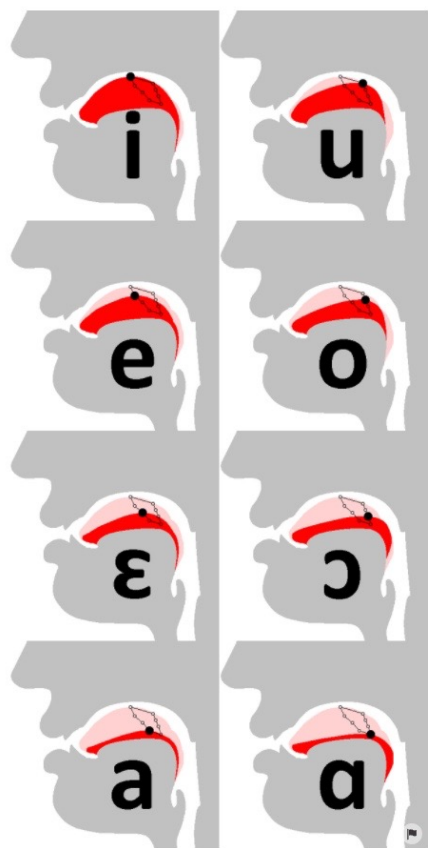




24.901/931, 2026

Introduction to Phonology

Lecture 15

- Problem set 5 posted, due 4-16
- On conspiracies: Kager 1999 chapter 2
- Also, Kisseberth 2010 section 2.1 onwards
- Section 1 is a reflection on K's 1970 analysis of Yokuts, the first conspiracy identified as such.

Today

- Back to ranking consistency
- Ranking arguments
- Opacity and harmonic bounding
- Conspiracies
- FAQs on correspondence

Integration in rule- vs. constraint-based grammars (1)

- In an OT grammar, the rankings that describe several processes must be mutually consistent.
- E.g. if $\text{DEP } i \gg \text{DEP } \emptyset$ for Process 1
but $\text{DEP } \emptyset \gg \text{DEP } i$ for Process 2, that's a contradiction (*ranking paradox*).

The analysis must be revised to remove the contradiction.

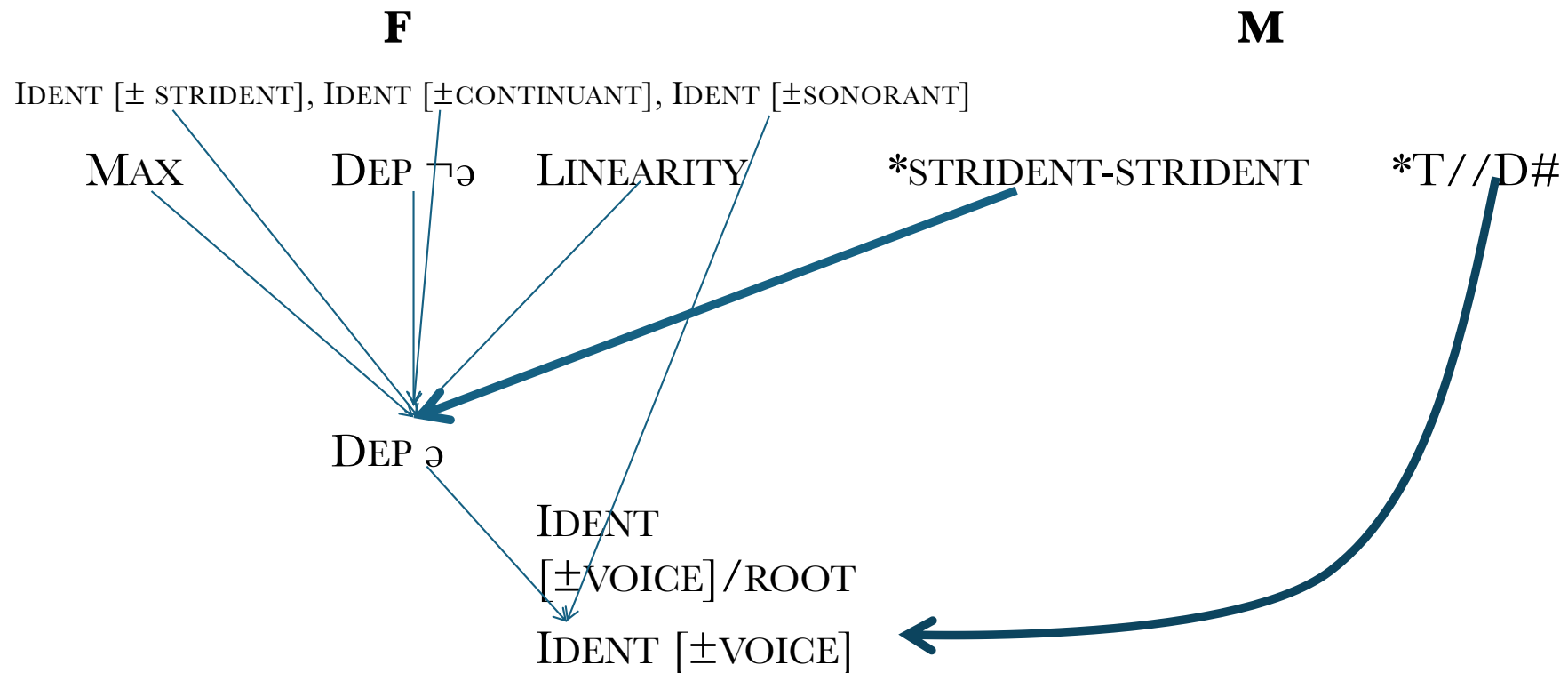
- In rule-based grammars, the SD or SC of some Rule 1 are independent of corresp. SD/SC of any Rule 2. Any SC can coexist with any other SC.
- E.g. Process 1 can insert $\emptyset$, while Process 2 inserts i , in similar contexts.
- OT grammars are more tightly integrated than rule grammars, because they require one overall ranking.

Integration in rule- vs. constraint-based grammars (2)

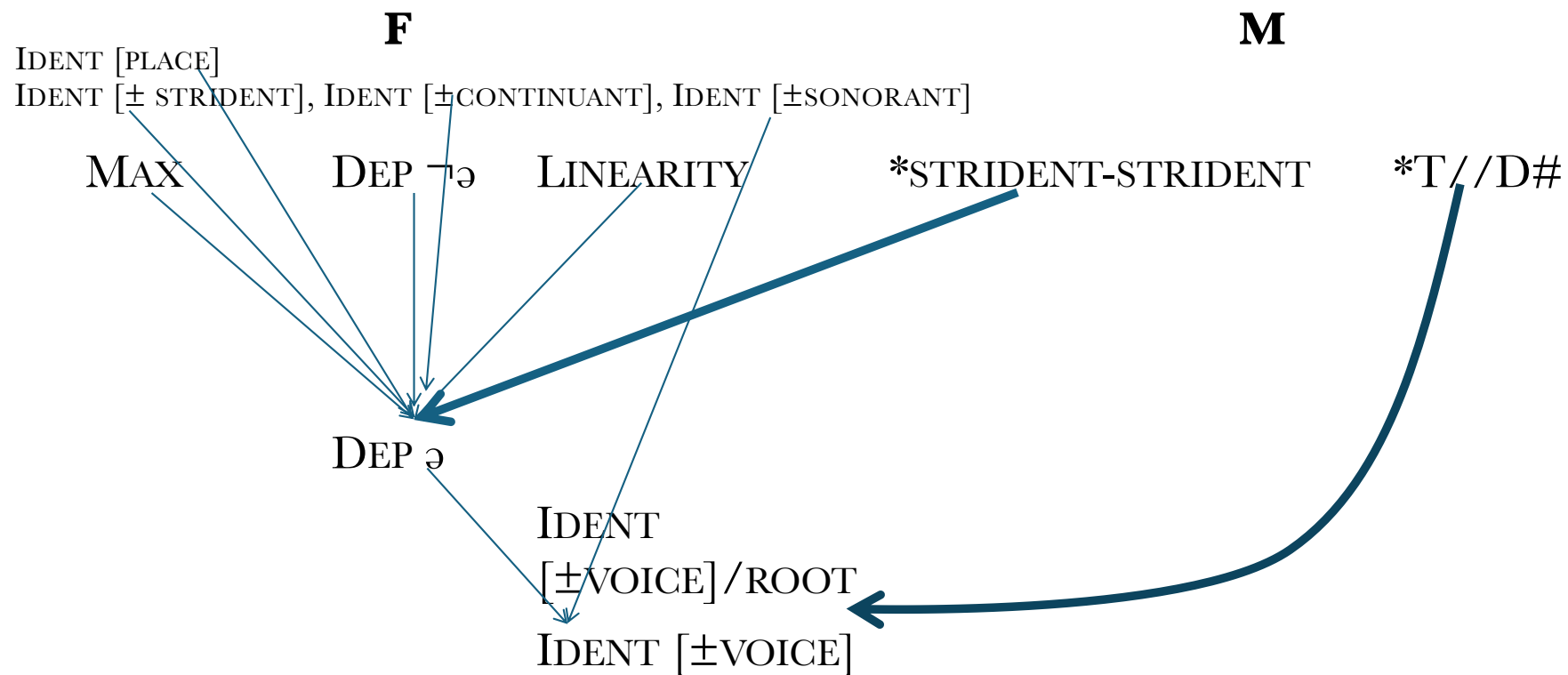
- Suppose natural languages are such that it's generally possible to describe them with analyses that are integrated, i.e. consistent in ranking.
- That is an unexpected coincidence if grammars consist of rules, but it is a predicted feature if they consist of constraints and rankings.
- So, whether ranking consistency can be easily attained in analyzing real phonological systems has some interest in comparing theories.

Back to ranking consistency in OT analyses of
multi-process English grammars

What we proposed for English (+ additions in last class)



We add epenthesis in TD (*cit*[ə]*d*, *mind*[ə]*d*, *bid*[ə]*d*)



Pairs of F constraints shared by 3 processes

- Rankings between pairs below are identical or mutually consistent

MAX C >> DEP ə	required for 2 processes; consistent with all 3
LINEARITY >> DEP ə	ditto
IDENT ±CONTINUANT >> DEP ə	ditto
DEP ¬ ə >> DEP ə	ditto
IDENT ± ¬VOICE >> IDENT ±VOICE	ditto (¬VOICE: STRIDENT, CONT, SON)
MAX C >> IDENT ±VOICE	required for 1, consistent w. 3
- No inconsistent rankings found.
- Then we looked at other English processes.

Other English processes

- Cluster (CC) simplifications suggesting IDENT F, DEP ə >> MAX C

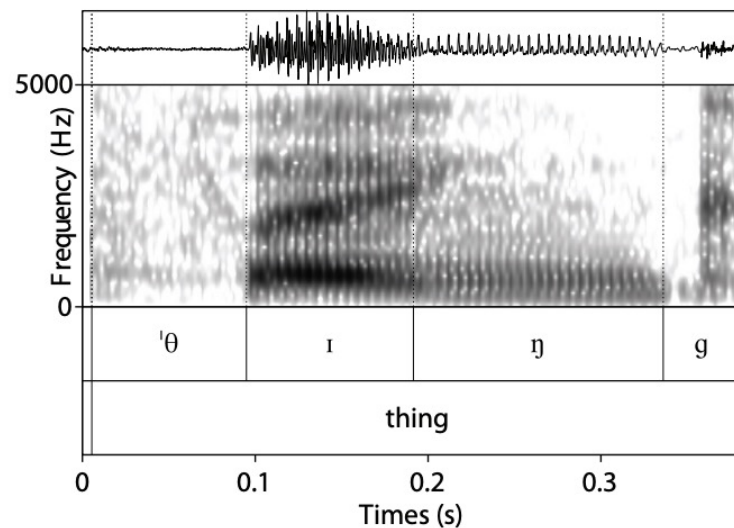
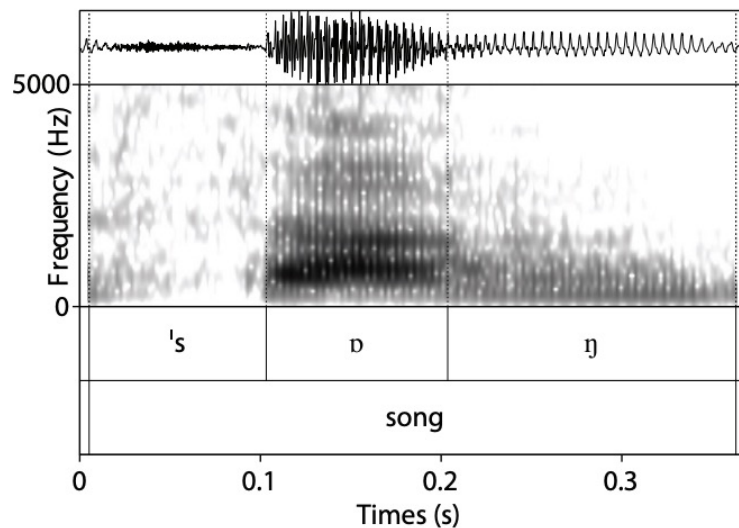
bomb *long* *column* *solemn* *sign* *design*
bombard *longer* *columnar* *solemnity* *signal* *designation*

- ŋg → ŋ, mb → m could be productive; ŋg → ŋ is only optional in some dialects.
- They seem to require 2 rankings contradicting others: IDENT >> MAX, DEP ə >> MAX

lŋg	*[+nas][cont,+voi]#[+alveolar]	Ident voice	Dep ə	Max	/lŋg, -ert	*[+nas][cont,+voi]#[+alveolar]	Ident voice	Dep ə	Max
lŋg	*!				ɹilŋg-ert				
lŋk		*!			ilŋ-ert				*!
lŋəg			*!						
ɹilŋ				*					

Can you adjust the analysis

- To remove the ranking paradox?
- One option: observe that voiced stops after N are very short.



Bailey 2019 Labphon: dialect of Manchester (Northwestern UK)

4/9/26

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Exploiting this difference T vs. D/N_

- Adjust the MAX constraints to reflect that only shortest stops delete N_.
- Longer stops: voiceless, voiced except after N.

Shortest stops: voiced after N

MAX C_{LONGER}, IDENT [$\pm$ VOICE], DEP ə >> MAX C_{SHORTEST}

lɔŋg	*[+nas][cont,+voi]#[br/>[-alveolar]	MAX C _{LONGER}	Ident voice	Dep	MAX C _{SHORTEST}
lɔŋg	*!				
lɔŋk			*!		
lɔŋəg				*!	
ɱlɔŋ					*

Limits of this approach

- We preserved ranking consistency by cloning an F constraint:
- $\text{MAX } C \rightarrow \text{MAX } C_{\text{LONGER}} \gg \dots \gg \text{MAX } C_{\text{SHORTEST}}$
- Are there principles that limit this kind of move?
- If any analysis can be saved by cloning, the idea of ranking consistency can't be proven wrong.
- General proposal: cloning F constraints can be justified by systematic differences in similarity/confusability.
- E.g. if pairs like *anga-anya* are significantly more confusable than *anka-anya* (they are: Cozier 2008).

Ranking arguments and non-arguments

In PS5 you will provide some ranking arguments.

= show that C1 *must rank above* C2.

The argument can go wrong in 2 ways:

the ranking isn't correct, the opposite ranking is.

the ranking isn't necessary; no ranking also gets the right result.

Ranking arguments (preliminary)

- We know that a ranking $C_1 \gg C_2$ is necessary when we know:
 - a. $C_1 \gg C_2$ is consistent with all the data, *and*
 - b. $C_2 \gg C_1$ is inconsistent with some datum D , *and*
 - c. there's no C_3 such that $C_3 \gg C_1$ derives that D
- Some ranking arguments of type (a-b) $\succ$ = 'better than'
 - *STRIDENT-STRIDENT $\gg$ DEP ə: /bʌs-z/ [bʌsəz] $\succ$ [bʌsz]
 - IDENT [$\pm$ STRIDENT] $\gg$ DEP ə: /bʌs-z/ [bʌsəz] $\succ$ [bʌts], [bʌst]
 - *T//D $\gg$ IDENT [$\pm$ VOICE]: ??
 - DEP ə $\gg$ IDENT [$\pm$ VOICE]: ??

Focus on (c)

- We know that a ranking $C_1 \gg C_2$ is necessary when we know:
 - a. $C_1 \gg C_2$ is consistent with all the data, and
 - b. $C_2 \gg C_1$ is inconsistent with some datum D, and
 - c. no C_3 is such that $C_3 \gg C_1$ derives D

Argument of type (b):

/A/	C_1	C_2
Y	*!	
$\neg X$		*

But (c): there **is** a C_3 , and $C_3 \gg C_1$, $C_2 \gg C_1$

/A/	C_3	C_2	C_1
Y	*!		*
$\neg X$		*	

Concretely: DEP u [ɯ] vs. DEP o in Japanese

DEP u >> DEP o consistent with this data, DEP o >> DEP u not so much

	L2 word	L2 in IPA	Borrowed into Japanese	
English	nomad	nomæd	nomado	
	contribute	kəntɹɪbjut	kontoribjuto	
	trophy	trofi	toroɸi	C/_V in Japanese: All C's precede some V. Epenthesis due to that.
	cement	səmənt	semento	
	pocket	pɒkət	poketo	
	lemonade	ləməneɪd	remoneedo	
	fight	fart	faito	
French	alerte	alɛʁt	areruto	
	travesti	tʁavesti	torabesufi ~ torabesuti	
German	Dioptrie	dioptʁi	dʒioputori ~ dioputori	
	Zeitgeist	tsaitgaist	tsaitogaisuto	
	Zeltsack	tseltzak	tsarutozaku	

DEP u vs. DEP o in Japanese

Full data suggests something contradictory: DEP u >><< DEP o

	L2 word	L2 in IPA	Borrowed into Japanese
English	snob	snɒb	sunobu
	rugby	ɹʌɡbi	rag ubi
	index	ɪndeks	indek usu
	crank	kɹæŋk	kuræŋ ku
	handkerchief	hæŋkətʃɪf	hanːkaʈʃiɸ u
	imply	ɪmplaɪ	imp urai
German French	Satz	zats	zats u
	cercle	sɛʁkl	ser ukuru
	abricot	abʁiko	abu riko

Japanese t/ts alternations

	negative	infinitive	volitional	potential	tentative	gloss
a	kasanai	kasu	kaʃitai	kaseru	kasoo	lead
b	ʃinanai	ʃinu	ʃinitai	ʃineru	ʃinoo	die
c	katanai	katsu	katʃitai	kateru	katoo	win

*TV_[+HIGH] >> IDENT [-STRID]; *TV_[+HIGH]

T = ALVEOLAR STOP

Effect: no *tu*, *ti*, *du* *di*.

Assume the same M >> F ranking holds in loanwords.

Can we use this info to solve our DEP conundrum?

Assume further that IDENT [-STRID] (L2↔JAPANESE)

Japanese speakers unwilling to turn an audible [-strident] (English) into [+strident]

$C/_V, *TV[+high], IDENT \text{ STRID} \gg DEP_o \gg DEP_u$

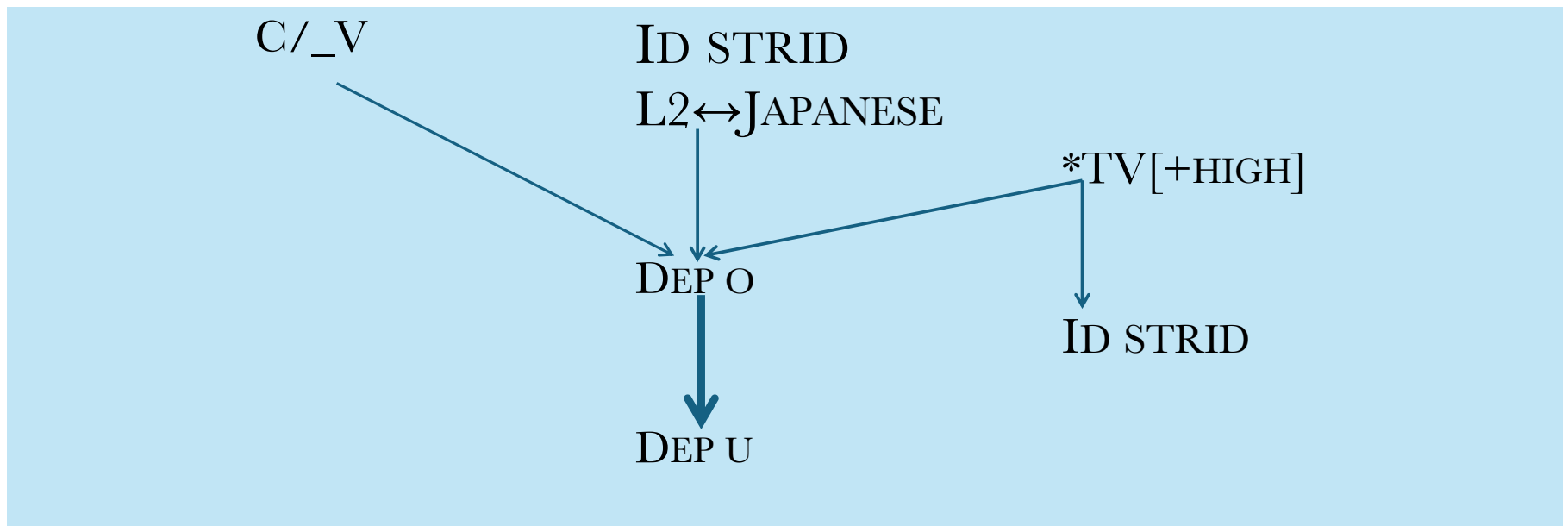
	C/_V	DEP_o	DEP_u
snob	*!*		
sonobo		*!*	
sunobu			**

C/_V: every C precedes a V

	C/_V	ID STRID L2↔JAPANESE	*TV_[+hi]	DEP_o	DEP_u
poket	*!				
poketu			*!		*
poketsu		*!			*
poketo				*	

ID STRID L2↔JAPANESE: One * for each instance of an $[\alpha \text{ strident}]$ sound in an L2 word corresponding to a $[-\alpha \text{ strident}]$ sound in its Japanese counterpart

Hasse diagram



Dep o >> Dep u is opposite ranking from the one that looked right at first.
That's because C/_V and ID STRIDENT outrank Dep u, not because Dep u >> Dep o

Reiterating

Type (b) arguments hold only when we know that *no relevant C3 outranks C1*.

An argument of type (b):

/A/	C ₁	C ₂
Y	*!	
$\neg$ X		*

Danger corresponding to (c):

/A/	C ₃	C ₁
Y	*!	*
$\neg$ X		

/A/	C ₃	C ₂	C ₁
Y	*!		*
$\neg$ X		*	

if $C_3 \gg C_1$ it could be that $C_2 \gg C_1$

Opacity in OT and harmonic bounding

candidate 1 *harmonically bounds* candidate 2
if 1 has a proper subset of the violations of 2

The English bleeding interaction of voicing and epenthesis in $/b_{\Delta} s-z/ \rightarrow [b_{\Delta} s_{\Theta} z]$

		M	F	F	F
	$/b_{\Delta} s-z/$	*STRID-STRID	*TD#	DEP Θ	IDENTVOICE
a	$b_{\Delta} s z$	*!	*		
b	$b_{\Delta} s_{\Theta} z$			*	
c	$b_{\Delta} s_{\Theta} s$			*	*!

In a rule-based grammar, a counter-bleeding interaction is possible too:
 $/b_{\Delta} s-z/ \rightarrow [b_{\Delta} s_{\Theta} s]$

Harmonic bounding

Hopeful news, for OT: <i>this</i> opaque interaction seems to not exist (some debate).					
	/b _Λ s-z/	*STRID-STRID	*TD#	DEP ə	IDENTVOICE
a	b _Λ sZ	*!	*		
☞b	b _Λ səZ			*	
c	b _Λ səs			*	*!

Candidate (c) is harmonically bounded by (b).

(c) results in a rule-based grammar, if Voicing Assim. counterbled by Epenthesis

But standard OT is unable to model certain opaque interactions, incl. this.

Conspiracies

In rule-based grammar: groups of rules frequently share lots of properties.
They ‘conspire’ to bring about a surface result Kisseberth 1970 (see 2010).
In OT: same M constraint satisfied through different F violations

*VV

- Many systems contain multiple ways of eliminating VV sequences
- Margi:
 - i, u $\rightarrow$ j, w / _ V
 - central V (ə, a) $\rightarrow \emptyset$ / next to non-central V (e, o)
 - central V (ə, a) $\rightarrow \emptyset$ / __ ə, a
- Lomongo, Kinyarwanda, Spanish have a version of this system

*VV in Spanish (a dialect of Mexico; Kisseberth 2010)

a. aV→V	paga Evita	pagevita	‘Evita pays’
	la iglesia	liglesia	‘the church’
	casa [u]milde	casumilde	‘humble home’
	niña orgullosa	niñorgullosa	‘proud girl’

*VV in Spanish

a. aV→V	paga Evita	pagevita	‘Evita pays’
	la iglesia	liglesia	‘the church’
	casa humilde [umilde]	casumilde	‘humble home’
	niña orgullosa	niñorgullosa	‘proud girl’
b. iV, uV→jV, wV	mi obra	m[jo]bra	‘my deed’
	mi ultima	m[ju]ltima	‘my last one’
	mi hebra [eβra]	m[je]bra	‘my thread’
	mi arbol	m[ja]rbol	‘my tree’
	tu alma	t[wa]lma	‘your soul’
	tu hijo [iho]	t[wi]ho	‘your son’
	su [o]mero	s[wo]mero	‘your Homer’

*VV in Spanish

a. aV→V	paga Evita	pagevita	‘Evita pays’
	la iglesia	liglesia	‘the church’
	casa umilde	casumilde	‘humble home’
	niña orgullosa	niñorgullosa	‘proud girl’
b. iV, uV→jV, wV	mi obra	m[jo]bra	‘my deed’
	mi ultima	m[ju]ltima	‘my last one’
	mi hebra [eβra]	m[je]bra	‘my thread’
	mi arbol	m[ja]rbol	‘my tree’
	tu alma	t[wa]lma	‘your soul’
	tu hijo [iho]	t[wi]ho	‘your son’
	su omero	s[wo]mero	‘your Homer’
c. eV, oV→jV, wV 4/9/26	me urge	m[ju]rge	‘it is urgent to me’
	tengo hipo	teng[wi]po	‘I have the hiccups’ ³¹

	consonantal	syllabic	low	high	back	front	round
a	-	+	+	-	-	-	-
e	-	+	-	-	-	+	-
o	-	+	-	-	+	-	+
i	-	+	-	+	-	+	-
u	-	+	-	+	+	-	+
j	-	-	-	+	-	+	-
w	-	-	-	+	+	-	+
ɛ	-	-	-	-	-	+	-
ɔ	-	-	-	-	+	-	+

Mid: e, o, ɛ, ɔ

High: i, u, j, w

Glides: j, w, ɛ, ɔ

One rule analysis

- MidRaise [-low, +syllabic] → [+high] / _ [+syllabic]
(e, o → i, u / _V)
- HighGlide [+high, +syllabic] → [-syllabic] / _ [+syllabic]
(i, u → j, w / _V)
- V Delete [+syllabic] → Ø / _ [+syllabic]
(V → Ø / _V)

	mi obra	me urge	paga Evita
MidRaise		e → i	
HighGlide	i → j	i → j	
VDelete			a → Ø
SR	mjobra	mjurge	pagevita

Recurring parts of the SDs: $[+syll][+syll] = VV$

- MidRaise $[-low, +syllabic] \rightarrow [+high] / _ [+syllabic]$
(e, o $\rightarrow$ i, u / $_V$)
- HighGlide $[+high, +syllabic] \rightarrow [-syllabic] / _ [+syllabic]$
(i, u $\rightarrow$ j, w / $_V$)
- V Delete $[+syllabic] \rightarrow \emptyset / _ [+syllabic]$
(V $\rightarrow \emptyset / _V$)

	mi obra	me urge	paga Evita
MidRaise		e $\rightarrow$ i	
HighGlide	i $\rightarrow$ j	i $\rightarrow$ j	
VDelete			a $\rightarrow \emptyset$
SR	mjobra	mjurge	pagevita

2 shared properties

- All 3 rules share part of their SD: $[+syllabic][+syllabic] = VV$
- And part of their SC: only *last V in a word* (V_1 in $V_1\#V_2$) is modified.
- Also relevant:
 - There's no VV on the surface in this dialect
 - No mid glides (e.g. ɤa, ɔa)

Conspiracy

- Collection of rules implementing shared SR goal. (Kisseberth 1970, 2010)
- The rules repeat information: their SDs are identical or similar; their SCs may be similar.
- They can't be unified if stated as rules.
- To avoid duplication:
 separate the shared objective (satisfying some M, the SD)
 from methods of M satisfaction (SCs: F violations).

Spanish conspiracy stated as a constraint set

- Has 1 main goal, 2 auxiliary ones:
 - (i) M1: *VV
 - (ii) M2: NO MID GLIDES
 - (iii) F: Don't change 1st V of the word (recall VH)

Why aren't grammars engineered so *one* rule could solve *VV?

- Conspiracies arise, in part, when:
 - (a) one method is preferred to satisfy an SR objective: e.g. gliding for *VV.
preferred because it keeps the input mostly unchanged
 - (a) but that isn't applicable to all inputs: not all glides are ok.
- In rule terms, n rules are attempted in order. Because they seek to solve the same problem, their SDs are similar.
- An OT analysis separates shared M, from F, and ranks various F.
- That expresses shared M objectives; shared F rankings. No duplication.

Spanish hiatus

- The preferred way of satisfying *VV is glide formation
- Both Vs keep a surface counterpart, if $V \rightarrow G$.
As in $i \rightarrow j$, $e \rightarrow j$
- But [a] has no recognizable glide counterpart.
- There is no Spanish [-high] glide, no central glide.
- $[a] \rightarrow [j]$ or $[w]$ is too massive a distortion of original V.
- Better: $aV \rightarrow \emptyset V$
- Intuitively:
 $V \rightarrow G$ ok only if original V is recognizable in G

Components of the analysis

- M *VV: a * to every sequence of two adjacent Vs
 *[-HIGH, -SYLL]: a * for every non-high glide (e.g. ɤa, ɔa)
- F MAX
 IDENT [±SYLLABIC], IDENT [±HIGH], IDENT [±LOW].

$*VV \gg \text{IDENT } \pm\text{SYLL}; \text{MAX} \gg \text{IDENT } \pm\text{SYLL}$

		M	F	F
	mi arbol	$*VV$	MAX	IDENT $\pm\text{SYLL}$
a	mi arbol	*!		
b	marbol		*!	
c	mirbol		*!	
→ d	m _̣ iarbol			*

$V_{̣}$ = glide corresponding to V

*VV, *[-HIGH, -SYLL] >> IDENT $\pm$ HI
 MAX >> IDENT $\pm$ HI

		M	M	F	F	F
	lo abla	*VV	*[-HIGH, -SYLL]	MAX	ID $\pm$ HIGH	ID $\pm$ SYLL
a	loabla	*!				
b.	lɔabla		*!			*
c.	labla			*!		
d. 	lɥabla				*	*

*[-HIGH, -SYLL] No non-high glide

IDENT $\pm$ LOW ($\pm$ FRONT, $\pm$ BACK) $\gg$ MAX

		M	M	F	F	F
	paga Evita	*VV	*[-HIGH, -SYLL]	ID $\pm$ LOW	MAX	ID $\pm$ SYLL
a.	paga Evita	*!				
b. 	pag Evita				*	
c.	pagu Evita pagi Evita			*!		*
d.	paga Evita		*!			*

Note IDENT [$\pm$ BACK]/[$\pm$ FRONT]/[ROUND] violations in (c)
 Spanish glides are either front of back/round

??

		M	M	F	F
	la iglesia	*VV	*[-HIGH, -SYLL]	ID LOW	MAX
a.	la iglesia	*!			
b.	laiglesia		*!		
c.	luiglesia			*!	
!d.	laglesia				*
!e.	liglesia				*

MAX/#_ vs. MAX

		M	M	F	F	F
	la iglesia	*VV	*[-HIGH, -SYLL]	ID LOW	MAX#_	MAX
a.	la iglesia	*!				
b.	la _ɪ glesia		*!			
c.	lu _ɪ glesia			*!		
d.	la _ɪ glesia				*!	*
☞ e.	liglesia					*

MAX/#_: Assign one violation for each segment s,
iff s is word-initial in UR (#_), and s has no SR counterpart.

No direct evidence for ranking MAX/#_. But it's never violated. 45

Why not *la_ɨglesia?

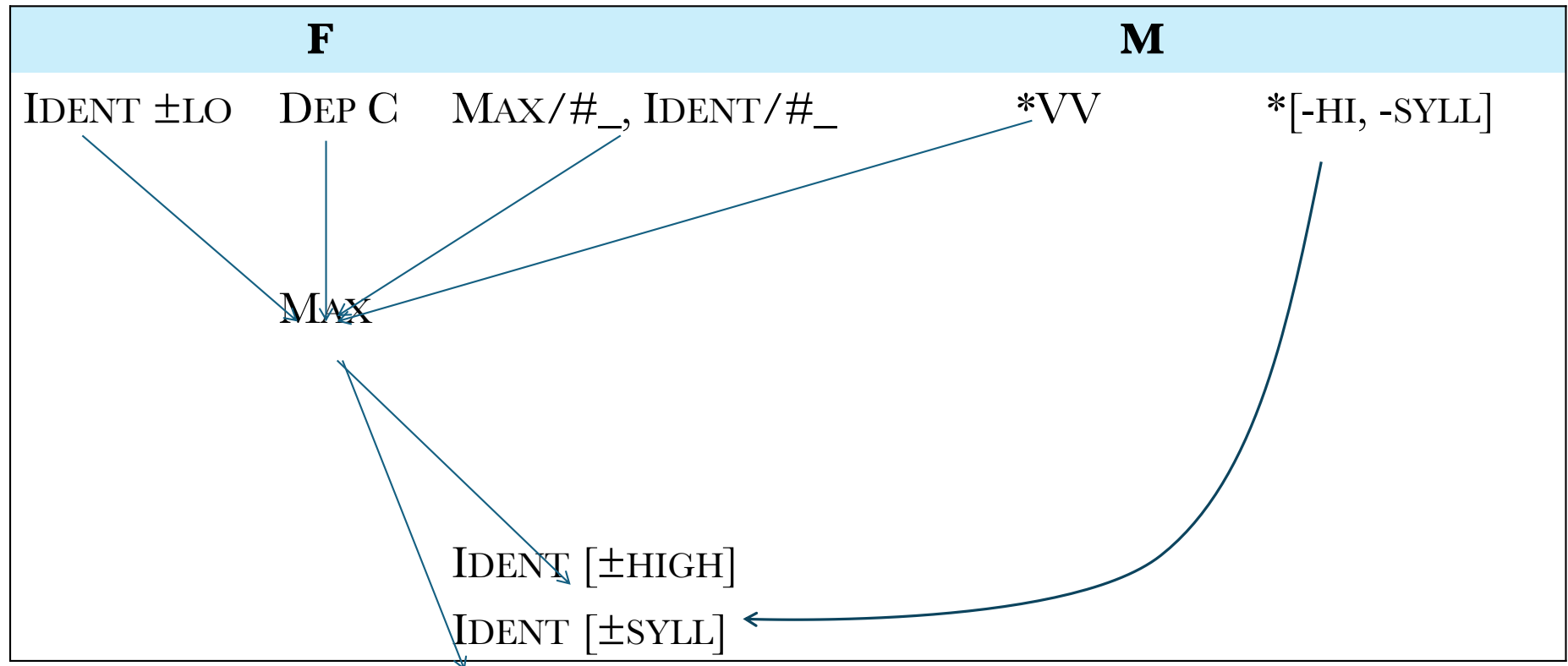
		M	M	F	F	F	F
	la iglesia	*VV	*[-HIGH, -SYLL]	ID LOW	MAX#_	MAX	ID SYLL
a.	la iglesia	*!					
b.	la _ɨ glesia		*!				
c.	lu _ɨ glesia			*!			
d.	laglesia				*!	*	
☹e.	liglesia					*	
☹f	la _ɨ glesia						*

IDENT/#_ : One * if first segment changes any one of its Fs

		M	M	F	F	F
	la iglesia	*VV	*[-HIGH, -SYLL]	ID LOW	MAX#_ IDENT#_	MAX
a.	la iglesia	*!				
b.	laiglesia		*!			
c.	luiglesia			*!		
d.	laglesia				*!	*
☞ e.	liglesia					*
f.	laiglesia				*!	

Looks like MAX/#_ and IDENT/#_ do the same thing. Not a good sign...
Suggests that these constraints are in fact less distinct than thought.

Hasse diagram



FAQs about correspondence

FAQ 1

Candidate (b) lost the [-voice] feature by losing /k/
Isn't this a violation of Ident [$\pm$ voice]?

Is IDENT F violated if a UR segment *deletes*? Example:

/pækz/		*TD#	MAX	IDENT $\pm$ VOICE
a.	pækz	*!		
b.	pæz		*! (k-Ø)	?↓
c.	pæks			*

Answer: No, not given the definition of Ident.

IDENT $\pm$ F: one * for every UR-SR pair of *correspondent* segs, x-x',
iff x is [α F] and x' is [- α F]

FAQ 2

But *why* is Ident defined in this way?

IDENT $\pm F$: one * for every UR-SR pair of *correspondent* segs, $x-x'$,
iff x is $[\alpha F]$ and x' is $[-\alpha F]$

Because we want to also describe processes in which a segment deletes rather than change some of its features. That corresponds to IDENT $F \gg \text{MAX}$.

/ae/		*VV	IDENT HEIGHT	MAX
a.	ae	*!		
!  b.	je		* (a-j)	
 c.	e		* (a-Ø)	*! (a-Ø)

If losing segment violates IDENT, in addition to MAX, deletion is hard to analyze.

FAQ 3

Q: How do I know that [s] in *packs* is the correspondent of /z/?
What part of the analysis guarantees that?

A: The representations record correspondence relations

/p ¹ a ² k ³ z ⁴ /		*TD#	MAX	IDENT VOICE
a.	p ¹ a ² k ³ z ⁴	*!		
b.	p ¹ a ² z ⁴		*! (k-Ø)	
c.	p ¹ a ² k ³ s ⁴			*

Co-superscripts indicate correspondence.

s⁴ = the SR correspondent of UR z⁴.

FAQ 4

Q: What mechanism assigns the co-superscripts, i.e. correspondence relations?

A: They're randomly assigned.

Faithfulness violations render most of these random assignments unviable.

Some random assignments of correspondence

/p ¹ a ² k ³ z ⁴ /		MAX	ID ±F	LINEARITY	DEP	ID ±VOICE
a.	p ¹ a ² k ³ s ⁴					*
b.	p ⁴ a ³ k ² s ¹		3-4! (p-s) Many! (a-k)	6*		*
c.	p ¹ a ² k ³ s ⁵	*! (z ⁴)			*	
d.	p ¹ a ² k ³ s ³	*! (z ⁴)	n (z-k)			*
e.	p ¹ a ² k ³ s ³	*! (z ⁴)	n (k-s)			*

Candidates (b), (d), (e) have a superset of (a)'s violations. They are harmonically bounded by it.

Candidate (c) has both MAX and DEP violations, because an unrelated [s] replaces /z/.

Candidate (c) is harmonically bounded by the deletion candidate p¹a²k³, which does not violate DEP.

In other words, the b-e assignments of correspondence are harmonically bounded by a couple of contenders.

Back to FAQ 3

Q: Then what about the candidate where s *doesn't* correspond to z?

A: That candidate violates DEP, in addition to MAX

/pakz ⁱ /		*TD#	MAX	DEP	IDENT VOICE
a.	pakz ⁱ	*!			
b.	pak		*! (z ⁱ -Ø)		
c.	paks ⁱ				*
d.	paks ^j		*! (z ⁱ -Ø)	* (Ø-s ^j)	

Co-superscripts signal correspondence.

sⁱ = the SR correspondent of UR zⁱ.

s^j = an inserted segment

Harmonic bounding, again

Candidate (b) *could* win against (c), if IDENT >> MAX

Candidate (d) never could: (b) has a proper subset of (d)'s violations.

/pakz ⁱ /		*TD#	MAX	IDENT VOICE	DEP
a.	pakz ⁱ	*!			
b.	pak		*! (z ⁱ -Ø)		
☞ c.	paks ⁱ			*	
d.	paks ^j		*! (z ⁱ -Ø)		* (sj)

Candidate (d) is harmonically bounded by (b).

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