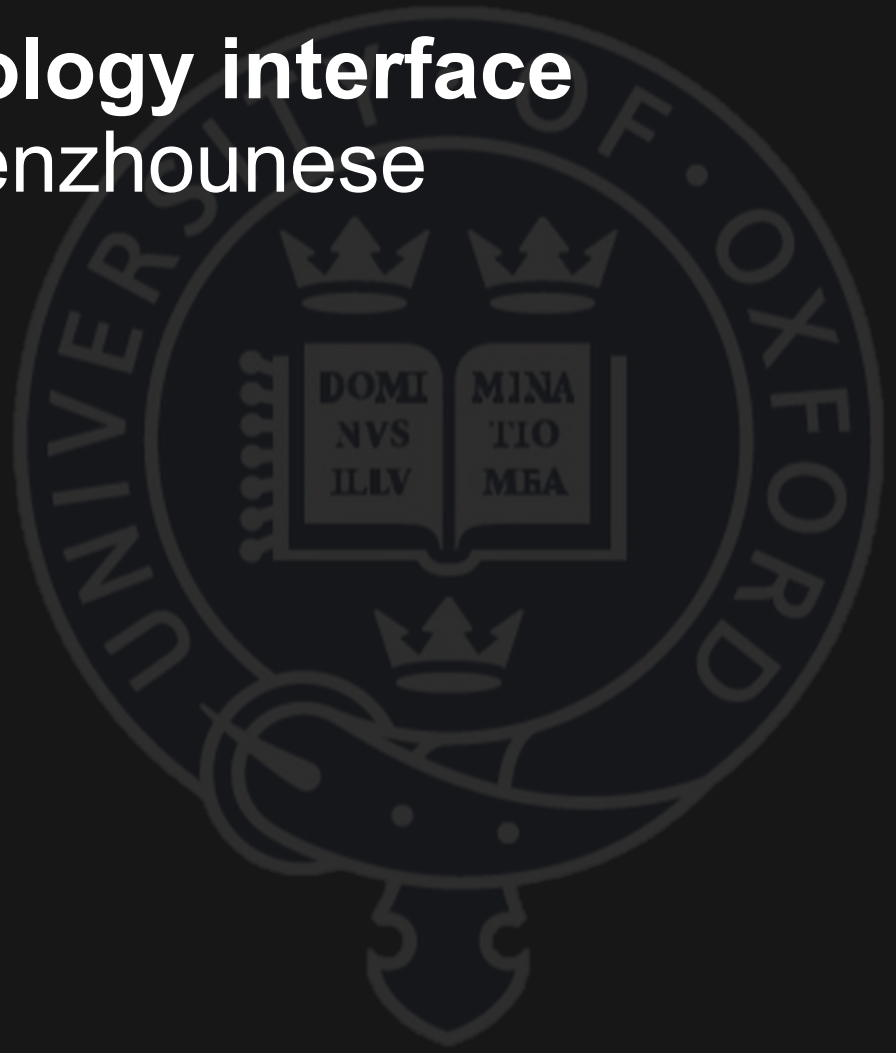
Gradience at the syntax-phonology interface
Evidence from Mandarin and Wenzhounese



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Roadmap

1. Introduction
2. The syllabicity constraint
    - In Mandarin
    - In Wenzhounese
3. Theoretical implications for LFG
4. Conclusion

Roadmap

1. Introduction

2. The syllabicity constraint

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1. Introduction

Target languages

- Mandarin Chinese (based on previous work)
- Wenzhounese: a southern Wu dialect (my field work)

Shared properties

- Canonical word order: SVO
- Topic prominence (Li & Thompson 1976)
- Many words have monosyllabic and disyllabic variants

1. Introduction

For example, in Mandarin,

- ‘to plant’ *zhong* or *zhong.zhi*
- ‘tree’ *shu* or *shu.mu*

Four logically possible combinations for the VP ‘to plant trees’

	Syllabicity	Verb	Object
a.	2+2	*zhong.zhi*	*shu.mu*
b.	1+2	*zhong*	*shu.mu*
c.	1+1	*zhong*	*shu*
d.	2+1	*zhong.zhi*	*shu*

1. Introduction

All of them are syntactically well-formed, but (d) is far less acceptable

	Syllabicity	Verb	Object
a.	2+2	*zhong.zhi*	*shu.mu*
b.	1+2	*zhong*	*shu.mu*
c.	1+1	*zhong*	*shu*
d.	2+1	*zhong.zhi*	*shu*

The syllabicity constraint:

2+1 VPs (disyllabic verb + monosyllabic object) are prosodically ill-formed[1]

[1]There is a similar constraint on nominal compounds (see, e.g., Feng 1997).

1. Introduction

Research questions

1. How much less acceptable are 2+1 VPs in Mandarin?
2. How much less acceptable are 2+1 VPs in Wenzhounese?
3. Implications for modularity
   - Does phonology have (direct) access to syntactic information?
   - How should the syllabicity constraint be formalised in LFG?
4. Implications for grammaticality
   - Binary or gradient?
   - How can LFG incorporate gradient grammaticality?

Roadmap

1. Introduction

2. The syllabicity constraint

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2. The syllabicity constraint in Mandarin

Duanmu's (2012) corpus study:

The token count of 2+1 VPs is exceptionally low, which would be unexpected if monosyllabic and disyllabic objects are freely variable.

Pattern	Token	Percentage
2+2	711	16.2%
1+2	838	19.91%
1+1	2,749	62.8%
2+1	81	1.8%

2. The syllabicity constraint in Mandarin

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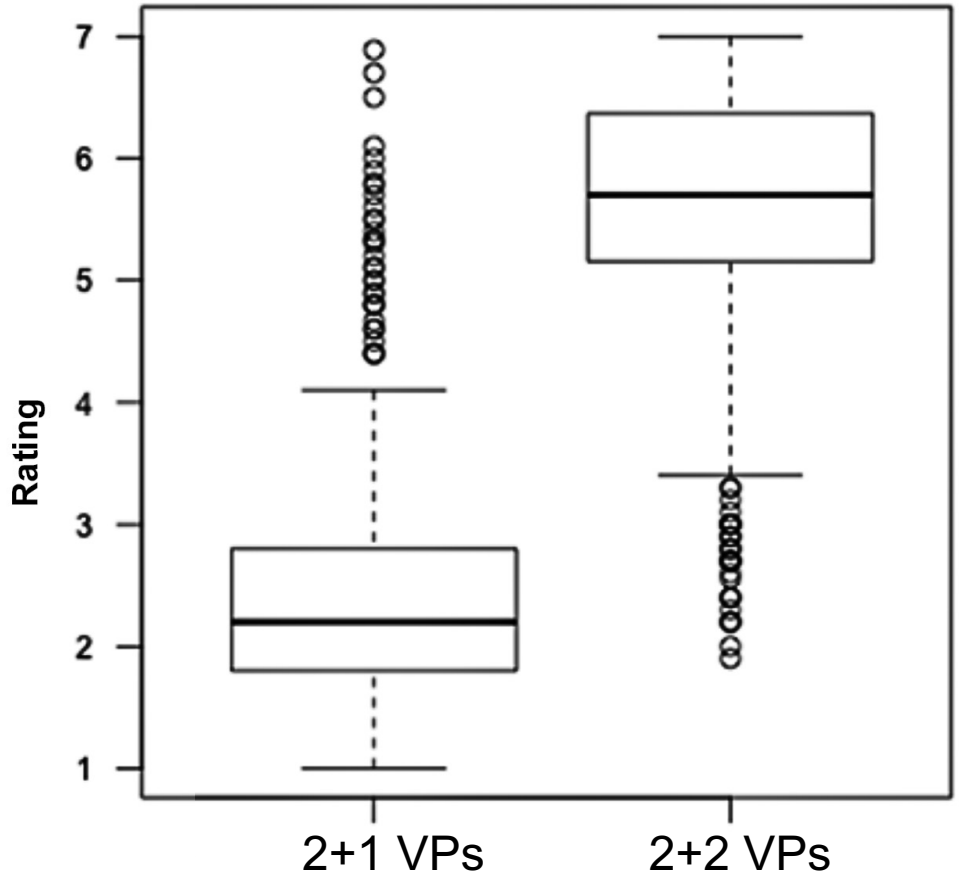
2. The syllabicity constraint in Mandarin

Judgment study (adapted from Duanmu et al. 2018):



Roadmap

1. Introduction

2. The syllabicity constraint

- In Mandarin
- **In Wenzhounese**

3. Theoretical implications for LFG

4. Conclusion

2. The syllabicity constraint in Wenzhounese

Experiment 1

- Production test: Is a disyllabic verb more likely to induce a disyllabic object (i.e. 2+2) than a monosyllabic verb is (i.e. 1+2)?
- Judgment test: Are 2+1 VPs considered less acceptable than 2+2 VPs?

2. The syllabicity constraint in Wenzhounese

Experiment 1: Procedure

- 32 native speakers of Wenzhounese (note: they also speak Mandarin)
- Production test: Wenzhounese sentences elicited
- Judgment test: listened to and rated audio stimuli

工人 修理
(worker) (repair)

2. The syllabicity constraint in Wenzhounese

Production test: Results

Monosyllabic verb

Pattern	Percentage
2+2	71%
1+2	46%
1+1	54%
2+1	29%

2. The syllabicity constraint in Wenzhounese

Production test: Results

Disyllabic verb

Pattern	Percentage
2+2	71%
1+2	46%
1+1	54%
2+1	29%

2. The syllabicity constraint in Wenzhounese

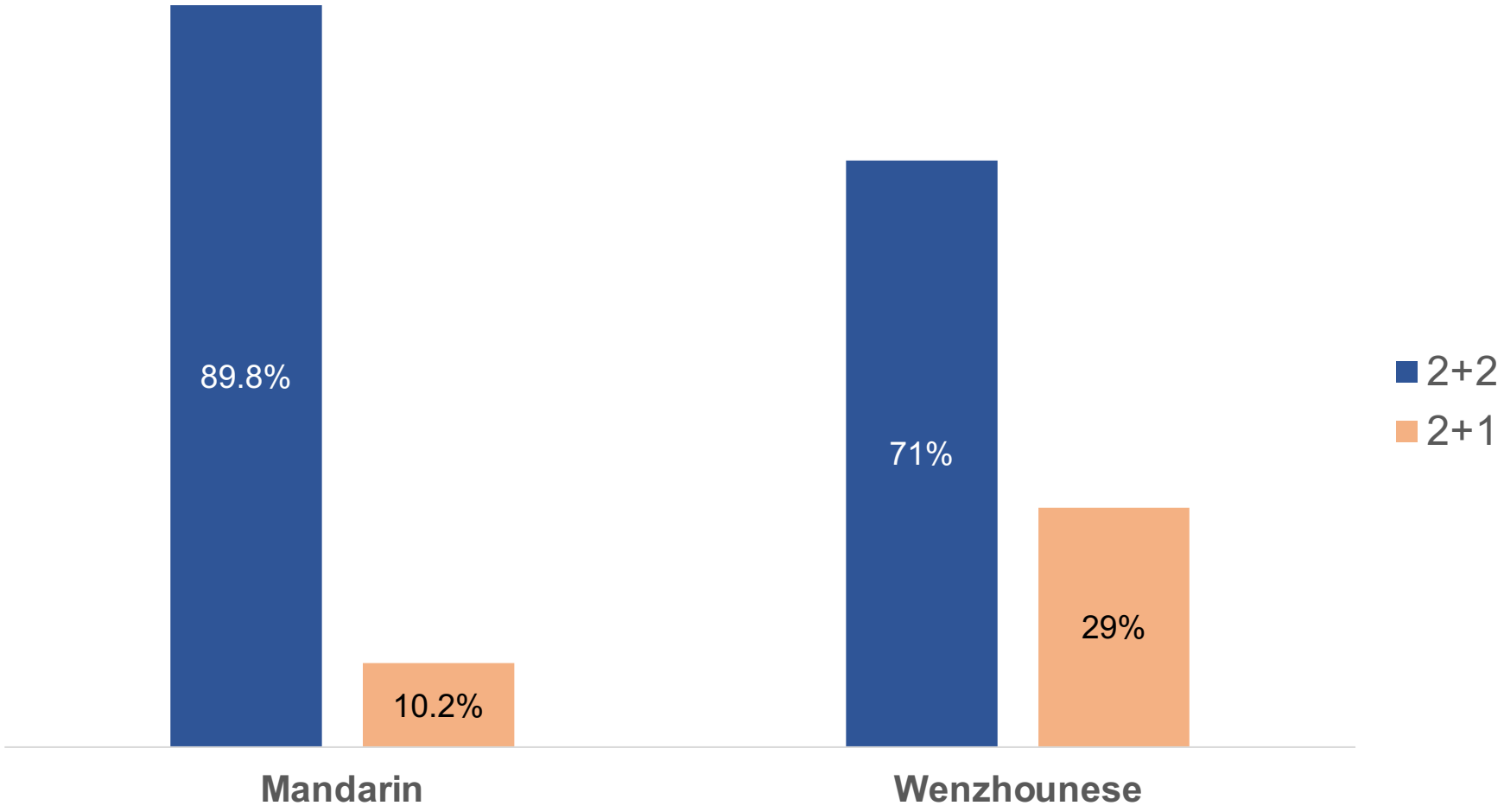
Production test: Results

Pattern	Percentage	Likelihood ratio test
2+2	71%	$\chi^2(1) = 20.90$, $p < 0.0001$
1+2	46%	
1+1	54%	
2+1	29%	

- Compared to a monosyllabic verb, a disyllabic verb is significantly more likely to induce a disyllabic object
- 2+1 VPs are disfavoured in production

2. The syllabicity constraint in Wenzhounese

Production test: Compare with 2+1 and 2+2 VPs in Mandarin



2. The syllabicity constraint in Wenzhounese

Production test: Compare with 2+1 and 2+2 VPs in Mandarin

Similarity: 2+1 VPs are disfavoured in both varieties

Difference: 2+1 VPs are more disfavoured in Mandarin than in Wenzhounese

Implication: Strong vs. weaker constraint

2. The syllabicity constraint in Wenzhounese

Judgment test: Results

Pattern	Rating	Z-score	SD	Likelihood ratio test
2+2	6.26	0.68	0.40	$\chi^2(1) = 16.37$, $p < 0.0001$
2+1	5.96	0.52	0.61	

- Both 2+1 and 2+2 VPs are acceptable (rated above 4)
- But 2+1 VPs are significantly less acceptable than 2+2 VPs

2. The syllabicity constraint in Wenzhounese

Judgment test: Linking hypothesis

Grammaticality vs. Acceptability

- The relation is indirect (Lau et al. 2017; Phillips et al. 2021)
- There can be mismatches (Haider 2019)

a. *The rat the cat the dog chased killed ate the malt*.

b. **The key to the cabinets are rusty*.

2. The syllabicity constraint in Wenzhounese

Judgment test: Linking hypothesis

- The stimuli in this experiment are simple SVO sentences, so the lower acceptability of 2+1 VPs is unlikely to result from processing difficulties.
- The results of the judgment test are corroborated by the results of the production test, according to which the preference for 2+2 over 2+1 VPs is high but not absolute.
- Therefore, at least in this experiment, acceptability is a reliable indicator of grammaticality (see also Almeida 2014 and Featherston 2005)

2. The syllabicity constraint in Wenzhounese

Judgment test: Interpretation

Pattern	Rating	Z-score	SD	Likelihood ratio test
2+2	6.26	0.68	0.40	$\chi^2(1) = 16.37$, $p < 0.0001$
2+1	5.96	0.52	0.61	

- Both 2+1 and 2+2 VPs are grammatical if grammaticality is binary.
- But 2+1 VPs are less grammatical than 2+2 VPs.
- Binary grammaticality misses the generalisation.

2. The syllabicity constraint in Wenzhounese

Judgment test: Compare with the judgement test in Mandarin

Pattern	Rating	Z-score	SD	Likelihood ratio test
2+2	6.26	0.68	0.40	$\chi^2(1) = 16.37$, $p < 0.0001$
2+1	5.96	0.52	0.61	

In Mandarin

- median of rating ≈ 6 for 2+2 VPs
- median of rating ≈ 2 for 2+1 VPs

The syllabicity constraint

- Strong in Mandarin but weaker in Wenzhounese

2. The syllabicity constraint in Wenzhounese

Experiment 2

- Topic prominence may affect word order
- What if the object is displaced?
- What is the target of the syllabicity constraint?
  - A local domain [V NP], or
  - The head-dependent relation regardless of word order

2. The syllabicity constraint in Wenzhounese

Experiment 2

A sample stimulus

Object	**Verb**				
tsʰo/tɕi-tsʰo	sei.tɕi	hɛ	ba	mei	a
car/petrol-car	design	PFV	SFP	NEG	Q

‘Have you finished designing the car?’

2. The syllabicity constraint in Wenzhounese

Experiment 2

- 30 participants, Wenzhounese-Mandarin bilinguals
- Listened to audio stimuli and asked to rate against a seven-point scale
- No significant difference ($\chi^2(1) = 0.66$, $p = 0.42$)

2. The syllabicity constraint

Summary:

- 2+1 VPs are dispreferred in production and acceptability judgment.
- Wenzhounese is more tolerant of 2+1 VPs than Mandarin is.
- The syllabicity constraint is strong in Mandarin but weaker in Wenzhounese, which challenges binary grammaticality.
- The syllabicity constraint only applies locally to the object governed by the verb.

Roadmap

1. Introduction

2. The syllabicity constraint

   - In Mandarin

   - In Wenzhounese

3. Theoretical implications for LFG

4. Conclusion

3. Theoretical implications for LFG

Q1: Is there a more general principle that subsumes the syllabicity constraint?

Non-head stress (Duanmu 2007: 146)

- In the syntactic structure [X XP] (or [XP X]), where X is the syntactic head and XP the syntactic nonhead, XP should be stressed.
- Asymmetrical tonal neutralisation cross-linguistically (Hyman 2019: 22)

3. Theoretical implications for LFG

Non-head stress + **Metrical requirements** (Duanmu 2012: 106)

a. Foot binary: A foot needs two syllables, i.e. (σσ)

b. Every stress represents a foot.

Pattern	**Metrical structure**[1]
2+2	(σσ)(σσ)
*2+1	(σσ)(σ)
1+2	σ(σσ)
1+1	(σσ)

[1]Colour coding: blue for verbs and orange for objects

3. Theoretical implications for LFG

Q2: How do we formalise non-head stress in a modular way, given that phonology should not know the difference between head and non-head (or, relatedly, the head-adjunct distinction; Tamelan & Arka 2021)?

Step 1: The metrical structure is stored in the lexicon (Levelt 1999; Bögel 2015)

e.g., ’to repair cars’ in Wenzhounese

	Monosyllabic	**Disyllabic**
repair	[sou]	[sou.lei]
car	[ts^{h}o]	[tɕ^{h}i.ts^{h}o]

3. Theoretical implications for LFG

Lexical entries for ‘repair’ in Wenzhounese

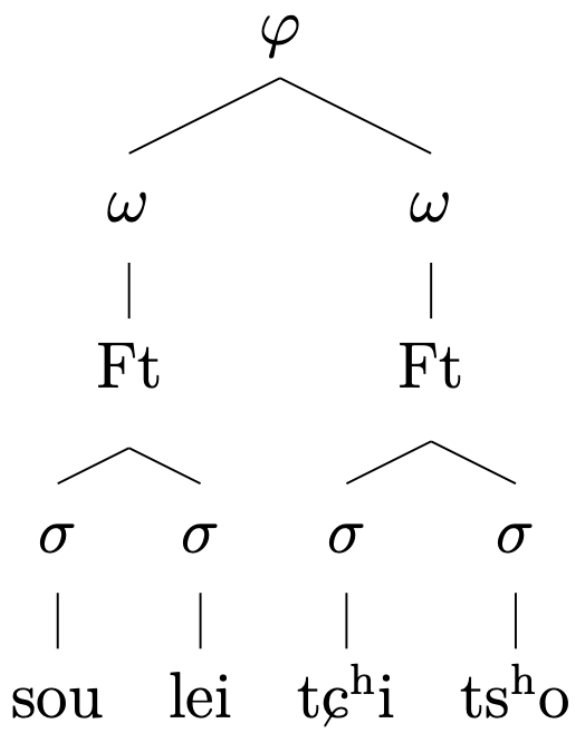
s-form	$(\bullet\ \text{FM}) = \text{sou}$ $\lambda(\pi(\bullet)) = \text{V}$	$(\bullet\ \text{FM}) = \text{soulei}$ $\lambda(\pi(\bullet)) = \text{V}$
p-form	/s o u/ σ	/s o u l e i/ $(\sigma\sigma)_{\text{Ft}}$

Lexical entries for ‘car’ in Wenzhounese

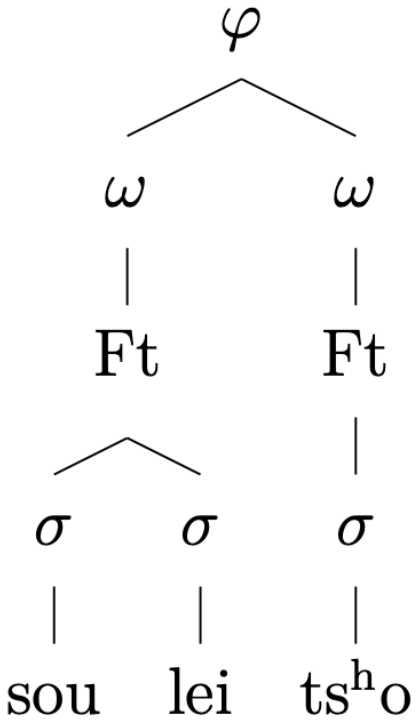
s-form	$(\bullet\ \text{FM}) = \text{ts}^{\text{h}}\text{o}$ $\lambda(\pi(\bullet)) = \text{N}$	$(\bullet\ \text{FM}) = \text{tɕ}^{\text{h}}\text{its}^{\text{h}}\text{o}$ $\lambda(\pi(\bullet)) = \text{N}$
p-form	/ts$^{\text{h}}$ o/ σ	/tɕ$^{\text{h}}$ i ts$^{\text{h}}$ o/ $(\sigma\sigma)_{\text{Ft}}$

3. Theoretical implications for LFG

Step 2: Prosodic phrasing (Selkirk 2011; Interface Harmony)



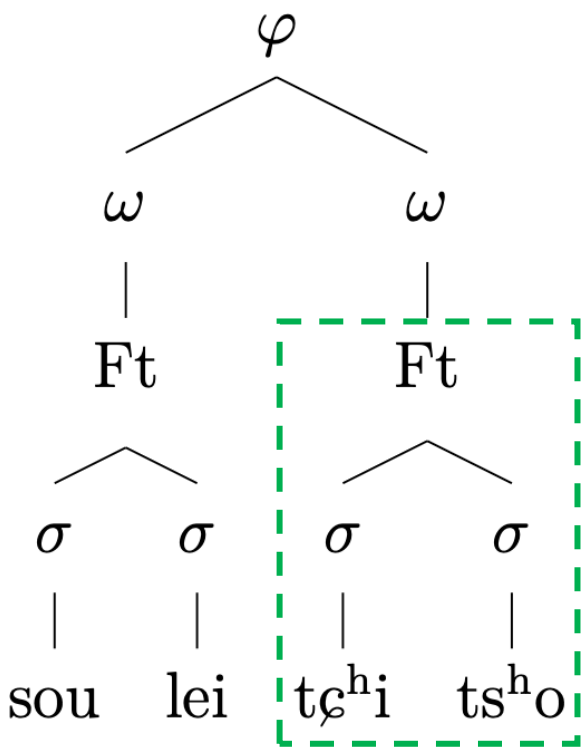
P-structure for 2+2 VPs

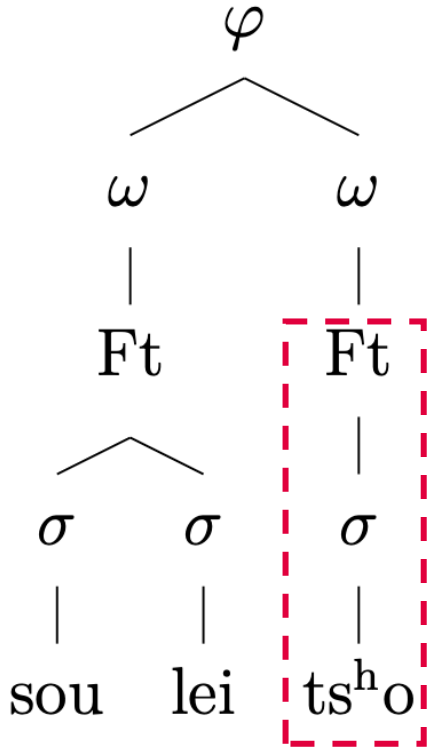


P-structure for 2+1 VPs

3. Theoretical implications for LFG

Step 3: Phrasal stress is assigned to the right edge of a Φ (cf. Dalrymple et al. 2019: 422), which must be realised on a binary foot (Duanmu 2012)

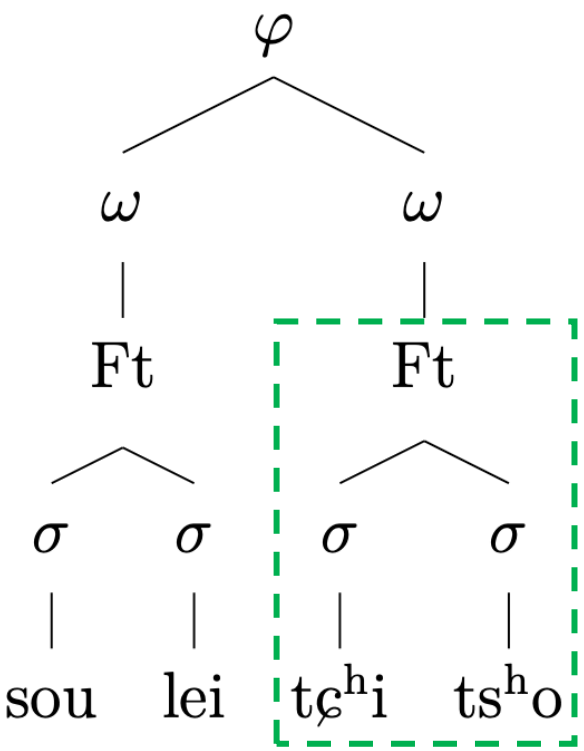


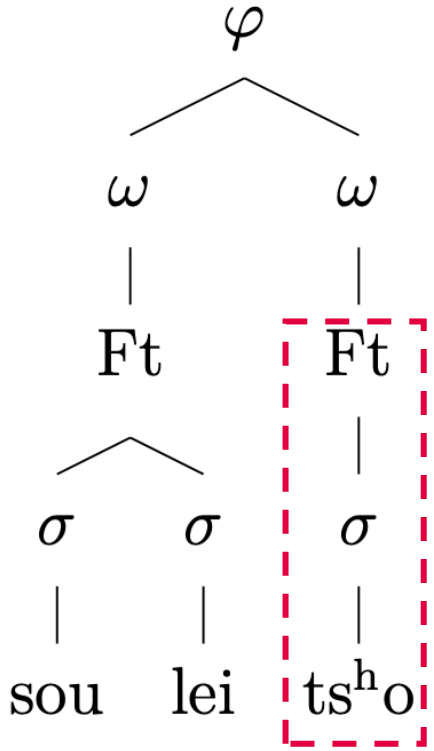


3. Theoretical implications for LFG

✅ Modularity

✅ Locality





3. Theoretical implications for LFG

Q3: How do we capture the difference between Mandarin and Wenzhounese?

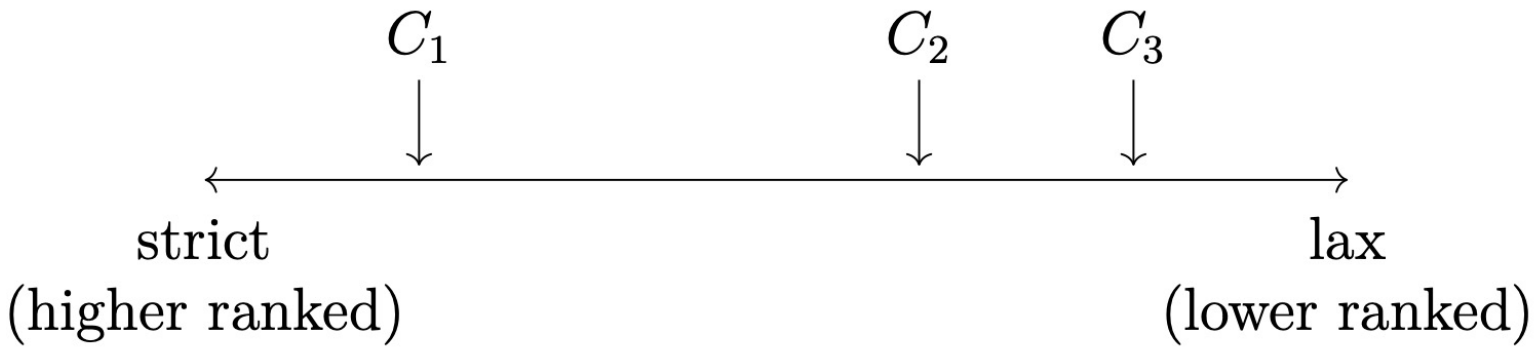
- Mandarin: 2+1 VPs are strongly dispreferred
- Wenzhounese: 2+1 VPs are grammatical but less acceptable

Step 1: Assume OT-LFG (e.g. Bresnan 2000; Lowe 2016)

Step 2: Assume Stochastic OT (SOT), where constraints are weighted and there is a noise component that temporarily impacts the grammar (Boersma 1999)

3. Theoretical implications for LFG

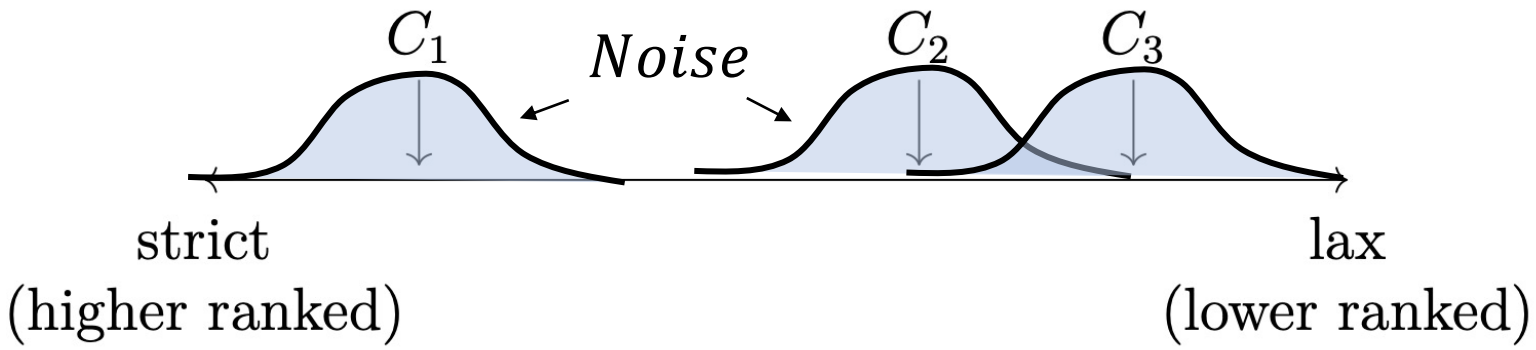
(adapted from Boersma & Hayes 2001: 47, 49)



- $C_1 \gg C_2 \gg C_3$
- $C_1 - C_2 > C_2 - C_3$

3. Theoretical implications for LFG

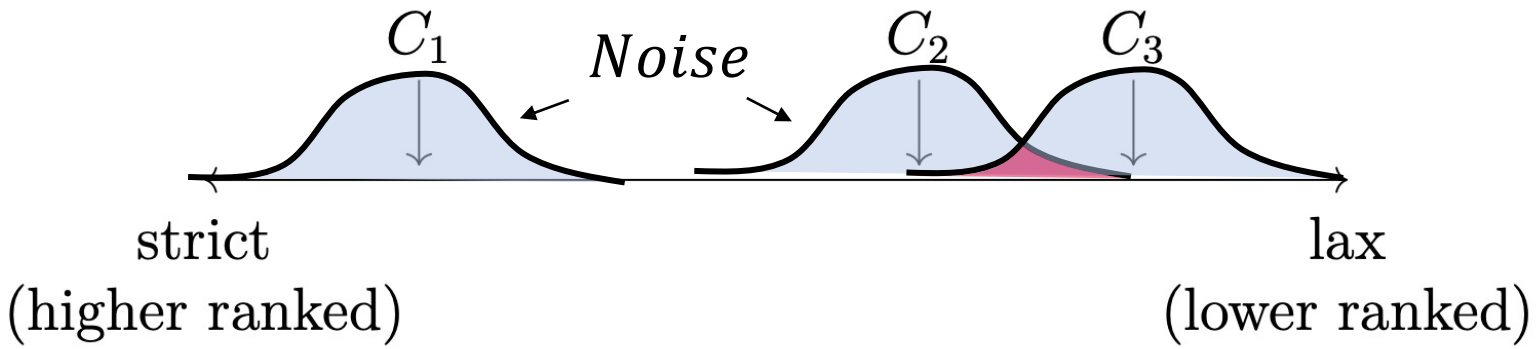
(adapted from Boersma & Hayes 2001: 47, 49)



- The ranking between C_2 and C_3 is more prone to the impact of noise.

3. Theoretical implications for LFG

(adapted from Boersma & Hayes 2001: 47, 49)



- Occasionally, $C_3 \gg C_2$

3. Theoretical implications for LFG

Two hypothetical constraints for the syllabicity constraint

- C_1: penalises 2+1 VPs
- C_2: an economy constraint that penalises longer forms, e.g. 2+2 VPs

$C_1 \gg C_2$ in both Mandarin and Wenzhounese

3. Theoretical implications for LFG

Mandarin	$C_1 = 53.5$	$C_2 = 50$
☞ 2+2 VP		*
2+1 VP	*!	

100-trial simulation in R: $C_1 \gg C_2$ = 90%, $C_2 \gg C_1$ = 10%

Result of the corpus study: 2+2 VP = 89.8%, 2+1 VP = 10.2%

Wenzhounese	$C_1 = 50.8$	$C_2 = 50$
☞ 2+2 VP		*
2+1 VP	*!	

100-trial simulation in R: $C_1 \gg C_2$ = 70%, $C_2 \gg C_1$ = 30%

Result of the production test: 2+2 VP = 71%, 2+1 VP = 29%

3. Theoretical implications for LFG

Q4: Does OT's domain-general computation undermine LFG's modularity?

One of the input-output relations in OT-LFG (Mohanan & Mohanan 2003: 313)

$\alpha \rightarrow \alpha, \beta, \gamma, \ldots$

Constraints from different modules are present in a single computation

3. Theoretical implications for LFG

Category-specific effects in Panoan languages: verbs and non-verbs have different phonological realisations (Elias-Ulloa 2021)

Hypothetical examples (where /C/ stands for an underspecified consonant)

Category	**UR**	**SR**
Verb	/saCa/	[sata]
Noun	/saCa/	[saka]
Adjective	/saCa/	[saka]

***t_{VERB}**: assign a violation mark to a verb whose /C/ is realised as [t]

(adapted from Elias-Ulloa 2021)

3. Theoretical implications for LFG

Are category-specific effects real?

3. Theoretical implications for LFG

Assume that every markedness constraint is domain-specific, for example:

1. *t: Assign a violation mark to a word whose /C/ is realised as [t]
2. *NEG-V: Assign a violation mark to expressions like *I eat not*, as opposed to *I don't eat* (adapted from Bresnan 2001: 28)

However these constraints are ranked, there is no interaction between syntax and phonology.

3. Theoretical implications for LFG

Q4: Does OT's domain-general computation undermine LFG's modularity?

No, as long as markedness constraints are domain-specific.

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4. Conclusion

1. 2+1 VPs are less acceptable than 2+2 VPs in Mandarin and Wenzhounese.
2. This syllabicity constraint can be formalised in a modular fashion.
3. The difference between Mandarin and Wenzhounese results from different constraint strength, which challenges binary grammaticality.
4. SOT-LFG can model gradient grammaticality without violating modularity.

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Thank you!

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