The CVX theory of syllable structure

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Outline

1. Introducing the CVX theory
2. Arguing for the CVX theory
3. Some implications
4. Summary

Syllable analysis must consider (cf. 'modular' approach to syllable, Cairns, this conference):
- *feature theory* (articulatory gestures)
- *morphology*
- *metrical structure*

1. The CVX theory

- Word template: **MCSCM**
  - **S**: one or more syllables
  - **C**: one C
  - **M**: one or more affix or affix-like Cs
- Maximal size of a syllable is CVX
- C, V, and X are each a single sound, including a 'complex sound'
- M and C only occur at word edge can be explained by morphology (cf. multiple unsyllabified segments in Salish, Shaw, this conference)

CVX and 'complex sounds'

CVX	CVX	CVX	VX	VX	VX
S	S	S	S	S	S
ONC	ONC	ONC	NC	NC	NC
pʲ a u	t ɛ̃ t	tʷɪ n	a i	i	m
'plow'	'tent'	'twin'	'I'	'E'	'yes?'

Complex sounds: [pʲ], [ɛ̃], [tʷ], [kʳ], etc.
Note: a syllable can be VX 'I', CV 'the', and V 'a', too.

What is a complex sound?

- Articulatory gesture overlap (cf. 'compressibility' of Steriade, this conference)
- Formally, a complex sound must observe the *No Contour Principle* (Duanmu 1994)*: An articulator cannot make the same feature (F) twice within one sound*.

*Articulator	*Articulator	*Articulator	*Articulator
/\	/\	/\	/\
[+F][-F]	[-F][+F]	[+F][+F]	[-F][-F]

Examples of sound merger

- Case (a): different articulators

Dorsal +	Labial →	Dorsal-Labial
[k]	[w]	[kʷ]
Labial +	Coronal →	Labial-Coronal
[p]	[l]	[pˡ]

- Case (b): same articulator

Cor-[+stop] +	Cor-[+fric] →	Cor-[+stop, +fric]
[t]	[s]	[tˢ]

Impossible complex sound

- Merger not possible: 'contour feature values'

SP-[-nasal] + [t]	SP-[+nasal] → [n]	SP-[-nasal, +nasal] *[tn]
Cor-[+ant] + [θ]	Cor-[-ant] → [r]	Cor-[+anterior, -anterior] *[θr]

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Examples

- Possible complex sounds (possible medial onsets):
  pl, pr, kw, kr, tr, dr, ks, ts, …
- Impossible complex sounds (not possible medial onsets):
  st, sp, sl, θr, sn, …

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[mlif] vs. [mdif]

- Berent et al (this conference):
  [mlif] is mostly heard as <u>one syllable</u>
  [mdif] is mostly heard as <u>two syllable</u>
- Why?
- [ml] is a possible complex sound:
  [mlif] → [mˡif], one syllable
- [md] is not a possible complex sound:
  *SP-[+nasal, -nasal]
  [mdif] → [m.dif] two syllables

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2. Arguing for the CVX theory

Proposed word template: **MCSCM**

Every sound must be accounted for ('exhaustive'), some by phonology and some by morphology

To be shown (illustrated by English):

- Maximal non-edge syllable is CVX
- Word-edge consonants (M and C) are accountable by morphology

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English onsets in CELEX

- CCC: str, skr, skw, spr, spl, stj, skj, spj, skl
  - These clusters are <u>not found in medial onsets.</u>
  - CC after [s] can all form a complex sound; found medially
- CC (possible complex sound): bj, bl, br, dw, ʃw, fj, fl, fr, gl, gr, gw, hj, kl, kr, kw, mj, nw, pj, pl, pr, sw, tw, vj, ʒw, θw, mw, pw, vw, dj, gj, kj, lj, nj, sj, tj, θj, zj, dr, tr, kv, tsw
- CC (not possible complex sound): [θr, ʃm, ʃn, ʃr, km, kn, sl, sr, zl, st, sp, sk, sn, sm, sf, sv].
  - These clusters are <u>not found in medial onsets.</u>

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English rhymes in CELEX

- Borowsky (1986): Non-final rhymes are mostly VX
- Some extra-large rhymes are noted

surplus	[s3:p][l@s]
sforzando	[sfort][san][do]
arctic	[ark][tlk]
deictic	[daik]tlk]
council	[kaun][s@l]
symptom	[slmp][t@m]
almost	[ɔ:l]most

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Explaining 'exceptions'

- Alternative syllabification

	VXC][CV →	VX][CCV (→ VX][C^{C}V)
surplus	[s3:p][l@s] →	[s3:][pl@s]
sforzando	[sfort][san][do] →	[sfor][tsan][do]

- 'Perceived affixes', Pierrehumbert (1994)
  drama-tic → arc-tic, deic-tic

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Explaining the 'exceptions'

- Nasal V (Malécot 1960, Bailey 1978)
  [VNC] → [Ṽ C]
  sympton [sɪmp]tom → [sɪ̃p]tom
- Tense V can be short in VC (Pike 1947, Giegerich 1985)
  [V:C] → [VC]
  aesthetic [i:s]thetic → [is]thetic
  almost [ɔ:l]most → [ɔl]most

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Summary of medial syllables

- Excluding word edge effects, the maximal size of the English syllable is CVX
- An exhaustive examination of the English lexicon shows no exception

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Morphology and word-edge Cs

- Word template: **MCSCM**
  S is maximally CVX
  M is accounted for by the 'affix rule'
  C is accounted for by 'potential V' and 'anti-allomorphy'

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The Affix Rule

- *Affix(-like) sounds can be pronounced, whether they fit into a syllable or not.*
- Examples:

cats	[kæt]s	[s] affix
fact	[fæk]t	[t] affix-like
facts	[fæk]ts	[t] affix-like; [s] affix
texts	[tɛk]sts	[s] affix-like; [t] affix-like, [s] affix

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Potential V and Anti-allomorphy

- Potential V support a word-edge C (Giegerich 1985, Borowsky 1986)
- Not the same as Ø in GP, but a real V from affix

  V-final prefix: CV + [**C**S… → CV**C**.S…
  V-initial suffix: …S**C**] + VC → …S.**C**V

- Anti-allomorphy (Burzio 1996):
  Keep a morpheme in the same phonological shape, regardless of the environment.

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Example

- [hel][per] [p] supported by potential V
- [hel]p [p] supported by anti-allomorphy
- [hel]p[ful] [p] supported by anti-allomorphy

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Other languages

- Berber (Ouali and Duanmu 2004)
- Hindi (Kumar 2005)
- German (Duanmu 2008)
- Jiarong (Duanmu 2008)
- Bella Coola (Bagemihl 1991)
- Spokane Salish (Bates and Carlson 1992)
- Polish (Bethin 1992)
- Georgian (Butskhrikidze 2002)

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Summary

	CVX	Traditional (syllable parameters)
Accounting for extra Cs	yes	yes
Syllable parameters	no	yes
Consistent syllable size	yes	no
Over-prediction	no	yes

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3. Some implications

- 3.1. Typology
- 3.2. Syllable boundaries
- 3.3. The CV effect
- 3.4. The CV-only analysis
- 3.5. The spotty-data problem
- 3.6. Metrical structure: the nature of the syllable

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3.1. Typology

- Languages do differ in consonant clusters, at least at word edges
- Previous approaches: syllable parameters
- CVX theory: morphology
  - V-final prefixes
  - V-initial suffixes
  - C affixes

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Variation without phonological parameters

Max word size	Morphological (CXV)	Phonological (syllable parameters)
S	No V-final prefixes, V-initial suffixes, or C affixes	No branching onset or rhyme
CS	Having V-final prefixes	Branching onset
C_mS	Having C prefixes	Branching onset; appendix
SC	Having V-initial suffixes	Branching coda
SC_m	Having C suffixes	Branching coda; appendix
CSC	Having V-final prefixes and V-initial suffixes	Branching onset and coda
SCC_m	Having V-initial suffixes and C suffixes	Branching coda and edge appendix

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3.2. Syllable boundaries

- Word-edge consonants
- Law of Initials and Law of Finals
- Maximal Onset
- Maximal stressed syllable
- Weight-Stress Principle (WSP)
- WSP plus CVX

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Word-edge consonants

- Decisions on word-edge consonants affect maximal syllable size
- Syllable sizes:

	texts	*helped*	Max rime
'All in'	[teksts]	[helpt]	VXCCC
'Suffix out'	[tekst]s	[help]t	VXC
'Coronals out'	[tek]sts	[help]t	VXC
'Medial only'	[tek]sts	[hel]pt	VX

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Problems of the 'all-in' analysis

- Over-prediction: syllable size based on edge clusters, e.g. CCVVCC for smiles [smailz], but medial syllables are small
- Claiming C cannot be pronounced alone without a syllable, but it can, e.g. [s], [z], [f], …
- If C is a syllable when pronounced alone, then there is no need for large syllables:
  smiles = [s.mai.l.z]

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Law of Initials and Law of Finals

- Law of Initials (LOI):
  Word-medial onsets should resemble word-initial onsets
- Law of Finals (LOF):
  Word-medial codas should resemble word-final codas

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Ambiguity under LOI and LOF

*[wɪ.ski] whisky	Violating LOF: no word-final [-ɪ].
[wɪs.ki] whisky	OK: miss, key
[wɪsk.i] whisky	OK: risk, even
[tai.ni] tiny	OK: tie, negotiate
[tain.i] tiny	OK: fine, Iran

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Maximal Onset

- Put as many consonants in the onset as possible.
- Possible onsets: those that occur in word-initial clusters
- Thus, Max Onset assumes LOI, but not LOF.

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No ambiguity under Max Onset

[wɪ.ski] whisky	OK: even though LOF is violated
*[wɪs.ki] whisky	Onset is not max
*[wɪsk.i] whisky	Onset is not max
[tai.ni] tiny	OK
*[tain.i] tiny	Onset is not max

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Three problems of Maximal Onset

- No respect for LOF, e.g.
  - Max Onset: [wɪ.ski] *whisky* (violating LOF)
  - LOF: [wɪs.ki] *whisky*
- Not supported by intuition, e.g.
  - Max Onset: [wɪ.ski] *whisky*
  - Intuition: [wɪs.ki] *whisky*
- Lack of independent evidence

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Maximal stressed syllable

- Hoard (1971), Bailey (1978), Wells (1990), Hammond (1999):
  Group as many consonants as possible with a stressed vowel
  E.g. [kækt.əs] *cactus*
- Both LOI and LOF happen to be satisfied

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Ambiguity in Maximal stressed syllable

- Ambiguity in syllabification:

	capital	*ability*
Bailey (1978):	[kæp.ɪt.l̩]	[ə.bɪl.ɪt.i]
Why not:	[kæp.ɪ.tl̩]	[ə.bɪl.ɪ.ti]

- Not supported by intuition, e.g.
  Max Stress: [wɪsk.i] *whisky*
  Intuition: [wɪs.ki] *whisky*

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Weight-Stress Principle

- WSP:
  a. Stressed syllables are heavy.
  b. Unstressed syllables are light.
- Syllabification by WSP satisfies both LOI and LOF

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Ambiguity under WSP
(V = stressed; v = unstressed)

- WSP does not require an onset
- WSP does not limit the length of a rhyme

VVC.v	col.a
VV.Cv	co.la
CVCC.v	risk.y
CVC.Cv	ris.ky

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WSP plus CVX

- WSP ensures minimal rhyme length for stressed syllables
- CVX limits maximal rhyme length
- Onset is not required, but will be often available, because an unstressed syllable cannot have a coda
- Both LOI and LOF are satisfied

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Syllabification with WSP plus CVX

- An unambiguous solution to syllabification

Good	Bad	Reason	Example
VC.v	*V.Cv	WSP-a	*city*
VC.VX	*V.CVX	WSP-a	*rabbi*
v.CVX	*vC.VX	WSP-b	*attack*
v.Cv	*vC.v	WSP-b	*Canada*
VX.Cv	*VXC.v	Max VX	*cola*

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Summary of syllabification

	LOI	LOF	Judgment	Unambiguous
Max Onset	yes	no	no	yes
Max stress	yes	yes	no	no
WSP	yes	yes	no	no
WSP+CVX	yes	yes	yes	yes

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3.3. The CV effect

- Jakobson (1958: 21): 'There are languages lacking syllables with initial vowels and/or syllables with final consonants, but there are no languages devoid of syllables with initial consonants or of syllables with final vowels.'
- Hooper (1976a: 199) CV syllables are 'optimal' universally
- Steriade (1982: 78): CV is 'maximally unmarked'.

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Explaining the CV effect

- Max Onset: VCV → V.CV always, which explains the CV effect
- CVX and WSP: There is no requirement for the onset. How can we explain the CV effect?

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Deriving CV effect from CVX and WSP

Two sources of CV syllables:
1. Unstressed rhyme is V, leaving following C as an onset
2. Stressed V can become V:, leaving following C as an onset

String	Initial stress	Final stress
CVCV	[CVC][v], [CV:][cv]	[cv][CV:]
CVCVC	[CVC][v](c), [CV:][cv](c)	[cv][CVC], [cv][CV:](c)
VCVC	[VC][v](c), [V:][cv](c)	[v][CVC], [v][CV:](c)
VCV	[VC][v], [V:][cv]	[v][CV:]

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3.4. The CV-only theory

- Lowenstamm (1996) and Scheer (2004): The only possible syllable is CV
- Empty elements abound

	Phoneme	CV-only
buy	[bai]	[ba.Øi]
fly	[flai]	[fØ.la.Øi]
text	[tekst]	[te.kØ.sØ.tØ]

- Is the theory simpler than CVX?

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Three criticisms

- The CV-only theory is more complicated

CVX	CV-only
[bai]	[ba][Øi]
[flai]	[fØ][la][Øi]
[tek]st	[te][kØ][sØ][tØ]

- Abstract empty elements with no phonetic content
- Circular: cannot distinguish from VC-only, CVC-only, etc.

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3.5. The spotty-data problem

- Most possible syllables seem to be missing
- Example: CVC syllables in English
  - Initial C = 23; lax V = 5; final C = 21
  - Total CVC: 2,415

Word form	Possible	Used	% used
CVC	2,415	615	25.5%
CVCCVC	5,832,225	6,000	0.1%

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Another example

- Onset + VC rhymes: 1/6 of possible patterns found

- Productive onsets (C=22, CC=30, CCC=6): 59
- Occurring VC rhymes: 101
- Possible monosyllables with VC rhymes: 5,959
- Occurring monosyllables with VC rhymes: 1,069

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101 VC rhymes (frequency)

- The most productive rhyme only occurs with 29 out of 59 onsets
- [ɪl] (29), [ɪp] (26), [æk] (25), [ɪt] (25), [Ot] (25), [æt] (24), [ɪk] (23), [Op] (23), [æg] (22), [æʃ] (22), [æp] (21), [æm] (20), [ʌm] (20), [ɪn] (19), [Ok] (19), [ʌg] (19), [æd] (18), [æn] (18), [ɛd] (18), [Ob] (18), [Od] (18), [ʌf] (18), [ɛl] (17), [ɛn] (17), [ɛt] (17), [ɪŋ] (17), [Og] (16), [ʌb] (16), [ʌt] (16), [æb] (15), [ɪm] (15), [ɪg] (14), [ɪʧ] (14), [ʌk] (14), [ɛs] (13), [Os] (13), [Oʃ] (13), [ʌn] (13), [ʌʃ] (13), [æŋ] (12), [ɛk] (12), [ɪf] (12), [ɪb] (11), [ɪz] (11), [ʌd] (11), [æʧ] (10), [ɛʤ] (10), [ɪd] (10), [On] (10), [Oŋ] (10), [ʌs] (10), [ʌʤ] (9), [ʌŋ] (9), [ɛg] (8), [ɛʧ] (8), [ɪs] (8), [Of] (8), [Oʧ] (8), [ʊk] (8), [ʌl] (8), [æs] (7), [ɛf] (7), [ɛm] (7), [Ol] (7), [Om] (7), [ʌʧ] (7), [ɛp] (6), [ɪʃ] (6), [Oθ] (6), [ʊd] (6), [Oʤ] (5), [ʌp] (5), [ʌv] (5), [æl] (4), [ɛb] (4), [ɛʃ] (4), [ɪʤ] (4), [ɪθ] (4), [ɪv] (4), [ʊl] (4), [ʊʃ] (4), [ʊt] (3), [ʌz] (3), [æʤ] (2), [æf] (2), [æv] (2), [æz] (2), [ɛθ] (2), [ʊʧ] (2), [æθ] (1), [əl] (1), [əm] (1), [əs] (1), [əv] (1), [ɛv] (1), [ɛz] (1), [ɪð] (1), [Ov] (1), [Oz] (1), [ʊf] (1), [ʊs] (1)

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For Davis and Baersch (this conference)

- How many missing CC-VC syllables can be attributed to *CC_i-VC_i?
- Probably just a few percent
- Is it better accounted for the missing ones by frequency?

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Grammar or not?

- Decision:
  with is an outlier (not good word) in English.
- Generalizations:
  [ɪð] is not a possible rhyme in English.
  [mɪð, nɪð, tɪð,…] are impossible (ungrammatical) words in English.

- Decision:
  with is a good word (not an outlier) in English.
- Generalizations:
  [ɪð] is a good rhyme in English.
  [mɪð, nɪð, tɪð,…] are potential words (holes) in English.

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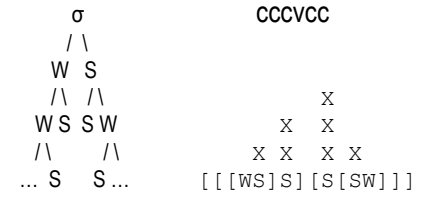
3.6. Metrical structure

- Kiparsky (1981): Syllable structure is metrical structure
- Why is the syllable so small?
- Answer: large syllables have metrical violations of stress clash



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Metrical structure

- CVX is the larges structure without 'clash' or 'lapse'

String	Rhythm	Analysis
*CCV	*WSS	Bad rhythm: stress clash
*CCV	*WWS	Bad rhythm: lapse of WW
*VCC	*SWW	Bad rhythm: lapse of WW
*VCV	SWS	good rhythm but bad syllable: two peaks
CVC	WSW	good rhythm and good syllable
VC	SW	good rhythm and good syllable
CV	WS	good rhythm and good syllable

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Some questions

- Is the maximal syllable CCVCC (van der Hulst, this conference) or CCVVCC (Samuels, this conference)?
- No.

- Is the syllable real?
- If it is so small, it needs an explanation

- Is it simpler to assume no syllable in UG?
- It is just as simple to assume CVX

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4. Summary

- Word-edge Cs can be explained by morphology; they need not be included in a stretched syllable
- Maximal syllable is CVX for all languages
- Syllable boundaries can be determined by CVX and WSP

- CVX is a true phonological universal (inviolable constraint)
- CVX is likely to be derivable from metrical structure
- Some areas of grammar may have no 'major' typology

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Link to a chapter

http://www-personal.umich.edu/~duanmu/Duanmu-Syllable08Ch3.pdf

This chapter offers more discussion of the ideas I presented here. It is from my forthcoming book:

Duanmu, San. 2008. Syllable structure: How different can it be in human languages? Oxford University Press.

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