How much overt agreement is needed for polysynthesis? Quantitative evidence from Cherokee.

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1. **Overview**
2. Polysynthesis & agreement
3. Cherokee word order & agreement
4. Quantitative analysis
5. Implications & conclusion

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1. Overview

Two properties that cluster in polysynthetic languages (Jelinek 1984, Baker 1996, Mithun 2017 a.o.):

- **Flexible clausal word order**
  - Often with free omission of argument NPs, non-configurational properties (Hale 1983).
- **Polypersonal agreement:** Coindexation of multiple thematic arguments in verbal agreement morphology

1. Overview

This paper re-examines a standard generative proposal on the causal relationship between these properties (Jelinek 1984; Baker 1996; 2006).

We focus on key grammatical properties of **Cherokee** (Southern Iroquoian: Oklahoma and North Carolina).

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1. Overview

Key grammatical properties of Cherokee:

(i) Highly flexible clausal word order, with known predictive factors (Scancarelli 1987; Hsu & Frey 2023)

Example: Agent arguments of transitive predicates can precede or follow verbs.

(1) *Subject* < *Verb*

[gitli] ogi-sdawadvs-v.

dog 1.PL.EXCL-follow-EXPP

'The dog followed us.' (Feeling et al. 2017; 101)

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1. Overview

Key grammatical properties of Cherokee:

(i) Highly flexible clausal word order, with known predictive factors (Scancarelli 1987; Hsu & Frey 2023)

Example: Agent arguments of transitive predicates can precede or follow verbs.

(2) *Verb* < *Subject*

a-n-adasdelis-g-o [yvwi j-u-n-asdi].

3-PL-help-PROG-HAB people DST-3-PL-little

'The little people help (others).' (Feeling et al. 2017; 43)

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1. Overview

Key grammatical properties of Cherokee:

(ii) Fewer NP arguments coindexed by verbal agreement than in other polysynthetic languages

(3) [**sagwu**=no] [j-un-atana ahwi] d-**a**-hih-e.
one=CN DST-3.PL-big deer DST-**3.SG**-kill-REPP
'One (of the hunters) killed big deer.' (Feeling et al. 2017; 53)

- Features of only one 3rd-person argument expressed on the pronominal prefix *a-*.

1. Overview

We present a **quantitative investigation** of the relation between overt coindexation of arguments and NP placement in Cherokee clauses.

Main result: Argument NP placement does *not* vary, based on whether its features are overtly coindexed.

Having fewer coindexed arguments does not lead to reduced word order flexibility relative to other polysynthetic languages (ex. Mohawk)

1. Overview

Proposal: The threshold for maintaining this type of word order flexibility is *abstract polypersonal agreement,* rather than *surface polypersonal agreement* (our terms)

Surface polypersonal agreement

Agreement morphology directly expresses features of multiple arguments of a verb.

Abstract polypersonal agreement

Agreement morphology systematically depends on relative properties of multiple arguments of a verb (not all argument features directly expressed).

1. Overview
2. **Polysynthesis & agreement**
3. Cherokee word order & agreement
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2. Polysynthesis & agreement

Next slides: Summary of Baker's (1996) analysis of Mohawk (Northern Iroquoian), and the relation between polypersonal agreement and flexible word order.

2. Polysynthesis & agreement

Mohawk: Flexible clausal word order.

	S	V	O
(4)a.	Sak	ra-núhwe’-s	ako-[a]tyá'tawi
	Sak	MsS-like-HAB	FsP-dress
	'Sak likes her dress'		

(Baker 1996; 10)

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2. Polysynthesis & agreement

Mohawk: Flexible clausal word order.

	V	S	O
(4)b.	ra-núhwe’-s	Sak	ako-[a]tyá'tawi
	MsS-like-HAB	Sak	FsP-dress
	'Sak likes her dress'		

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2. Polysynthesis & agreement

Mohawk: Flexible clausal word order.

	S	O	V
(4)c.	Sak	ako-[a]tyá'tawi	ra-núhwe'-s
	Sak	FsP-dress	MsS-like-HAB
	'Sak likes her dress'		

(Baker 1996; 10)

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2. Polysynthesis & agreement

Mohawk: Flexible clausal word order.

	V	O	S
(4)d.	ra-núhwe’-s	ako-[a]tyá'tawi	Sak
	MsS-like-HAB	FsP-dress	Sak
	'Sak likes her dress'		

(Baker 1996; 10)

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2. Polysynthesis & agreement

Mohawk: Flexible clausal word order.

	O	V	S
(4)e.	ako-[a]tyá'tawi	ra-núhwe’-s	Sak
	FsP-dress	MsS-like-HAB	Sak
	'Sak likes her dress'		

(Baker 1996; 10)

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2. Polysynthesis & agreement

Mohawk: Flexible clausal word order.

	O	S	V
(4)f.	ako-[a]tyá'tawi	Sak	ra-núhwe'-s
	FsP-dress	Sak	MsS-like-HAB
	'Sak likes her dress'		

(Baker 1996; 10)

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2. Polysynthesis & agreement

Mohawk: Flexible clausal word order.

Other non-configurational properties (Baker 1996):

- Absence of weak cross-over effects
- Free omission of non-pronominal NP arguments

2. Polysynthesis & agreement

Mohawk: Verbal agreement prefixes coindex features of up to two thematic arguments (including two 3rd-person arguments)

- *Shako-* expresses gender, number properties of two arguments (masc. sg. subject, fem. object)

(5) **Shako**-nuhwe'-s (ne owira'a) *Mohawk* (Baker 1996; 21)
MsS/FO-like-HAB NE baby
'He likes them (babies)'

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2. Polysynthesis & agreement

Mohawk: Productive noun incorporation (cf. Mithun 2017b), in complementary distribution with pronominal object agreement

(6) Ra-wir-a-nuhwe'-s *Mohawk* (Baker 1996; 21)
MsS-baby-ø-like-HAB
'He likes babies'

- Baker (1996): Incorporated objects fill the "slot" taken by object agreement.

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2. Polysynthesis & agreement

Baker's proposed condition on agreement, argument licensing in polysynthetic languages:

The Morphological Visibility Condition (MVC)

> A phrase X is visible for θ-role assignment from a head Y only if it is coindexed with a morpheme in the word containing Y via:
>
> > An agreement relationship, or
> >
> > A movement relationship

(Baker 1996; 17)

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2. Polysynthesis & agreement

Baker (1996): If this condition is met, all non-pronominal NPs pattern as adjuncts: they can be freely omitted, freely ordered.

> [In a certain class of languages], a verb [Y] agrees with an overt NP [X] if and only if [X] is in a dislocated, adjunct position.
>
> (Baker 2006: 290)

2. Polysynthesis & agreement

Verbs do not overtly coindex all argument features in all polysynthetic languages with flexible word order.

How does the MVC accommodate this?

- The MVC tolerates some degree of phonologically null agreement (Baker 1996):
  - Some argument features, or combinations thereof, can be expressed by a null (Ø) agreement morpheme.
  - i.e. Particular cells in the paradigm are expressed as Ø

2. Polysynthesis & agreement

Verbs do not overtly coindex all argument features in all polysynthetic languages with flexible word order.

How does the MVC accommodate this?

- The MVC tolerates some degree of phonologically null agreement (Baker 1996):
  - The structural position of arguments indexed by null (Ø) agreement morphemes does not differ from arguments indexed overtly (Baker 2006).

2. Polysynthesis & agreement

Our question: How much overt agreement is necessary to maintain general word order freedom, general polysynthetic characteristics?

Next sections: Quantitative evidence from Cherokee shows that *abstract polypersonal agreement* is sufficient to satisfy the MVC.

1. Overview
2. Polysynthesis & agreement
3. **Cherokee word order & agreement**
4. Quantitative analysis
5. Implications & conclusion

3. Cherokee word order & agreement

Language background: Southern Iroquoian language, once spoken throughout lower Appalachian regions.

Most speakers (~2000 native/fluent) now reside in Oklahoma and Western North Carolina.

Next slides: Key aspects of clausal word order, agreement morphology.

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3. Cherokee word order & agreement

Flexible clausal word order:

- All orders of subject, object, verb are grammatical (Pulte & Feeling 1975, Scancarelli 1987).

(7) *Subject* < *Verb*

[gitli] ogi-sdawadvs-v.

dog 1.PL.EXCL-follow-EXPP

'The dog followed us.' (Feeling et al. 2017; 101)

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3. Cherokee word order & agreement

Flexible clausal word order:

- All orders of subject, object, verb are grammatical (Pulte & Feeling 1975, Scancarelli 1987).

(8) *Verb* < *Subject*

a-n-adasdelis-g-o [yvwi j-u-n-asdi].

3-PL-help-PROG-HAB people DST-3-PL-little

'The little people help (others).' (Feeling et al. 2017; 43)

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3. Cherokee word order & agreement

Flexible clausal word order:

- All orders of subject, object, verb are grammatical (Pulte & Feeling 1975, Scancarelli 1987).

(9) *Object* < *Verb*

No	kil	[am]	ji-todis-g-o
Then	until	water	1-heat.water-PROG-HAB

'Then I heat some water.' (Feeling et al. 2017; 129)

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3. Cherokee word order & agreement

Flexible clausal word order:

- All orders of subject, object, verb are grammatical (Pulte & Feeling 1975, Scancarelli 1987).

(10) *Verb* < *Object*

u-sdu-hnv [galohisdi?i].

3-close-EXPP door

‘(he) closed the door.’ (Feeling et al. 2017; 35)

3. Cherokee word order & agreement

Flexible clausal word order:

- Non-configurational properties shared with Mohawk (Beghelli 1996)
  - Absence of weak cross-over effects
  - Free omission of non-pronominal NP arguments

3. Cherokee word order & agreement

Recent findings (Hsu & Frey 2023):

- No subject/object asymmetry in word order:
  - NP placement insensitive to number of NPs in clause:
  - Ex: Themes of transitive verbs show same placement as themes of unaccusative verbs.
- Placement of each NP determined probabilistically by its properties related to *contrast*, *referential accessibility* and *thematic role.*

3. Cherokee word order & agreement

Recent findings (Hsu & Frey 2023):

- Word order principles qualitatively similar to clausal word order in related Nothern Iroquoian languages:
  - Mohawk (Baker 1996; Mithun 2017b)
  - Cayuga (Mithun 1992)
  - Tuscarora (Mithun 1995)

3. Cherokee word order & agreement

Pronominal agreement system:

- All verbs have one pronominal prefix
  - Person and number properties of at least one argument are indexed
  - No paradigmatic gaps, all combinations of person and number are available.
- If both arguments are local (1st person, 2nd person), features of both, and their relative thematic prominence, are expressed by the prefix

3. Cherokee word order & agreement

Pronominal agreement system:

- *If both arguments are local (1st or 2nd person)*: features of both, and their relative thematic prominence, are expressed by the prefix

(11) hi? da-**jv**-nej-el-i.
this FUT-**1SG/2PL**-tell-DAT-FUT
'I will tell you about this'

(Feeling et al. 2017; 75)

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3. Cherokee word order & agreement

Pronominal agreement system:

- *If one argument is local, and the other is not*: the prefix expresses features of the local argument
  - Regardless of relative thematic prominence of the arguments

3. Cherokee word order & agreement

Pronominal agreement system:

- *If one argument is local, and the other is not*: the prefix expresses features of the local argument
  - Regardless of relative thematic prominence of the arguments

(12) [gitli] **ogi**-sdawadvs-v.
dog **1.PL.EXCL**-follow-EXPP
'The dog followed us.'

(Feeling et al. 2017; 101)

3. Cherokee word order & agreement

Pronominal agreement system:

- *If both arguments are 3rd person*: The prefix expresses number features of the more animate argument
  - If they are equally animate, the more thematically prominent argument is overtly agreed with

(13) [sagwu=no] [j-un-atana ahwi] d-**a**-hih-e.
one=CN DST-3.PL-big deer DST-**3.SG**-kill-REPP
'One (of the hunters) killed big deer.'

(Feeling et al. 2017; 53)

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3. Cherokee word order & agreement

Pronominal agreement system:

- *If both arguments are 3rd person*: The prefix expresses number features of the more animate argument.
    - If they are equally animate, the more thematically prominent argument is overtly agreed with

(14) [ijul] y-**uni**-kevs-e
both NONFIN-**3.PL**-chase-REPP
'(The bull) would chase them both.'

(Feeling et al. 2017; 114)

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3. Cherokee word order & agreement

- Mohawk: Features of two 3rd person arguments can be expressed on a pronominal prefix.
  - (Baker 1996; 191; Mithun 2017b; 33)
- Cherokee: Features of two 3rd person arguments are *never* simultaneously expressed on a prefix.
  - Pronominal prefixes on transitive verbs are only partially informative about the features of the non-coindexed argument.
  - Ex. A 3rd person prefix on a transitive verb only indicates that the other argument is not local

3. Cherokee word order & agreement

- Cherokee only consistently expresses features of one argument of a transitive verb.
  - Unlike Mohawk
- There is no productive noun incorporation
  - Also unlike Mohawk

1. Cherokee word order & agreement

A proposed distinction among polypersonal agreement systems:

Surface polypersonal agreement

Agreement morphology directly expresses features of multiple arguments of a verb

Abstract polypersonal agreement

Agreement morphology systematically depends on relative properties of multiple arguments of a verb (not all argument features directly expressed)

3. Cherokee word order & agreement

Pronominal prefixes in Cherokee typically express features of only one argument of transitive verb.

- Few patterns of **surface polypersonal agreement**, compared to Mohawk.

However, the choice of which argument to coindex depends on relative properties of *more than one* thematic argument.

- Evidence for **abstract polypersonal agreeement**.

3. Cherokee word order & agreement

Next section: Does this reduced amount of visible argument features on verbs result in a distinct structural representation of NPs in the clause?

Or, is abstract polypersonal agreement sufficient to maintain word order flexibility?

3. Cherokee word order & agreement

Interim summary

- Cherokee has less overt coindexation than the other Iroquoian languages
  - Taken as the "prototypical examples of polysynthesis" (Mithun 2017b; 747)
- We know what predicts word order in Cherokee

We use Cherokee to test hypotheses about the relationship between word order flexibility and morphology

3. Cherokee word order & agreement

If *Surface Polypersonal Agreement* is needed to satisfy the MVC…

> Whether or not an argument is *overtly* agreed with will significantly affect its position in the clause.

If *Abstract Polypersonal Agreement* meets the agreement threshold for the MVC…

> Whether an argument is *overtly* agreed with will have *no* significant effect on its position in the clause.

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4. Quantitative analysis

Hsu and Frey (2023) identify factors that best predict clausal word order in Cherokee:

- All non-pronominal NPs in a corpus are tagged for a range of grammatical properties.

Two word order factors found to be significant in predicting the placement of NPs:

- Thematic role
- Referential accessibility (a.k.a. newness / givenness)

4. Quantitative analysis

Probabilistic tendencies of Cherokee word order in relation to thematic role and referential accessibility:

	NP is an agent	*NP is a theme*
NP is new	**92%** preverbal (12/13)	**73%** preverbal (36/49)
NP is given	**76%** preverbal (37/49)	**50%** preverbal (57/114)

(Hsu & Frey 2023)

4. Quantitative analysis

This paper: We expand the Hsu & Frey corpus by tagging all NPs for whether their features are coindexed by a pronominal prefix on the verb.

We can thus identify whether overt coindexation on a pronominal prefix influences placement of NP arguments of transitive verbs.

- On intransitive verbs, features of the sole argument NP are always coindexed.

4. Quantitative analysis

We control for factors that influence NP placement, and/or argument coindexation:

- *Thematic role* affects **word order** and **coindexation**
- *Argument animacy* affects only **coindexation**
- *Referential accessibility* affects only **word order**

(Montgomery-Anderson 2015; Hsu & Frey 2023)

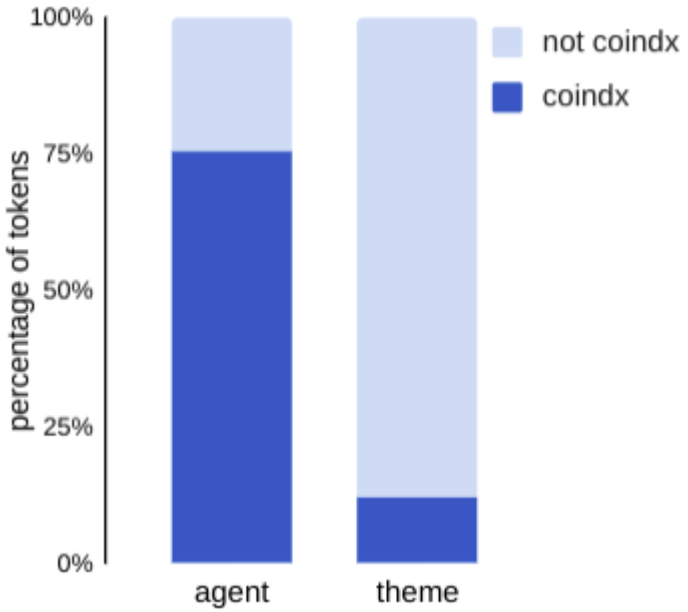
4. Quantitative analysis

Agent NPs are coindexed significantly more than themes are. It also has a word order effect: agent NPs are likelier to precede verbs than themes (H&F 2023)

X-squared = 67.803,

df = 1,

p-value < $2.2e^{-16}$



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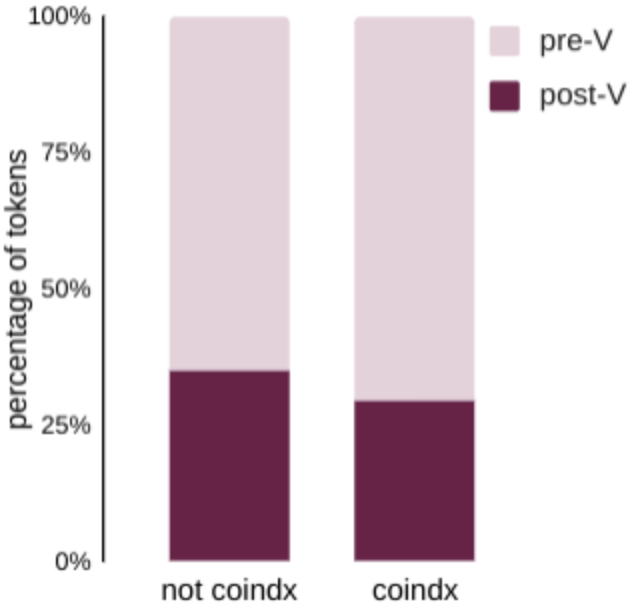
4. Quantitative analysis

When controlling for **thematic role:** No significant effect of coindexation on NP position.

Figure: Placement of *theme NPs* only, by coindexed vs. non-coindexed status.



X-squared = 0.040695,

df = 1,

p-value = 0.8401

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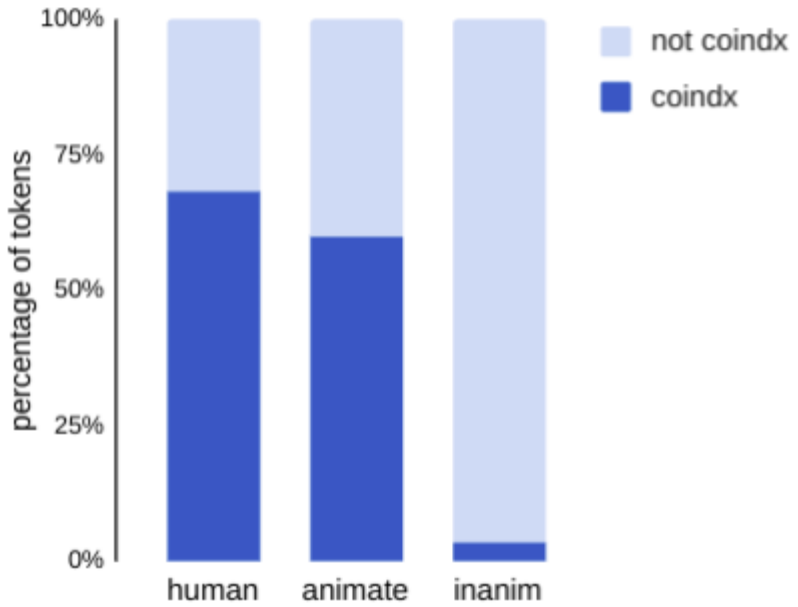
4. Quantitative analysis

Animacy significantly affects which arguments are coindexed but not word order.

X-squared = 170.01,
df = 2,
p-value < 2.2e-16



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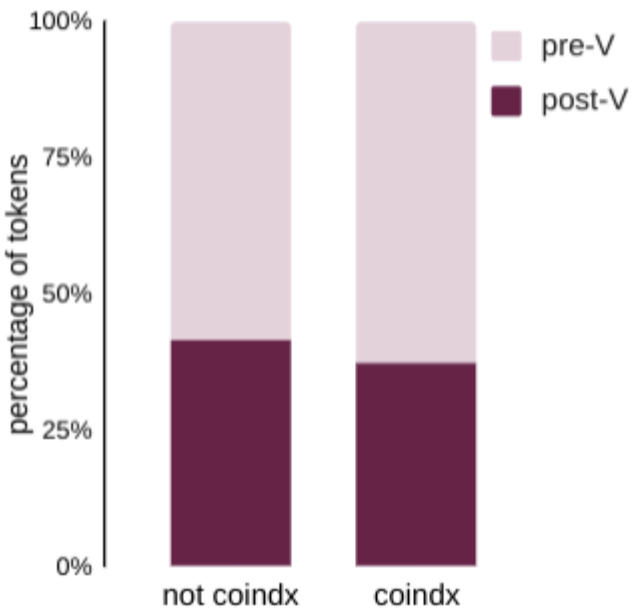
4. Quantitative analysis

When controlling for **animacy contrasts**: No significant effect of coindexation on NP position.

Figure: Placement of *animate NPs only*, by coindexed vs. non-coindexed status.



X-squared = 0.021634,

df = 1,

p-value = 0.8831

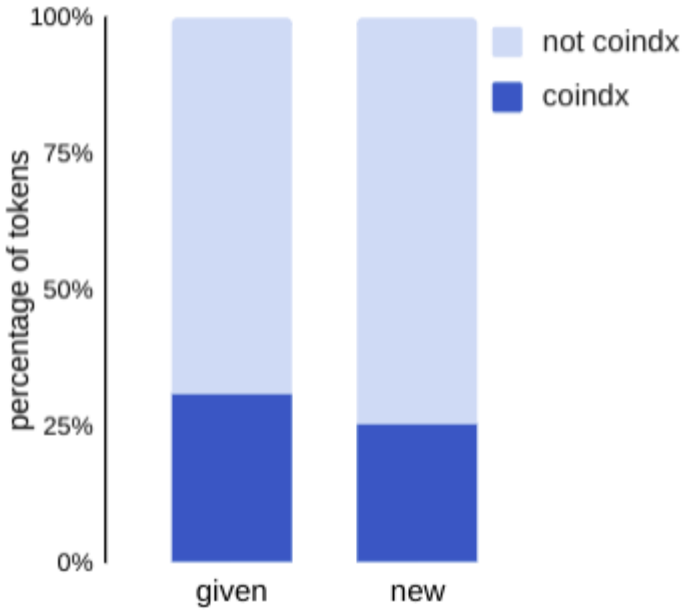
4. Quantitative analysis

Referential accessibility does not significantly affect which argument is indexed. It does have word order effects; discourse-new NPs likelier to precede verbs than given NPs (H&F 2023)

X-squared = 0.5467,

df = 1,

p-value = 0.4597



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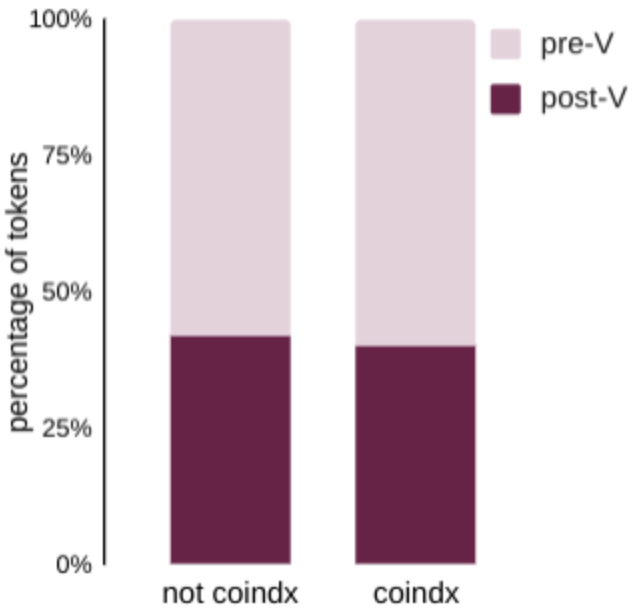
4. Quantitative analysis

When controlling for **referential accessibility:** No significant effect of coindexation on NP position.

Figure: Placement of *discourse-given NPs only*, by coindexed vs. non-coindexed status.



X-squared = 0.0038223,

df = 1,

p-value = 0.9507

4. Quantitative analysis

The placement of an argument NP in relation to a verb does **not** depend on whether its features are **visibly coindexed** by a pronominal prefix

In Cherokee, non-coindexed arguments appear to have **the same structural status** as coindexed arguments

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5. Implications & conclusion

Cherokee does not have less word order freedom than other polysynthetic languages, while showing overt agreement with systematically fewer arguments.

Abstract polypersonal agreement is sufficient to meet the agreement threshold for maintaining general polysynthetic properties.

5. Implications & conclusion

What does this mean for the MVC?

Baker (2006): Nonvisibly-coindexed NPs show flexible placement if their features happen to be expressed by a null affix (Ø represents a slot in the agreement paradigm)

Cherokee agreement is hard to characterize as such: Whether features of an NP are coindexed depends on relative properties of two arguments.

5. Implications & conclusion

What does this mean for the MVC?

Crucially, verbal agreement in Cherokee requires all NP arguments to be visible to the verb, in order to determine which features are coindexed.

- Can be modeled by Multiple Agree between verbs and argument NPs (Oxford 2019).

A one argument to one affix correspondence is not strictly required.

5. Implications & conclusion

The Morphological Visibility Condition (MVC)

A phrase X is **visible for θ-role assignment** from a head Y only if it is **coindexed** with **a morpheme** in the word containing Y via:

An agreement relationship*, or

A movement relationship

(Baker 1996; 17)

**abstract polypersonal agreement* is sufficient to meet this threshold

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5. Implications & conclusion

Summary of main results:

- NP placement in the Cherokee clause does not depend on whether its features are visibly coindexed on a pronominal prefix.
- Abstract polypersonal agreement is sufficient to maintain free word order in polysynthetic languages

5. Implications & conclusion

Future directions:

- More quantitative analysis of word order predictors in polysynthetic languages and/or languages with flexible word order.

- How much can languages vary in the movement-triggering propensities of particular features? Is it predicted by any (morphological) properties?

Thank you!

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