Emergent Strength Strata in Cherokee Hiatus Resolution

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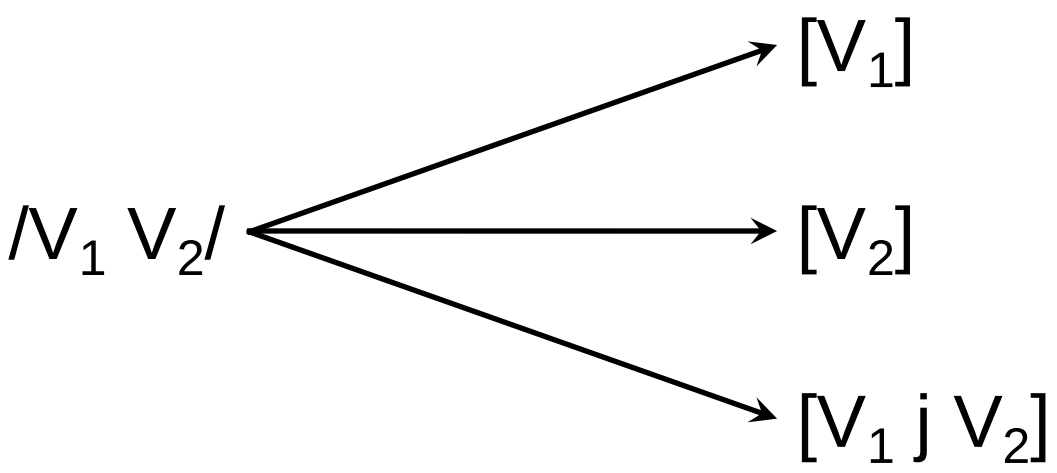
Introduction: Cherokee Hiatus Resolution

- Cherokee (Southern Iroquoian; North Carolina, Oklahoma): when morpheme concatenation places two vowels in adjacent positions, hiatus is always repaired

- Several attested hiatus resolution strategies:



Idiosyncrasy in Cherokee Hiatus Resolution

Identity of morphemes each vowel belongs to determines which repair strategy occurs (Montgomery-Anderson 2008):

/t͡si**i**ː- **a**li-/ → [t͡si**i**ːli…] (p. 131)

1A.AN- MDL

V_1 surfaces

/uːn**i**ː- **a**tuːliha/ → [uːn**a**tuː…] (p. 78)

3B.PL- want:PRC

V_2 surfaces

same underlying vowel sequence

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/t͡si:- **a**li-/ → [t͡s**i**:li…] (p. 131)

1A.AN- MDL

V_1 surfaces

/t͡si:- **a**ta?jiha/ → [t͡s**i**:**ja**ta…] (p. 157)

1A.AN- deny:PRC

glide insertion

same prefix

The (Un)predictability of Hiatus Resolution

- Cherokee hiatus resolution is idiosyncratic (i.e. lexically specific), and not predicted by factors previously proposed to condition hiatus repair

- Cherokee hiatus resolution is orderly: from combinations of verbal roots and prefixes in Cherokee, we observe multiple **transitive** degrees of vowel **strength** (propensity to surface under hiatus)

Proposal: Gradient Harmonic Grammar

Cherokee hiatus resolution analyzed in Gradient Harmonic Grammar (GHG; Smolensky and Goldrick 2016):

- Input elements are specified for degrees of **activity** (i.e. presence) between zero and one
- Faithfulness constraints are sensitive to **activity contrasts** among segments

Result: Multiple degrees of vowel **strength** under hiatus emerge from underlying contrasts in non-integer activity levels

Cherokee Hiatus Resolution in Gradient Harmonic Grammar

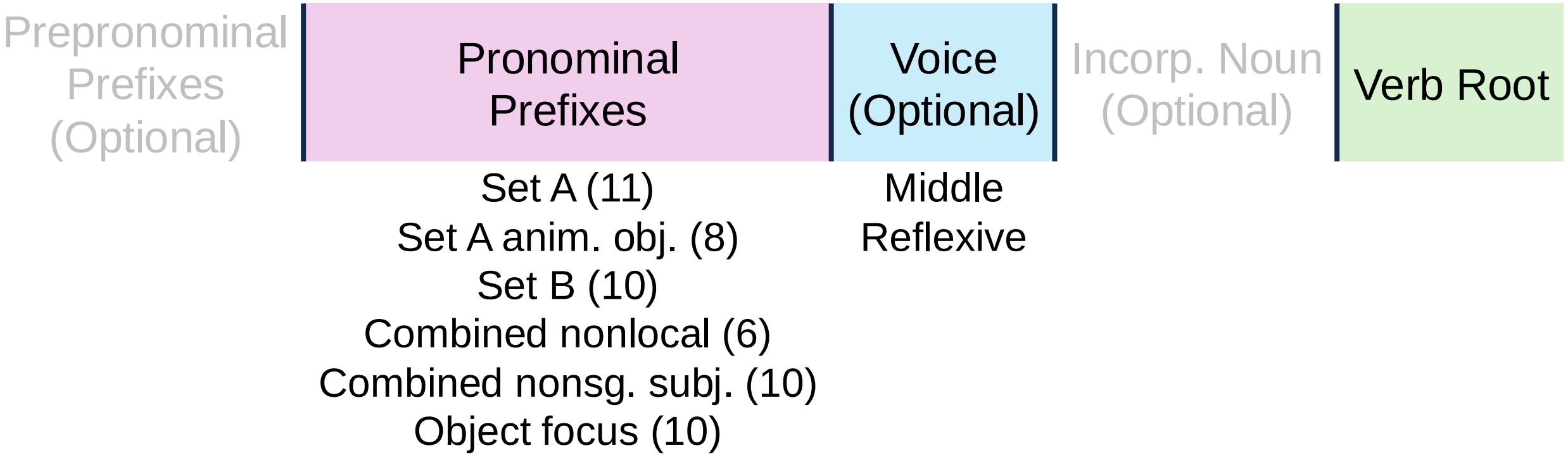
Cherokee hiatus resolution exhibits combination of properties best suited to analysis within GHG:

- Deletion/preservation of whole segments
- Multiple levels of idiosyncrasy
- Conditioning by specific combinations of lexical items

Cherokee Verbal Morphophonology

Cherokee Verbal Morphology

Cherokee verbs may surface with a number of prefixes (Montgomery-Anderson 2008):



Pronominal Prefixes and Verb Roots

- Some pronominal prefix + verb root combinations undergo glide insertion:

/t͡si:- **a**taʔjiha/ → [t͡si:**ja**ta…] (p. 157)
1A.AN- deny:PRC

- Others undergo deletion of pronominal prefix vowel:

/h**i**- **a**tit^{h}ask/ → [h**a**tit^{h}a…] (p.178)
2A -drink:INC

Pronominal and Voice Prefixes

- In some combinations, pronominal prefix vowel surfaces and voice prefix vowel deletes:

/sk**ʌː**-**a**li-/ → [sk**ʌː**l…] (p. 306)
2/1PL-MDL-

- In other combinations, pronominal prefix vowel deletes and voice prefix vowel surfaces:

/iːt͡s**iː**-**a**li-/ → [iːt͡s**a**l…] (p. 229)
2A.PL-help:MDL

Voice Prefixes and Verb Roots

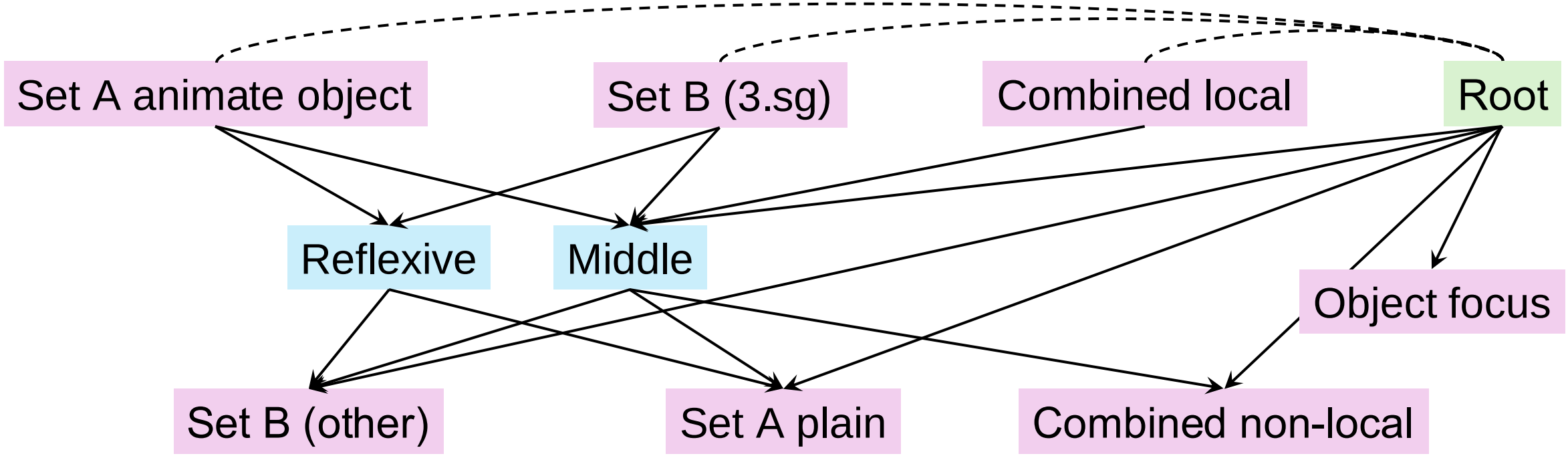
Verb root vowels surface while voice prefix vowels delete:

/at**aː**- **o**luhwatʰiːha/ → [aːt**o**luhwa…] (p. 370)
MDL- develop:PRC

/at**aː**- **eː**joːhʌsk/ → […t**eː**joː…] (p. 452)
MDL- teach:INC/AGT

Emergent Pattern in Hiatus Resolution

Observed hiatus resolution patterns among verbal prefix and root combinations:



Emergent Strength Strata

Based on patterns of hiatus resolution, three strength strata emerge:

Strong	Set A anim. obj.	Set B (3.sg)	Comb. local	Root
Medium	Reflexive		Middle	
Weak	Set B (other)	Set A plain	Comb. nonsg. subj.	Object focus*

Strong vowels always surface; undergo glide insertion in hiatus with another strong vowel

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Medium vowels delete in hiatus with strong vowels but surface in hiatus with weak vowels

Emergent Strength Strata

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Weak vowels delete in hiatus with strong and medium vowels

The (Un)predictability of Hiatus Resolution

- These strength designations do not align with previously proposed predictors of hiatus repair (cf. Casali 1997, a.o.):
  - Directionality
  - Morphological structure
  - Vowel quality
  - Vowel quantity

- Successful analysis of Cherokee's multiple hiatus resolution strategies relies on relative strengths of adjacent input vowels

Gradient Harmonic Grammar

Gradient Harmonic Grammar
(Smolensky & Goldrick 2016)

- Gradient Harmonic Grammar: variant of Harmonic Grammar with an enriched representational system
- Elements in input representations are specified with **non-integer degree of activity** (i.e. degree of presence) between 0 and 1.0
- Penalty of each faithfulness constraint violation is proportional to activity of structure that violates it
- Phonological idiosyncrasy arises from contrastive specifications of input activity (Zimmermann 2018; Hsu 2019, 2022)

Lexical Idiosyncrasy in Gradient Harmonic Grammar

Faithfulness constraints are sensitive to input activity values, but markedness constraints are not

Output codas incur full markedness violations

/$p_1a_1k_{0.75}$/	NoCoda w=1	Max w=4	Dep w=2	H
☞ a. pak	−1		−0.25 (1−k)	−1.5
b. pa		−0.75 (k)		−3
/$p_1a_1k_{0.25}$/				
a. pak	-1		−0.75 (1−k)	−2.5
☞ b. pa		−0.25 (k)		−1

Lexical Idiosyncrasy in Gradient Harmonic Grammar

Faithfulness constraints are sensitive to input activity values, but markedness constraints are not

Faithfulness violations scaled by input activity level

/$p_1a_1k_{0.75}$/	NoCoda w=1	Max w=4	Dep w=2	H
☞ a. pak	−1		−0.25 (1−k)	−1.5
b. pa		−0.75 (k)		−3
/$p_1a_1k_{0.25}$/				
a. pak	-1		−0.75 (1−k)	−2.5
☞ b. pa		−0.25 (k)		−1

Lexical Idiosyncrasy in Gradient Harmonic Grammar

The constraint set and constraint weights determine a single **threshold value** that determines whether a coda will surface

Segments above threshold surface; segments below threshold delete

/$p_1 a_1 k_{0.75}$/	NoCoda w=1	Max w=4	Dep w=2	H
☞ a. pak	−1		−0.25 (1−k)	−1.5
b. pa		−0.75 (k)		−3
/$p_1 a_1 k_{0.25}$/				
a. pak	-1		−0.75 (1−k)	−2.5
☞ b. pa		−0.25 (k)		−1

Analysis: Strength Strata in Cherokee

Cherokee Hiatus Resolution in Gradient Harmonic Grammar

- Stronger segments (those more resistant to deletion) represented in GHG with higher levels of input activity than weaker ones

- Cherokee hiatus resolution pattern arises from interaction between faithfulness constraints MAX and DEP and markedness constraint *VV

*VV: Assign a violation for any pair of adjacent vowel root nodes.

- Segments with higher input activity incur relatively high MAX penalties when deleted, and relatively low DEP violations for surfacing

Cherokee Hiatus Resolution in Gradient Harmonic Grammar

- Assumed output candidate set:
  - Faithful surfacing of V_1+V_2 in hiatus
  - Glide insertion
  - Deletion of V_1
  - Deletion of V_2

- Our sets of constraints and candidates determine a **threshold activity value** above which vowels pattern as Strong and always surface

- Preservation of both vowels + glide insertion occurs if both vowels are above an input activity threshold of:

$$\frac{2 \times w(\text{DEP})}{w(\text{DEP}) + w(\text{MAX})}$$

Activity Values and Constraint Weights

One set of constraint weights and activity values meeting these criteria:

Activity Values	Constraint Weights
Strong vowels: 1.0	*VV: 5
Medium vowels: 0.67	Max: 4
Weak vowels: 0.33	Dep: 3

Glide Insertion

Glide insertion occurs between two strong vowels:

	/$i_{1.0}$ - $a_{1.0}$/	*VV w=5	MAX w=4	DEP w=3	H
Hiatus	a.[i a]	−1			−5
Glide insertion	☞ b.[i j a]			−1 (j)	−3
Delete V_2	c.[i]		−1 (a)		−4
Delete V_1	d.[a]		−1 (i)		−4

Deletion of Weaker Vowel

Strong vowel surfaces, medium vowel deletes:

	/$i_{1.0}$ - $a_{0.67}$/	*VV w=5	MAX w=4	DEP w=3	H
Hiatus	a.[i a]	−1		−0.33 (1−a)	−5.99
Glide insertion	b.[i j a]			−1 (j) + −0.33 (1−a)	−3.99
Delete V_2	☞ c.[i]		−0.67 (a)		−2.68
Delete V_1	d.[a]		−1 (i)	−0.33 (1−a)	−4.99

Deletion of Weaker Vowel

Medium vowel surfaces; weak vowel deletes:

	/$i_{0.33}$ - $a_{0.67}$/	*VV w=5	MAX w=4	DEP w=3	H
Hiatus	a.[i a]	−1		−0.67 (1−i) + −0.33 (1−a)	−8
Glide insertion	b.[i j a]			−1 (j) + −0.67 (1−i) + −0.33 (1−a)	−6
Delete V_2	c.[i]		−0.67 (a)	−0.67 (1−i)	−7.37
Delete V_1	☞ d.[a]		−0.33 (i)	−0.33 (1−a)	−2.31

Theoretical Implications

Gradient Harmonic Grammar and Phonological Idiosyncrasy

GHG is especially suited to analyzing idiosyncratic phonological patterns involving:

- Deletion/preservation of whole segments (Smolensky & Goldrick 2016; Hsu 2019)
- Multiple levels of idiosyncrasy (Hsu & Smith 2023)
- Conditioning by specific combinations of lexical items (Smolensky & Goldrick 2016; Rosen 2016, 2018, 2019)

Deletion and Preservation of Whole Segments

Gradient Harmonic Grammar

Any input element may have gradient activity, including segmental root nodes

- ✓ Idiosyncratic deletion/ surfacing of whole segments

Featural Underspecification

Subsegmental features may be present or absent (Kiparsky 1993; Inkelas 1994)

- ✓ Idiosyncratic application of feature-filling rules
- ✗ Idiosyncratic deletion/ surfacing of whole segments (Inkelas 2015)

Multiple Levels of Idiosyncrasy

Gradient Harmonic Grammar

Number of possible levels of idiosyncrasy emerges from constraint set and candidate set

✓ No restriction on number of degrees of idiosyncrasy within a phonological pattern

Featural Underspecification

Subsegmental features may be present or absent (Kiparsky 1993; Inkelas 1994)

✗ Patterns with >2 degrees of idiosyncrasy

Multiple Levels of Idiosyncrasy

Gradient Harmonic Grammar

Number of possible levels of idiosyncrasy emerges from constraint set and candidate set

- ✓ No restriction on number of degrees of idiosyncrasy within a phonological pattern

Indexed Constraints

Each stratum in an idiosyncratic pattern requires a set of indexed constraints (Pater 2000)

- ✓ No restriction on number of degrees of idiosyncrasy within a phonological pattern
- ✗ Proliferation of indexed constraints and rankings

Conditioning by Combinations of Lexical Items

Gradient Harmonic Grammar

Gradiently active elements cumulatively contribute to candidate harmony

✓ Patterns conditioned by combinations of elements (Rosen 2016 et seq.)

Morpheme-Specific Indices + Ranked Constraints

Morphemes indexed to constraints (Pater 2000) or a cophonology (Orgun 1996)

✓ Patterns conditioned by combinations of elements

✗ Relies on local constraint conjunction (Sande 2020)

Conditioning by Combinations of Lexical Items

Gradient Harmonic Grammar

Gradiently active elements cumulatively contribute to candidate harmony

✓ Patterns conditioned by combinations of elements

Morpheme-Specific Indices + Weighted Constraints

Morphemes indexed to constraints (Moore-Cantwell & Pater 2016) or patterns of reweighting (Coetzee & Kawahara 2013, Sande 2020)

✓ Patterns conditioned by combinations of elements

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