Polish Clitics: Consequences for the Analysis of Optionality in OT

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Optionality (or variation)

- Optionality: variable pronunciation of a given form
  (varying forms are associated with certain frequencies)
- Optionality in OT
  - Ties

	C_1	C_2
a. → $cand_1$		*
b. → $cand_2$	*	

Not sufficient to account for the variation pattern in Polish – ranking paradox

More elaborate models of optionality

- Stochastic OT
  (Boersma 1998, Boersma & Hayes 2001)
- Model of Partially Ordered Grammars
  (Anttila 1997, 2002)

- These models solve the ranking paradox

But

- The probabilities predicted by these models are incompatible with known relative frequencies

Polish clitic /z/: voicing assimilation

z+ignɔrɔvɑt͡ɕ	‘to ignore’
z+gɑzɛtɔ̃	‘with a newspaper’
z+zɛgɑrkɑ	‘from a watch’
s+kɔtɛm	‘with a cat’
s+sʊnɔ̃t͡ɕ	‘to slip down’

Agree[voi] >> Ident[voi]

Input: /z+kfasɛm/	AGREE[voi]	IDENT[voi]
a. [z+kfasɛm]	*!	
b. → [s+kfasɛm]		*

Polish clitic /z/: vowel epenthesis

Epenthesis before {z/s}C		No epenthesis	
zɛ+zvʲɛʒɛ̃t͡ɕit͡ɕ	‘to make animal-like’	z+gʒɛʃɨt͡ɕ	‘to sin’
zɛ+znɑkʲɛm	‘with a sign’	z+bʒdɛ̃kʲɛm	‘with a plunk’
zɛ+stʃɛlit͡ɕ	‘to shoot down’	s+frʊnɔ̃t͡ɕ	‘to fly down’
zɛ+skɑwɔ̃	‘with a rock’	s+pʃt͡ʃɔwɔ̃	‘with a bee’
		z+zɑmkʊ	‘from a castle’
		s+sɛrɛm	‘with cheese’

$\emptyset \rightarrow V / C_1 \_\_ C_2C$

where C_1 and C_2 are ‘sufficiently identical’
(i.e., identical except for voicing)

Avoidance of identical consonants

Voicing assimilation is obligatory

- Epenthesis applies to avoid sequences of *identical* consonants in a cluster (not 'sufficiently identical')

/z+znɑkʲɛm/ ⟶‖ *z+znɑkʲɛm
zɛ+znɑkʲɛm

/z+skɑwɔ̃/ ⟶‖ *s+skɑwɔ̃
zɛ+skɑwɔ̃

- This analysis was shown to work for English and Lithuanian (Baković 2005)

Epenthesis – OT analysis

NoGem+C No adjacent identical consonants (geminate) in a cluster

NoGem+C >> Dep(V)

Input: /z+znakʲem/	NoGem+C	Dep(V)
a. [z+znakʲem]	*!	
b. → [zɛ+znakʲem]		*

Combining epenthesis and assimilation

Agree[voi] >> Dep(V)

Input: /z+skawɔ̃/		NoGem+C	Agree[voi]	Dep(V)
a.	[z+skawɔ̃]		*!	
b.	[s+skawɔ̃]	*!		
c. →	[zɛ+skawɔ̃]			*

Dep(V) >> Ident[voi]

Input: /z+kfaɕit͡ɕ/		NoGem+C	Agree[voi]	Dep(V)	Ident[voi]
a.	[z+kfaɕit͡ɕ]		*!		
b. →	[s+kfaɕit͡ɕ]				*
c.	[zɛ+kfaɕit͡ɕ]			*!	

Polish clitic /z/: coronal place assimilation (CPA)

Alveolo-palatal

ʑ+d͡ʑɛt͡ɕmi	or	z+d͡ʑɛt͡ɕmi	‘with children’
ɕ+ɕana		s+ɕana	‘from hay’

Postalveolar

ʒ+ʒabɨ	or	z+ʒabɨ	‘from a frog’
ʃ+t͡ʃkafkɔ̃		s+t͡ʃkafkɔ̃	‘with hiccups’

optionality

Agree[cor] ~ Ident[cor]

Input: /z+ʑɛ̃bnɔ̃t͡ɕ/	AGREE[cor]	IDENT[cor]
a. → [z+ʑɛ̃bnɔ̃t͡ɕ]	*	
b. → [ʑ+ʑɛ̃bnɔ̃t͡ɕ]		*

constraint tie

Polish clitic /z/: optional epenthesis

/z+ʑrɛbakʲɛm/	z+ʑrɛbakʲɛm	or	zɛ+ʑrɛbakʲɛm	‘with a colt’
/z+ʒbikʲɛm/	z+ʒbikʲɛm		zɛ+ʒbikʲɛm	‘with a wildcat’
/z+ɕfʲatɑ/	s+ɕfʲatɑ		zɛ+ɕfʲatɑ	‘from the world’
/z+ʃfɛt͡sʲi/	s+ʃfɛt͡sʲi		zɛ+ʃfɛt͡sʲi	‘from Sweden’

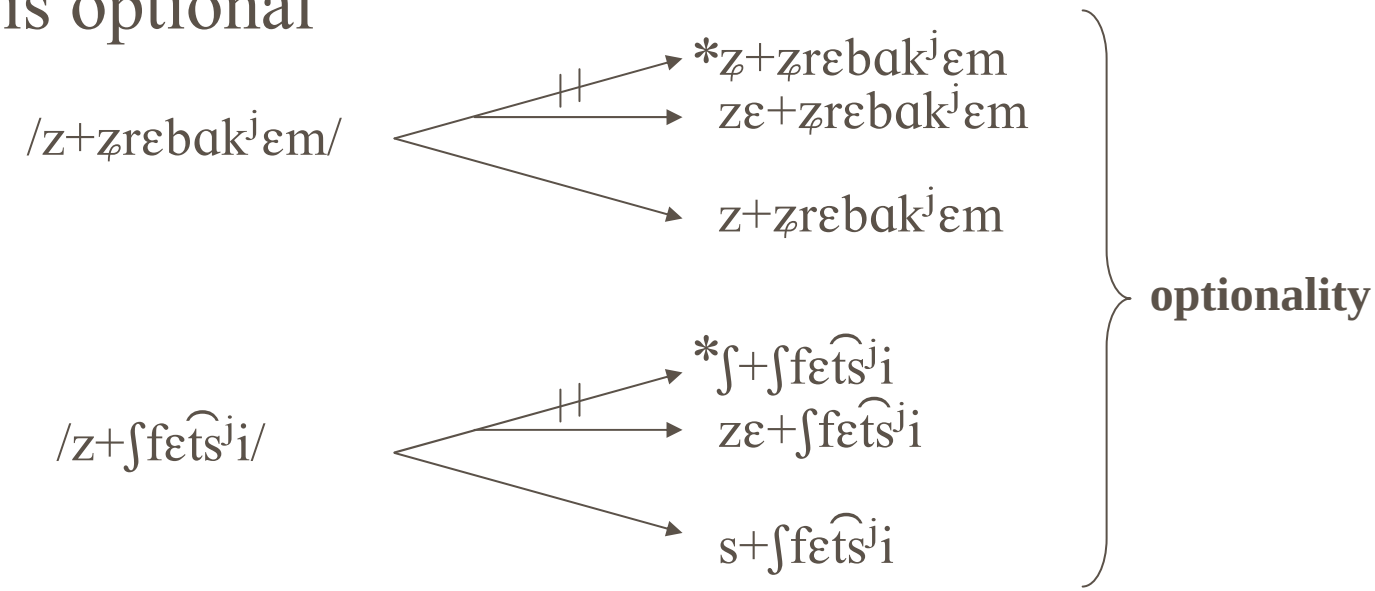
cf. *ʑ+ʑrɛbakʲɛm
*ʒ+ʒbikʲɛm
*ɕ+ɕfʲatɑ
*ʃ+ʃfɛt͡sʲi

$\emptyset \rightarrow V / C_1 \_\_ C_2C$

where C_1 and C_2 are ‘sufficiently identical’ (i.e., identical except for voicing and coronal place of articulation)

Contingent optionality (Baković & Pająk 2008, LSA)

CPA is optional



- Again, epenthesis applies to avoid sequences of *identical* consonants in a cluster
- Epenthesis is optional because it is *contingent* on the optionality of CPA

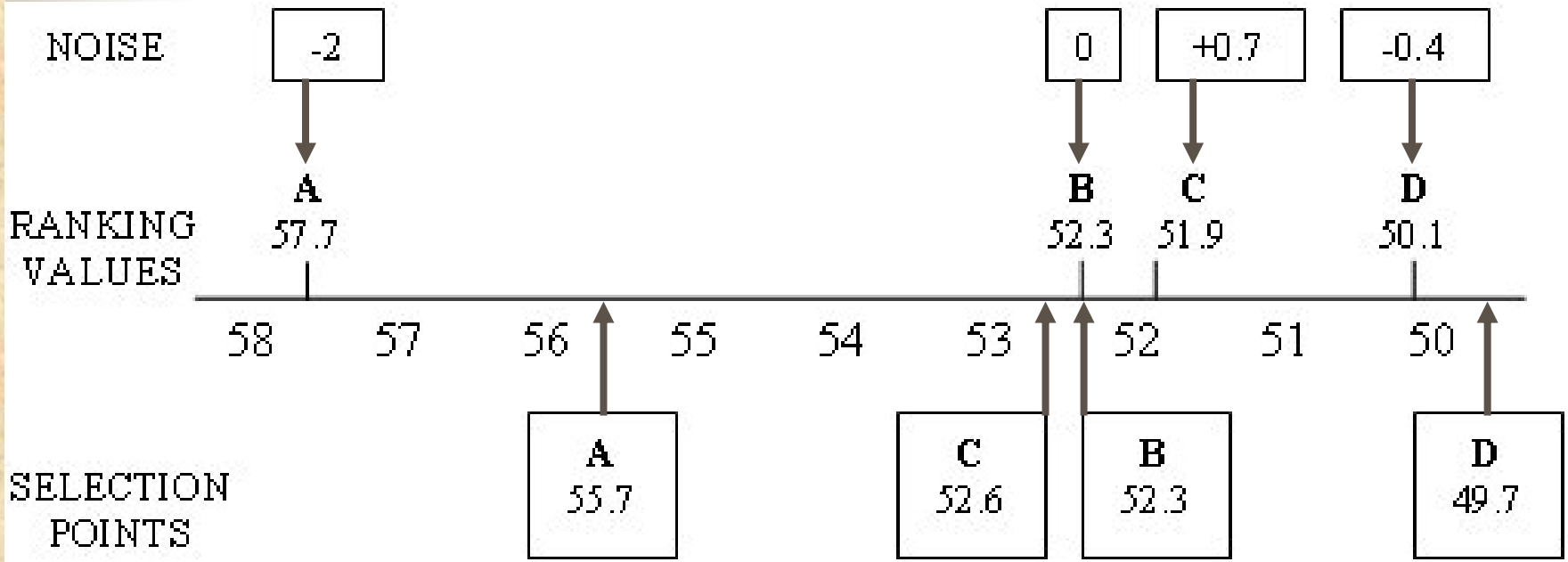
Optionality induces a ranking paradox

/z+d͡ʒɛmɛm/	→	ʒ+d͡ʒɛmɛm ~	z+d͡ʒɛmɛm	*zɛ+d͡ʒɛmɛm
		CPA	no CPA	*epenthesis
/z+ʒbikʲɛm/	→	zɛ+ʒbikʲɛm ~	z+ʒbikʲɛm	*ʒ+ʒbikʲɛm
		epenthesis	no CPA	*CPA

Input: /z+d͡ʒɛmɛm/	NoGem+C	Dep(V)	Agree[cor]	Ident[cor]
a. → [z+d͡ʒɛmɛm]			*	
b. → [ʒ+d͡ʒɛmɛm]				*
c. → [zɛ+d͡ʒɛmɛm]		*		

Input: /z+ʒbikʲɛm/	NoGem+C	Dep(V)	Agree[cor]	Ident[cor]
a. → [z+ʒbikʲɛm]			*	
b. [ʒ+ʒbikʲɛm]	*!			*
c. → [zɛ+ʒbikʲɛm]		*		

Stochastic OT (Boersma 1998, Boersma & Hayes 2001)



Stochastic OT: Polish data

- ʒ+d͡ʒɛmɛm ~ z+d͡ʒɛmɛm

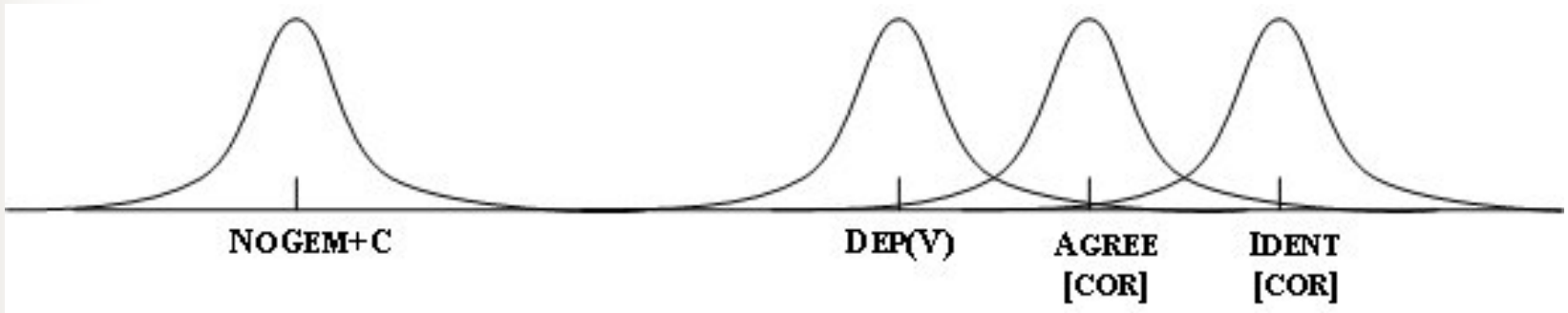
Dep(V) >> Ident[cor] / Agree[cor]
Agree[cor] ~ Ident[cor]

Normal distribution of noise

- zɛ+ʒbikʲɛm ~ z+ʒbikʲɛm

NoGem+C >> Dep(V)
Agree[cor] ~ Dep(V)

Stochastic OT: probabilities



- Ranking with the highest probability:

  (1) NoGem+C >> Dep(V) >> Agree[cor] >> Ident[cor]

- Rankings with lower probability:

  (2) NoGem+C >> Dep(V) >> Ident[cor] >> Agree[cor]

  (3) NoGem+C >> Agree[cor] >> Dep(V) >> Ident[cor]

Stochastic OT: probabilities

(1) NoGem+C >> Dep(V) >> Agree[cor] >> Ident[cor]

(2) NoGem+C >> Dep(V) >> Ident[cor] >> Agree[cor]

(3) NoGem+C >> Agree[cor] >> Dep(V) >> Ident[cor]

Ranking	Predicted Winner			
	ʒ+d͡ʒɛmɛm ~ z+d͡ʒɛmɛm		zɛ+ʒbikʲɛm ~ z+ʒbikʲɛm	
(1)	W			W
(2)		W		W
(3)	W		W	

Ranking with the highest probability

Actual Relative Frequencies			
ʒ+d͡ʒɛmɛm < z+d͡ʒɛmɛm		zɛ+ʒbikʲɛm > z+ʒbikʲɛm	
25%	75%[1]	99%	1%[2]

[1] Based on an experimental study by Osowicka-Kondratowicz (2004)

[2] Based on a search through a written corpus of Polish

Stochastic OT: probabilities

- Impossible to predict the right probabilities

Input: /z+d͡ʒɛmɛm/	NoGem+C	Dep(V)	Ident[cor]	Agree[cor]	Dep(V)
a. → [z+d͡ʒɛmɛm]				*	
b. [ʒ+d͡ʒɛmɛm]			*!		
c. [zɛ+d͡ʒɛmɛm]		*!			

Input: /z+ʒbikʲɛm/	NoGem+C	Dep(V)	Ident[cor]	Agree[cor]	Dep(V)
a. [z+ʒbikʲɛm]				*!	
b. [ʒ+ʒbikʲɛm]	*!		*		
c. → [zɛ+ʒbikʲɛm]					*

Model of Partially Ordered Grammars (POG)
(Anttila 1997, 2002)

	Grammar	Total Rankings (tableaux)		
(a)	$C_1 >> C_2$	C_1	C_2	C_3
		C_1	C_3	C_2
		C_3	C_1	C_2
(b)	$C_1 >> C_2$	C_1	C_2	C_3
	$C_1 >> C_3$	C_1	C_3	C_2
(c)	$C_1 >> C_2$	C_1	C_2	C_3
	$C_1 >> C_3$			
	$C_2 >> C_3$			

$$p = n / t$$

p = a candidate's probability of occurrence

n = number of tableaux in which this candidate wins

t = total number of tableaux

POG: Polish data

D - DEP(V)
A - AGREE[cor]
I - IDENT[cor]

RANKING	INPUT-OUTPUT MAPPING /z+d͡ʒɛmɛm/	/z+ʒbikʲɛm/
a. D >> A >> I	ʒ	z
b. D >> I >> A	z	z
c. A >> D >> I	ʒ	zɛ
d. I >> D >> A	z	z
e. A >> I >> D	zɛ	zɛ
f. I >> A >> D	zɛ	zɛ

POG: Polish data & probabilities

D - DEP(V)
A - AGREE[cor]
I - IDENT[cor]

ORDERED PAIRS:

D >> I

PREDICTED PROBABILITIES			
/z+d͡ʒɛmɛm/		/z+ʒbikʲɛm/	
ʒ+d͡ʒɛmɛm	2/3 = 0.67	**z+ʒbikʲɛm**	2/3 = 0.67
z+d͡ʒɛmɛm	1/3 = 0.33	zɛ+ʒbikʲɛm	1/3 = 0.33

ACTUAL RELATIVE FREQUENCIES	
ʒ+d͡ʒɛmɛm < **z+d͡ʒɛmɛm**	**zɛ+ʒbikʲɛm** > z+ʒbikʲɛm
25% 75%	99% 1%

RANKING

a. D >> A >> I
b. D >> I >> A
c. A >> D >> I

INPUT-OUTPUT MAPPING

	/z+d͡ʒɛmɛm/	/z+ʒbikʲɛm/
a. D >> A >> I	**ʒ**	z
b. D >> I >> A	z	z
c. A >> D >> I	**ʒ**	zɛ

POG: Polish data & probabilities

NG	NoGem+C
D	Dep(V)
A(v)	Agree[voi]
I(v)	Ident[voi]
A(c)	Agree[cor]
I(c)	Ident[cor]

Ordered Pairs:

NG >> D
A(v) >> I(v)
A(v) >> D
D >> I(v)
D >> I(c)

Total Rankings

(a)	1.	NG	A(v)	D	I(v)	A(c)	I(c)
	2.	NG	A(v)	D	A(c)	I(v)	I(c)
	3.	NG	A(v)	D	A(c)	I(c)	I(v)
	4.	A(v)	NG	D	I(v)	A(c)	I(c)
	5.	A(v)	NG	D	A(c)	I(v)	I(c)
	6.	A(v)	NG	D	A(c)	I(c)	I(v)
(b)	7.	NG	A(v)	D	I(v)	I(c)	A(c)
	8.	NG	A(v)	D	I(c)	I(v)	A(c)
	9.	NG	A(v)	D	I(c)	A(c)	I(v)
	10.	A(v)	NG	D	I(v)	I(c)	A(c)
	11.	A(v)	NG	D	I(c)	I(v)	A(c)
	12.	A(v)	NG	D	I(c)	A(c)	I(v)
(c)	13.	NG	A(v)	A(c)	D	I(v)	I(c)
	14.	NG	A(v)	A(c)	D	I(c)	I(v)
	15.	NG	A(c)	A(v)	D	I(v)	I(c)
	16.	NG	A(c)	A(v)	D	I(c)	I(v)
	17.	A(c)	NG	A(v)	D	I(v)	I(c)
	18.	A(c)	NG	A(v)	D	I(c)	I(v)
	19.	A(v)	NG	A(c)	D	I(v)	I(c)
	20.	A(v)	NG	A(c)	D	I(c)	I(v)
	21.	A(v)	A(c)	NG	D	I(v)	I(c)
	22.	A(v)	A(c)	NG	D	I(c)	I(v)
	23.	A(c)	A(v)	NG	D	I(v)	I(c)
	24.	A(c)	A(v)	NG	D	I(c)	I(v)

POG: Polish data & probabilities

Ranking	Input-Output Mapping /z+d͡ʒɛmɛm/	/z+ʒbikʲɛm/
a. 1-6	ʒ	z
b. 7-12	z	z
c. 13-24	ʒ	zɛ

Predicted probabilities have changed (Smolensky 2007)

Predicted Probabilities			
/z+d͡ʒɛmɛm/		/z+ʒbikʲɛm/	
ʒ+d͡ʒɛmɛm	18/24 = 0.75	**z+ʒbikʲɛm**	12/24 = 0.5
z+d͡ʒɛmɛm	6/24 = 0.25	**zɛ+ʒbikʲɛm**	12/24 = 0.5

Actual Relative Frequencies	
ʒ+d͡ʒɛmɛm < **z+d͡ʒɛmɛm**	**zɛ+ʒbikʲɛm** > z+ʒbikʲɛm
25% 75%	99% 1%

Why these frequencies?
- *morphological transparency*
(Matt Goldrick, p.c.)

Conclusions

- Some models (Stochastic OT, POG) can account for the variation pattern, but not for the relative frequencies
- This result presents a challenge for theories that claim to predict probabilities of the varying forms
- Frequency depends on multiple factors
  - Grammar provides possibilities
  - Probabilities are better predicted by factors such as morphological transparency

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