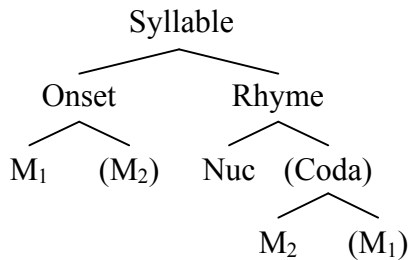


On the Relationship between Codas and Onset Clusters
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1. A standard view in syllable theory is that there are no dependency relations between onsets and codas. To cite an example from Zec (2007:164), “If a language requires onsets, it does not ban or require codas, and vice versa.” Similarly, Clements (1990:303) who defines the domain of sonority sequencing as the demisyllable states that, “the sonority profile of the first part of the syllable [i.e. the beginning of the syllable to the vocalic peak] is independent of the sonority profile of the second” [i.e. from the vocalic peak to the end of the syllable]. In this paper we will take issue with this view in one very particular way. We present evidence from a variety of languages and phenomena that point to a close connection between a second member on an onset cluster and a coda consonant. This is formalized in the split margin approach to the syllable in (2) in which a coda and a second member of the onset are marked in the same way.

2. The Split Margin Approach to the Syllable (Baertsch 2002, Baertsch & Davis 2003, Davis & Baertsch 2005)



- a. Both a single onset consonant and the first member of an onset cluster is an M_1 consonant
- b. A single coda consonant is an M_2 consonant (with the possible exception of a word-final coda which could either be an M_1 consonant or an M_2 consonant depending on the language – Piggott 1999)
- c. We distinguish between onset clusters (typically an obstruent followed by a sonorant) and adjunct clusters (typically, though not always, an obstruent-obstruent sequence)
- d. The Split Margin Approach readily extends to an analysis of syllable contact which we do not address in this paper (but see Baertsch & Davis 2005, 2007 and Davis & Baertsch (to appear))

3. Phenomena mentioned in the literature where researchers have explicitly or implicitly have suggested a connection between the second member of an onset and a coda consonant

a. Phonotactics: Clements & Keyser (1983), Davis (1988), Cairns (1988) and others have noted a phonotactic link in languages like English, Dutch, and German that disallows sequences like “*plil*, **flilf*, and **snan* (vs. *lilt*, *nun*, *pop*), probably best stated as what Cairns terms as ‘pan-syllabic constraints’ that prevent identical consonants from flanking both sides of a vowel only if there is a (marked) onset cluster. As Cairns (1988:231) specifically notes, “this would suggest that the */l/* in C_r [rhymal consonant] is marked the same way as in A_o , [second member of an onset] and distinct from C_o , [initial member of an onset] to account for **klull*”

b. Sonority: Clements (1990) implicitly views the 2nd member of an onset & a coda consonant as being high sonority positions within the syllable. Other researchers have recognized the coda as being a position favoring high sonority (e.g. Gouskova 2004) or the second member of an onset as being a position favoring high sonority (e.g. Green 2003). However, as far as we know, other researchers have not made the formal connection offered by the Split Margin Approach.

c. Implication universal (based on Kaye and Lowenstamm 1981:291) – the presence of a complex onset in a language implies the presence of a coda ("the existence of syllables with branching onsets implies the existence of syllables with branching rimes." Note that Kaye & Lowenstamm are clear in their article that by branching rime they mean branching into a coda.) That is, if a language allows for CCV syllables then it must also allow for CVC syllables; but the reverse does not hold. If a language allows for CVC syllables it may or may not have CCV syllables. Another way of putting it, if a language does not permit syllables with codas then it does not permit syllables with complex onsets. This proposed implicational universal by Kaye & Lowenstamm has never been fully explored.

5. Note: Examples of CCV languages from Blevins (1995, 2006) are questionable

a. Mazateco (Blevins 1995) – Steriade (1994) reanalyzes as complex segments (note that Mazateco does not have obstruent-liquid sequences)

b. Arabela (Blevins 1995) – Complex onsets consist of a consonant followed by a glide. However, see Topintzi (2006) who notes that glides can also occur in coda position.

c. Cheke Holo (Blevins 2006) – Blevins notes though that codas can occur in loans (Better examples would be Niger Congo languages of West Africa like Fongbe (Benin) or Wan (Ivory Coast) where complex onsets are only obstruent-plus-sonorant)

6. Formalization (using OT type constraints) – Following Baertsch (2002) we divide Prince & Smolensky's (1993/2004) Margin Hierarchy so as to distinguish the M₁ position that prefers low sonority from the M₂ position that prefers high sonority. The M₁ constraint hierarchy in (7) governs the first member of an onset giving priority to low sonority consonants, and the M₂ hierarchy in (8) governs a single coda as well as a second member of an onset giving priority to high sonority consonants.

7. The M₁ Hierarchy (like Prince & Smolensky's Margin Hierarchy)

*M₁/[+low] >> *M₁/[+high] >> *M₁/[r] >> *M₁/[l] >> *M₁/Nas >> *M₁/Obs

8. The M₂ Hierarchy governs single codas and a second member of an onset.

*M₂/Obs >> *M₂/Nas >> *M₂/[l] >> *M₂/[r] >> [*M₂/[+high] >> *M₂/[+low]]

(Note: A low vowel would not be in a coda because of the low ranked constraint *Peak/[+low])

a. In a language like Latin where a single coda consonant is not restricted, the entire M₂ hierarchy would be low-ranked (i.e. lower-ranked than the relevant faithfulness constraint)

b. While we will not detail this here, onset clusters are formally accounted for by the local conjunction (adjacent within the syllable onset) of the *M₁ and *M₂ constraints. On this view, the cross-linguistic preference for obstruent_rhotic onset clusters (and obstruent-sonorant ones more generally) is because such clusters involve the conjunction of the lowest ranked *M₁ constraint (*M₁/Obs) with the lowest ranked (relevant) *M₂ constraint (*M₂/[r]). Consequently *M₁/Obs&*M₂/[r] would be the lowest ranked of the (relevant) conjoined constraints accounting for the preference of obstruent_rhotic onset clusters. This level of detail will not be shown in this paper (but see Davis & Baertsch 2005).

9. Benefits of the Split Margin Hierarchy -- The high sonority preference for a single coda and a second member of an onset (4b) is accounted for since these are governed by the M_2 Hierarchy. The pansyllabic constraint in (4a) can be considered as an OCP-type constraint on the M_2 position. The implicational universal noted by Kaye & Lowenstamm (4c) can be understood as follows: if a single M_2 position cannot occur (as a coda) then it follows that it should not occur in conjunction with another consonant (i.e., with an M_1 consonant as a complex onset).

10. Purpose of this paper: Show another type of evidence for the relationship between codas and onset clusters, namely parallel changes in codas and onset clusters.

11. Diachronic implication -- If a language which at one stage has codas and complex onsets starts to restrict its coda consonants, then, at that later stage, onset clusters should become lost or more restricted accordingly.

12. Campidanian Sardinian (Bolognesi 1998, Alber 2001, Frigeni 2004)
 Latin allowed for complex onsets and coda consonants. Campidanian Sardinian has a syllable structure that is more restricted than in Latin. Specifically, both the nature of the coda and onset clusters are more restricted than in Latin. The only (unassimilated) singleton coda allowed in Campidanian Sardinian is the rhotic (ignoring certain complications involving coronal fricative) as shown by the historical change in (13a) where a coda lateral from Latin has a rhotic reflex. Moreover, as shown in (14a), what is interesting in Sardinian and what previous researchers have noted but have viewed as an independent change is the change of the lateral to a rhotic when it is the 2nd member of an onset cluster

13. a. ALBUS > arba 'white' (b. ORKU > orku 'ogre')

14.	a.	Latin	Sardinian	Gloss
		PLUS	prus	more
		CLAVE	krai	key
		(LONGUS	longu	long)
	b.	PRIMU	primu	first
		CRAS	krazi	tomorrow

15. A partial OT analysis

a. Ranking for Latin : **Ident-Manner** >> $*M_2/[l]$ >> $*M_2/[r]$

b. Ranking for Sardinian: $*M_2/[l]$ >> **Ident-Manner** >> $*M_2/[r]$

(Note: Ident-manner is violated if a lateral liquid changes to a rhotic liquid or vice-versa.)

16. /alba/ -- [ar.ba] 'white'

/alba/	$*M_2/[l]$	Ident-Manner	$*M_2/[r]$
a. al.ba	*!		
√ b. ar.ba		*	*

17. /plus/ - [prus] 'more'

/plus/	*M ₂ /l	Ident-Manner	*M ₂ /r
a. plus	*!		
√ b. prus		*	*

18. As the coda becomes more restricted so does the nature of the onset cluster.

19. Development of Pali from Sanskrit (Zec 1995) and Middle Indic from Sanskrit more generally (Vaux 1992). Sanskrit allowed coda consonants in a fairly unrestricted way and true onset clusters (i.e. obs + son). Pali has a strict coda condition like Japanese (Ito 1986) and no (true) onset clusters.

	<u>Sanskrit</u>	<u>Pali</u>	<u>Gloss</u> (Zec 1995)
a.	mudga	mugga	bean
b.	sarpa	sappa	snake
c.	dharma	dhamma	righteousness
d.	danta	danta	tamed
e.	traana	taana	protection

20. In our view, the development of a strict coda condition in Pali and the lost of onset clusters is formally connected (see also Vaux 1992) since it can be viewed as a constraint on the M₂ position, *M₂Con (requiring that an M₂ consonant share place features with a following consonant).

21. /mudga/ [mugga] 'bean'

/mudga/	*M ₂ Con	MAX	*M ₂ [obs]	*M ₂ [nas]	*M ₂ [lat]	*M ₂ [r]
a. mud.ga	*!		*			
b. mu.ga		*!				
√ c. mug.ga			*			

22. /traana/ [taana] 'protection'

/traana/	*M ₂ Con	MAX	*M ₂ [obs]	*M ₂ [nas]	*M ₂ [lat]	*M ₂ [r]
a. traa.na	*! *M ₂ Con					*
√ b. taa.na		*				

23. In Sanskrit, *M₂Con would be low-ranked since codas do not have to share place features and onset clusters are allowed. It is an interesting question as to whether languages that obey the classic coda condition (where a coda must be assimilated as in Japanese) ever allow for (true) onset clusters.

24. Diachronic implication -- If a language which at one stage has simple (CV) syllable structure and starts to develop complex onsets, then it should also develop codas.

25. Standard vs. Colloquial Bambara (Bamana) (Data from Diakite 2006)

	<u>Standard</u>	<u>Colloquial</u>	<u>gloss</u>
a.	[buu.ru]	[bru]	bread
b.	[kabila]	[ka.bla]	tribute
c.	[mo.ri.ba]	[mor.ba]	Name
d.	[melekuya]	[mel.ku.ya]	literature
e.	[ba.ra.ma]	[bra.ma] or [bar.ma]	pot
f.	[fa.ra.ti]	[fra.ti] or [far.ti]	carelessness
g.	[safunE]	[sa.fnE] *[sfa.nE]	soap
h.	[kalabāci]	[kla.bā.ci] [kal.bā.ci] *[ka.lab.ci]	hypocrite

26. Ranking for Standard Bambara

*M₂/Obs >> *M₂/Son >> **Syncope** >> *M₁/Son >> *M₁/Obs

(Note: Syncope is shorthand for a series of constraint that have the effect of favoring deletion)

27. /moriba/ [mo.ri.ba] Name (Standard Bambara)

/moriba/	*M ₂ /Obs	*M ₂ /Son	Syncope	*M ₁ /Son	*M ₁ /Obs
√ a. mo.ri.ba			*	**	*
b. mor.ba		*!		*	*

28. Ranking for Colloquial Bambara

*M₂/Obs >> **Syncope** >> *M₂/Son >> *M₁/Son >> *M₁/Obs

29. /moriba/ [mor.ba] Name (Colloquial Bambara)

/moriba/	*M ₂ /Obs	Syncope	*M ₂ /Son	*M ₁ /Son	*M ₁ /Obs
a. mo.ri.ba		*!		**	*
√ b. mor.ba			*	*	*

30. /kabila/ [ka.bla] ‘tribute’ (Colloquial Bambara)

/kabila/	*M ₂ /Obs	Syncope	*M ₂ /Son	*M ₁ /Son	*M ₁ /Obs
a. ka.bi.la		*!		*	**
b. kab.la	*!			*	
√ c. ka.bla			*		**

31. Colloquial Bambara represents a language in which onset clusters and codas are emerging simultaneously

32. Note that there are many West African languages reported to have obstruent-sonorant onset clusters without allowing codas (such as Fongbe). These have come about historically through the deletion of the first vowel in historical OVLV sequences resulting in OLV. While these seem to be counterexamples to the Kaye and Lowenstamm implicational universal in (3c), they may only be apparent counterexamples. Note that Fongbe is the substrate language for Haitian Creole which does allow for coda consonants.

33. Further evidence for the connection between onset clusters and coda – understanding why Dorsey’s Law epenthesis occurs in Winnebago. Winnebago witnesses vowel epenthesis to break up potential obstruent-sonorant clusters (known as Dorsey’s Law), but does not break up obstruent-obstruent clusters. There has been a fair amount of recent discussion on this in order to understand the articulatory or perceptual motivation behind it. Lost in much of the discussion is the more fundamental question as to why source obstruent_sonorant clusters are broken in Winnebago but not in a language like English or Spanish. Why does Dorsey’s Law happen in Winnebago and not in English or Spanish? As seen in (34), the oddity with respect to Dorsey’s Law is that relatively unmarked potential onset clusters of obstruent-plus-sonorant are broken up by epenthesis whereas potentially marked obstruent-obstruent onsets are not broken up.

34. Dorsey’s Law in Winnebago (Miner 1979, 1992, 1993 and Hale & White Eagle 1980)

/hipres/	[hi.pe.res]	‘know’
/krepnã/	[ke.re.pã.nã]	‘unit of ten’
/sgaa/	[sgaa]	‘white’
/kšee/	[kšee]	‘revenge’
/ha-k-ru-gas/	[ha.ku.ru.gas]	‘I tear my own’
/pšoopšoc/	[pšoo.pšoc]	‘fine’

35. A phonetic explanation (after Blevins 2004) -- The audible release of the obstruent before the sonorant is misperceived as a vowel. The vowel is perceived to be colored by the post-sonorant vowel because of anticipatory articulation of vowel gestures and is then phonologized since the inserted vowel counts for stress placement and can be stressed.

36. A perceptual explanation (after Fleischhacker 2002, Flemming 2008) – If potential onset clusters are to be split up by epenthesis, it is more preferable to split an Obs_Son cluster as opposed to an Obs_Obs cluster. This is because on a P-Map account Obs_V_Son is perceptually closer to the source cluster (Obs_Son) than would be an Obs_V_Obs which is not as perceptually close to its source cluster (Obs_Obs) which consequently surfaces.

37. Both the phonetic and perceptual accounts beg the question as to why Obs-Son sequences are split up in Winnebago and not in languages like English or Spanish. If one considers syllable structure more generally in Winnebago there is a relevant observation (thanks to Bill Andersen of the American Indian Research Institute at Indiana University regarding this), namely, that the language has no sonorant consonants in coda position. If the language does not allow for sonorant codas, there is internal pressure within language not to have them in an onset cluster (such internal pressure does not exist in English or Spanish since both languages allow sonorants in coda position). We would maintain that Winnebago eschews codas generally and as a consequence there is a dispreference for an M₂ consonant as part of an onset cluster. (Note: obstruent-obstruent syllable-initial sequences are best analyzed as adjuncts; i.e., with the first obstruent of the sequence not formally part of the syllable onset.) [Baertsch & Davis 2005, 2007]

38. In Winnebago, the entire M_2 hierarchy ranks above FAITH (=DEP) and so no consonants surface in M_2 position.

- a. $*M_2/\text{Obs} \gg *M_2/\text{Nas} \gg *M_2/[l] \gg *M_2/[r] \gg \text{FAITH}$

39. /kre.../ --- [kere]

/kre.../	$*M_2$	Dep	$*M_1$
a. [kre]	$*M_2/r!$		$*M_1/\text{obs}$
√ b. [kere]		*	$*M_1/\text{obs}$ $*M_1/r$

40. Our analysis does not really explain why specifically epenthesis occurs in Winnebago as opposed to deletion, such as we see in Pali in (19e) where historic obstruent-sonorant sequences are ‘repaired’ by deletion rather than epenthesis. Our analysis though does offer a deeper understanding as to why Obs-Son sequences are not allowed to surface in Winnebago. This suggests that if one wants to know why Dorsey’s Law epenthesis might occur in some language, one must take into consideration its syllable structure in general for a deeper explanation.

41. Conclusion: What we have done in this paper is to offer additional evidence for the patterning together of a coda consonant with the second member of an onset and consequently for the split Margin Approach to the syllable in which these positions are marked in the same way. Evidence for this came from parallel changes in the coda and second member of an onset as witnessed in the historical phonology of Sardinian and Pali as well as in contemporary Bambara. Also, the Split Margin view of the syllable provides us with an understanding as to why Dorsey’s Law epenthesis occurs in Winnebago but not languages like English or Spanish that have similar obstruent-sonorant source clusters.

42. Implication (not discussed here) - on the relationship between onset clusters and syllable contact sequences (Baertsch & Davis 2005 2007, Davis & Baertsch to appear). As mentioned in (8b), under the Split Margin Approach to the syllable, onset clusters are handled by the local conjunction of the $*M_1$ constraints with the $*M_2$ constraints under the domain of the syllable. Though not discussed in this paper, syllable contact clusters are also handled by the conjunction of the $*M_1$ and $*M_2$ constraints. This is because in syllable contact a coda consonant (M_2) is adjacent to a syllable initial consonant (M_1). With syllable contact sequences the local domain is the word (not the syllable). Now since onset clusters are both adjacent within the syllable domain and the word domain while syllable contact clusters are adjacent only within the word domain, a prediction is made in the split margin approach to the syllable that onset clusters are a subset of the syllable contact clusters; more specifically, onset clusters in a language should be a subset of the mirror-image syllable contact clusters. For example, if a language like English allows for ‘bl’ as a possible onset (as in ‘blow’) then it should allow for ‘lb’ in syllable contact (as in ‘elbow’). This prediction needs to be further explored but it is neatly exemplified by the colloquial Bambara data in (25) (compare 25a with 25c or 25h with 25d).

References:

- Alber, Birgit. 2001. Maximizing first positions. Linguistics in Potsdam 12 (HILP 5) 1-19.
- Baertsch, Karen. 2002. An Optimality Theoretic Approach to Syllable Structure: The Split Margin Hierarchy. Ph.D. thesis, Indiana University.
- Baertsch, Karen & Stuart Davis. 2003. The split margin approach to syllable structure. ZAS Papers in Linguistics 32: 1-14
- Baertsch, Karen & Stuart Davis. 2005. Syllable contact: relational hierarchies or locally conjoined margin constraints. Conference on Manner Alternations in Phonology, ZAS, Berlin, Germany, June 24-25.
- Baertsch, Karen & Stuart Davis. 2007. Strength relations between consonants: A syllable-based OT approach. Unpublished MS. Southern Illinois University and Indiana University.
- Blevins, Juliette. 1995. The syllable in phonological theory. In The Handbook of Phonological Theory, ed. by John Goldsmith, pp. 206-266, Cambridge, MA: Blackwell.
- Blevins, Juliette. 2004. Evolutionary Phonology. Cambridge: Cambridge University Press.
- Blevins, Juliette. 2006. Syllable: typology. Encyclopedia of Language and Linguistics (2nd ed.) v. 12, pp. 333-337.
- Bolognesi, Roberto. 1998. The Phonology of Campidanian Sardinian. Ph.D thesis, University of Amsterdam.
- Cairns, Charles. 1988. Phonotactics, markedness and lexical representation. Phonology 5:209-236.
- Clements, G. N. 1990. The role of the sonority cycle in core syllabification. In Papers in Laboratory Phonology I: Between the Grammar and Physics of Speech, ed. by J. Kingston and M. Beckman, 283-333. New York: Cambridge University Press.
- Clements, G. & Keyser, S. 1983. CV Phonology: A Generative Theory of the Syllable. Cambridge, MA: MIT Press.
- Davis, Stuart. 1988. Topics in Syllable Geometry. New York: Garland Press.
- Davis, Stuart & Karen Baertsch. 2005. The diachronic link between onset clusters and codas. BLS 31:397-408.
- Davis, Stuart & Karen Baertsch. To appear. Decomposing the syllable contact asymmetry in Korean. In Asymmetries in East Asian Languages, ed. by Haruo Kubozono.
- Diakite, Boubacar. 2006. The synchronic link between onset clusters and codas in Bambara. Unpublished Ms., Indiana University.
- Fleischhacker, Heidi. 2002. Cluster-dependent epenthesis asymmetries. UCLA Papers in Phonology 5:71-116.
- Flemming, Edward. 2008. Asymmetries between assimilation and epenthesis. Paper presented at LSA, Chicago.
- Frigeni, Chiara. 2004. Metathesis and assimilation in liquids from Latin to Campidanian Sardinian: A similarity account. In Going Romance 2003, Selected Papers. Amsterdam: John Benjamins.
- Gouskova, Maria. 2004. Relational hierarchies in optimality theory: The case of syllable contact. Phonology 21:201-250.
- Green, Tonio. 2003. Extrasyllabic consonants and onset well-formedness. In The Syllable in Optimality Theory, ed. by Caroline Fery & Ruben van de Vijver, 238-253, Cambridge: Cambridge University Press.
- Hale, Ken & Josie White Eagle. 1980. A Preliminary metrical account of Winnebago accent. IJAL 46: 117-132.
- Kaye, Jonathan & Lowenstamm, Jean. 1981. Syllable structure and markedness theory. Theory of Markedness in Generative Grammar: Proceedings of the 1979 GLOW Conference 287-315. Pisa, Italy: Scuola normale superiore di Pisa.
- Miner, Kenneth. 1979. Dorsey's Law in Winnebago-Chiwere and Winnebago accent. IJAL 45: 25-33.
- Miner, Kenneth. 1992. Winnebago accent: The rest of the data. In Indiana University Linguistics Club 25th Anniversary Volume.
- Miner, Kenneth. 1993. On some theoretical implications of Winnebago phonology. Kansas Working Papers in Linguistics 18.
- Piggott, Glyne. 1999. At the right edge of words. The Linguistic Review 16:143-185.
- Prince, Alan & Smolensky, Paul. 1993/2004. Optimality Theory: Constraint Interaction in Generative Grammar. In Rutgers Optimality Archives. Published 2004, Blackwell: Malden, MA
- Steriade, Donca. 1994. Complex Onsets as single segments: The Mazateco pattern. In Perspectives in Phonology ed. by Jennifer Cole & Charles Kisseberth, pp. 203-291, Stanford: CSLI.
- Topintzi, Nina (2006) Moraic Onsets. Ph.D. thesis, University College, London.
- Vaux, Bert. 1992. Gemination and syllable integrity in Sanskrit. The Journal of Indo-European Studies 20:283-303.
- Zec, Draga. 1995. The role of moraic structure in the distribution of segments within syllables. In Frontiers of Phonology, ed. by Jacques Durand and Francis Katamba, pp. 149-179, London: Longman.
- Zec, Draga. 2007. The syllable. In The Cambridge Handbook of Phonology, ed. by Paul de Lacy, pp. 161-194. New York: Cambridge University Press.