the configuration in (13).

References

Myers, Scott. 1987. *Tone and the structure of words in Shona*: University of Massachusetts, Amherst dissertation.

Myers, Scott. 1997. OCP effects in Optimality Theory. *Natural Language & Linguistic Theory* 15(4). 847–892.