

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

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1 Overview

A considerable body of work has shown that languages classified as polysynthetic typically show two defining properties: the systematic morphological marking of arguments on verbal morphology and highly flexible clausal word order. In an influential generative account of this generalization, the second property emerges as a consequence of the first (Jelinek 1984, Baker 1996). In this paper, we consider the proposal of Baker (1996) that the defining property of polysynthetic languages is a grammar that expresses all arguments of a predicate through verbal morphology (i.e. *polypersonal agreement*), via inflectional affixes or noun incorporation. This is formalized as the Morphological Visibility Condition, stated in (1).

(1) 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:

- a. An agreement relationship, or
- b. A movement relationship

(Baker 1996:17)

According to Baker, if this condition is met, all non-pronominal nominal expressions (henceforth *NPs*) occur in dislocated, adjoined position (see also Jelinek 1984). This gives rise to the hallmarks of non-configurationality (Hale 1983): the flexible ordering and free omission of arguments, and the existence of discontinuous noun phrases. In brief, a sufficiently rich system of agreement is a prerequisite for language to have a non-configurational clausal syntax.

A separate question arises, then, about how “rich” such a system of agreement needs to be. It is fairly clear that polysynthetic languages can show flexible order without the overt coindexation of every argument on an agreement morpheme, a standard which we term *surface polypersonal agreement* (2). As one example, Baker (1996:207–211) notes that on ditransitive verbs in Mohawk, only two of the three arguments (the agent and goal) can be visibly co-indexed by a morpheme on the verb. Despite not being visibly coindexed, the theme patterns like the other argument NPs of the ditransitive verb in that they can be freely ordered or freely omitted; they have the same structural status, despite the absence of visible coindexation. It is possible, then, for polysynthetic languages to maintain word-order flexibility of all argument NPs, even when some argument features or combinations thereof are expressed by null (\emptyset) agreement morphemes (see Mithun 2017 for discussion of common gaps). Baker (2006:317–320) posits that the MVC can be satisfied if there is sufficient general evidence that syntactic agreement targets multiple arguments, even if some instances of agreement are not reflected in surface morphology. In other words, polysynthetic languages must exhibit what we term *abstract polypersonal agreement*, defined in (3).

(2) Surface polypersonal agreement:

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

(3) Abstract polypersonal agreement:

Agreement morphology systematically depends on relative properties of multiple arguments of a verb (not all argument features need to be overtly expressed)

This paper proposes that abstract polypersonal agreement is a sufficient condition for

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maintaining the MVC, based on the patterning of Cherokee (Southern Iroquoian). Polypersonal agreement in Cherokee is in relevant ways less surface-visible than other polysynthetic languages, including its Northern Iroquoian relatives like Mohawk. In brief, the modern language does not have productive noun incorporation (Uchihara 2014), and agreement morphology on transitive verbs in many instances expresses features of only one thematic argument. However, there is general evidence that its system of inflectional morphology still refers to multiple arguments of a verb (Scancarelli 1987), thus exhibiting abstract polypersonal agreement.

We present a quantitative study of word-order variation in an annotated corpus of Cherokee sentences, focusing on the relation between overt coindexation and NP placement. The key benefit of our quantitative methodology is that it provides a rigorous way to determine whether coindexed and non-coindexed NPs show distinct word-order characteristics, given that word-order preferences in the language are generally known to be probabilistic in nature (Hsu & Frey 2024). To preview our results, we find that whether an NP is overtly coindexed by a pronominal prefix has no observable effects on its placement in the clause, as consistent with a model in which verbs agree with all arguments in the syntactic representation. This supports the type of criteria for morphological visibility posited by Baker (1996, 2006), and suggests that the amount of non-overt agreement tolerated in polysynthetic languages is higher than previously assumed.

2 Clause structure and agreement in Cherokee

2.1 Nonconfigurational word order properties

In terms of word order, Cherokee exhibits the defining characteristics of nonconfigurational syntax (Hale 1983). The placement of non-pronominal arguments in the clause is flexible (Pulte & Feeling 1975, Scancarelli 1987). As shown in the examples below, all orders of a transitive verb with an agent NP and theme NP are possible, and discourse-given argument NPs can generally be omitted. Furthermore, Cherokee shows an absence of weak cross-over effects (Beghelli 1996), and there is at least preliminary evidence that nominal expressions can be discontinuous (Beghelli 1996, Hsu & Frey 2024).¹

- | | | |
|-----|---|--------------|
| (4) | [gitli] ogi-sdawadvs-v.
dog 1B.PL.EXCL-follow-EXPP
'The dog followed us.'
(Feeling et al. 2017:101) | Agent > Verb |
| (5) | a-n-adasdelis-g-o [yvwi j-u-n-asdi].
3A-PL-help-PROG-HAB people DST-3B-PL-little
'The little people help (others).' | Verb > Agent |
| (6) | No kil [am] ji-todis-g-o.
Then until water 1A-heat.water-PROG-HAB
'Then I heat some water.'
(Feeling et al. 2017:129) | Theme > Verb |
| (7) | u-sdu-hnv [galohisdi?i].
3B-close-EXPP door
'(He) closed the door.'
(Feeling et al. 2017:35) | Verb > Theme |

Another pattern in Cherokee indicative of nonconfigurationality is the apparent absence of a subject/object asymmetry in word order. As observed by Hsu & Frey (2024), the preferred placement of non-pronominal NPs is insensitive to the number of arguments of the verb. For instance, NPs that are theme arguments of transitive verbs show the same placement tendencies as theme arguments of intransitive (unaccusative) verbs. As discussed further in Section 3, the placement of

¹Here, we list glosses used for less common terms (Pulte and Feeling 1975, Montgomery-Anderson 2015): AN = animate object, A/B = set A/B class prefixes, CT = contrast, EXPP = experienced past, DST = distributive.

each NP is determined probabilistically by properties related to information-structural contrast, referential accessibility, and thematic role. Although an in-depth comparison has not yet been conducted, the clausal word order principles of Cherokee are qualitatively similar to those of related Northern Iroquoian languages, including Mohawk (Baker 1996, Mithun 2017), Cayuga (Mithun 1992), Tuscarora (Mithun 1995), and Seneca (Chafe 2015).

2.2 Pronominal (non-)agreement with third-person arguments

We present a brief overview of the pronominal agreement system of Cherokee (see Montgomery-Anderson 2015 for a comprehensive overview). Cherokee verbs obligatorily occur with a pronominal prefix that expresses person and number properties of at least one thematic argument. We restrict our attention to agreement on transitive verbs and focus on the relatively restricted expression of third-person arguments in agreement, as they are most likely to correspond to non-pronominal NPs.

In general, the principles of Cherokee agreement morphology differentiate *local* (first- and second-person) arguments from *non-local* (third-person) arguments. Broadly, local arguments inflect for a greater number of contrasts (such as dual number, not marked on third-person forms), and in some contexts only features of local arguments are overtly expressed. As shown in (8), when both arguments of a transitive verb are local, the pronominal prefix expresses person features of both arguments and their relative thematic prominence (the prefix *(i)jv* indicates the presence of a first-person subject and second-person object, and that at least one of the arguments is plural). For convenience, we use the term ‘subject’ here to refer to the more thematically prominent argument, and ‘object’ to the less prominent argument. Note, though, that the grammatical-function distinction between subjects and objects does not seem to be active in Cherokee syntax.

- (8) hi? da-**jv**-nej-el-i
 this FUT-**1/2PL**-tell-DAT-FUT
 ‘I will tell you about this.’
 (Feeling et al. 2017:75)

On transitive verbs that have a local argument and a third-person argument, only a subset of third-person arguments can be expressed, depending on a combination of factors related to the thematic prominence, animacy, and number of the argument. First, some pronominal prefixes express the presence of a local-person subject and an animate, third-person object (9). A pronominal prefix can also express the combination of a non-singular third-person subject and a local object (10).

- (9) gago-hv **esdi**-wahtvhid-o
 who-CT **2.DL.AN**-visit-HAB
 ‘Who are you two visiting?’
 (Feeling et al. 2017:185)
- (10) **gogi**-hnohiseh-i
 3.NS/1.PL.EX-tell-NOM
 ‘their telling to us’
 (Feeling et al. 2017:45)

While not expressed on a pronominal prefix, the presence of a third-person plural object can be expressed by the distributive prefix *d(e)-*, which precedes the pronominal prefix. However, the appearance of this prefix is conditioned by other factors; *d(e)-* can also indicate that an action has been repeated, and there is a class of verbs that always co-occur with the prefix in an idiosyncratic manner (Montgomery-Anderson 2015:109–133).

- (11) **de-g**-alihdis-g-o tili
 DST-1A-boil-PROG-HAB chestnut
 ‘I boil the chestnuts.’
 (Feeling et al. 2017:129)

Other third-person arguments are not expressed. This occurs, for example, when the third-person subject is singular, as in (12). Third-person object arguments are not expressed when they are inanimate and singular (13). In these cases, the prefixes are identical to those that occur on intransitive verbs with a local argument only, suggesting that they cannot be analyzed as portmanteau forms realizing features of both a local and non-local argument (see Dukes 1996 for a similar conclusion).

- (12) gitli **ogi**-sdawadv-s-v
 dog **1A.PL.EXCL**-follow-EXPP
 ‘The dog followed us.’
 (Feeling et al. 2017:101)
- (13) no kil am **ji**-todis-g-o.
 then until water **1A**-heat.water-PROG-HAB
 ‘Then I heat some water.’
 (Feeling et al. 2017: 129)

Overt agreement with third-person arguments is further restricted on transitive verbs that take two third-person (non-local) arguments. In these contexts, features of only one argument are visibly coindexed on the prefix, as is apparent when the two arguments differ in number (singular vs. nonsingular). If the two arguments differ in animacy, the prefix expresses person and number features of the more animate argument, regardless of their thematic prominence. For example, in (14) the prefix *uni-* indexes the theme argument ‘both (the men),’ as it is of higher animacy than the agent argument (a bull). When the arguments are of equal animacy, the prefix expresses features of the more thematically prominent argument. In (15), where both arguments are non-human animals, the prefix expresses number features of the agent argument (the rabbits). As with the forms shown in the previous paragraph, these prefix forms are identical to those that occur on intransitive verbs with a single third-person argument.

- (14) ijul y-**uni**-kevs-e
 both NONF-**3B.PL**-chase-REPP
 ‘(The bull) would chase both (men)’
 (Feeling et al. 2017:114)
- (15) suli **uni**-hwatvh-e
 buzzard **3B.PL**-find-repP
 ‘(The rabbits) found the buzzard.’
 (Feeling et al. 2017:144)
- (16) sagwu=no j-un-atana ahwi d-**a**-hih-e
 one=CN DST-3.PL-big deer DST-**3A.SG**-kill-REPP
 ‘One (of the hunters) killed big deer.’
 (Feeling et al. 2017:53)

In these contexts, each pronominal prefix is only partially informative about features of the non-coindexed argument. The occurrence of a third-person prefix on a transitive verb only unequivocally indicates that the other argument is not first or second person.

An important observation here is that features of two third-person arguments cannot be simultaneously coindexed by a single affix in Cherokee. In this respect, it differs from other polysynthetic languages like Mohawk (Northern Iroquoian), in which features of two third-person arguments can be expressed on a transitive verb, with some syncretism (Baker 1996:191, Mithun 2017:33). In the Mohawk example in (17), the agreement prefix *shako-* expresses gender and number properties of two arguments: a masculine, singular subject and a feminine object. Taken with the absence of productive noun incorporation (also unlike Mohawk), the Cherokee verb systematically expresses features of fewer arguments than many other polysynthetic languages.

- (17) **Shako**-nuhwe’-s (ne owira’a)
MS.SG.SUB/F.OBJ-like-HAB NE baby
 ‘He likes them (babies)’
 (Baker 1996:21)

We have seen in this section that in a number of contexts, Cherokee does not show *surface* polypersonal agreement; features of many third-person arguments are not visibly expressed on a morpheme. Nonetheless, in situations where such arguments are not visibly coindexed, the choice of pronominal prefix is determined by relative properties of both arguments (local vs. nonlocal status, animacy, thematic prominence). This type of pattern supports a formal model in which the grammatical module that generates inflectional morphology must have access to features of more than one syntactic argument, even if those features are not always visibly expounded due to language-specific morphological rules. This characterizes Scancarrelli’s (1987) analysis of Cherokee inflectional morphology within the realizational Extended Word and Paradigm model of Anderson (1997, 1982, et seq.). In terms of contemporary Minimalism, the Cherokee pattern may be analyzed as arising from Multiple Agree in the syntactic representation, subject to post-syntactic rules that lead to the non-exponence of some argument features (Oxford 2019).

3 Quantitative Analysis

3.1 Overview of the corpus

We investigate whether this reduced number of visible argument features on verbs in Cherokee results in a distinct structural representation of NPs in the clause, or whether abstract agreement with multiple arguments is sufficient to maintain word order flexibility. Using a quantitative analysis of a corpus, we examine whether NPs whose features are not visibly coindexed by a verb prefix are subject to distinct or more rigid ordering restrictions than NPs whose features are coindexed by a verb prefix.

We adopt much of our methodology from the corpus study of Hsu & Frey (2024), and build on several of its key findings, which we briefly present here. All non-pronominal thematic argument NPs in their corpus are tagged for a range of observable grammatical properties. Each NP is also tagged for two word order values: whether it precedes its verb (*preverbal*) or follows it (*postverbal*). For our study, we focus on two word order factors that they find to be significant predictors of NP placement preferences: their thematic role and their referential accessibility (the listener’s assumed ability to identify the referent of an expression: Prince 1981). In brief, NPs corresponding to prominent thematic arguments (e.g. agents) are more likely to precede verbs than NPs that are less prominent thematic arguments (e.g. themes).² NPs that refer to discourse-new entities are more likely to precede verbs than those that refer to discourse-given entities. The cumulative interaction of these factors is shown in the table below for one set of features, in clauses with one NP.

	NP is agent	NP is theme
NP is new information	93% preverbal (13/14)	77% preverbal (43/56)
NP is given information	74% preverbal (32/43)	44% preverbal (44/100)

Table 1: Probability of preverbal placement of NP, by select thematic role and referential accessibility values (Hsu & Frey 2024:Table 11).

For the quantitative analysis presented in this paper, we expanded the set of annotated properties in their corpus file by additionally tagging each thematic argument NP according to whether its features are coindexed by the pronominal prefix on its associated verb. We did not count the distributive pre-pronominal prefix *d(e)-* as an unambiguous marker of coindexation, as it is sometimes conditioned by distinct factors (see Section 3.3). We investigate whether NPs of transitive verbs that are coindexed by a prefix show distinct word order effects from NPs that are not coindexed, while controlling for the factors found by Hsu & Frey to condition word order (the referential accessibility

²While the full inventory of thematic roles is much larger, and additional contrasts could be detectable in a larger corpus, the agent vs. theme contrast the only one to show statistical significance in Hsu & Frey (2024).

and thematic roles of NPs). We restrict our attention to whether overt coindexation on a pronominal prefix influences the placement of NP arguments of transitive verbs. NP arguments of intransitive verbs are not included in the sample, since features of a sole argument are always coindexed on a pronominal prefix.

If non-coindexed argument NPs were to show the same word order patterns as coindexed NPs (in terms of their propensity for preverbal vs. postverbal NP placement), it would suggest that all arguments are represented in the same type of structural configuration. This would be predicted if Abstract Polypersonal Agreement is sufficient to satisfy the Morphological Visibility Condition. If non-coindexed argument NPs were to show distinct ordering properties, it would suggest that overt agreement is required for an NP to be dislocated, as predicted if Surface Polypersonal Agreement is needed to satisfy the Morphological Visibility Condition.

To control for possible confounding factors, all of the crucial quantitative comparisons below are made while restricting the sample to one category of a potential confounding property. The variables that we consider as possible confounding factors include nominal properties known from prior literature to condition either NP placement preferences, verbal agreement morphology (i.e. the choice of prefix form), or both. Specifically, this includes thematic role contrasts (which influence word order preference and determine prefix forms), referential accessibility contrasts (which influence only word order preferences), and noun animacy contrasts (which influences only prefix forms).

3.2 Results

We first consider the thematic role of argument NPs as a control variable. Figure 1 presents the percentage of agent argument NPs and theme argument NPs that are coindexed by a pronominal prefix on their selecting verb. 76% (37/49) of agent NPs are indexed by the pronominal prefix, while only 12% (17/139) of theme NPs are coindexed. This difference is statistically significant ($\chi^2 = 67.803$, $df = 1$, $p = 2.2e-16$), and consistent with the expectation that the more thematically prominent argument is typically coindexed when arguments are of equal animacy.

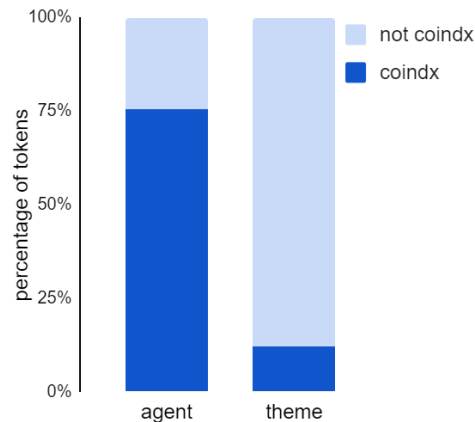


Figure 1: Percentage of coindexed vs. non-coindexed arguments, agent and theme NPs.

Agent NPs in Cherokee are observed by Hsu & Frey (2024) to show a greater tendency to precede verbs than theme NPs. To control for the independent effect of this on NP placement, we examine the placement of coindexed and non-coindexed NPs of the same thematic role. Figure 2 shows the placement of theme argument NPs, depending on whether they are overtly coindexed. Coindexed and non-coindexed NPs occur on either side of the verb with roughly equal frequency. Among themes, 71% (12/17) of coindexed arguments are preverbal, while 64% (79/122) of non-coindexed arguments are preverbal. This difference is not statistically significant ($\chi^2 = 0.040695$, $df = 1$, $p = 0.8401$). Coindexing also has no statistically significant effect on the placement of agent NPs ($\chi^2 = 1.605$, $df = 1$, $p = 0.2052$; not graphed here).

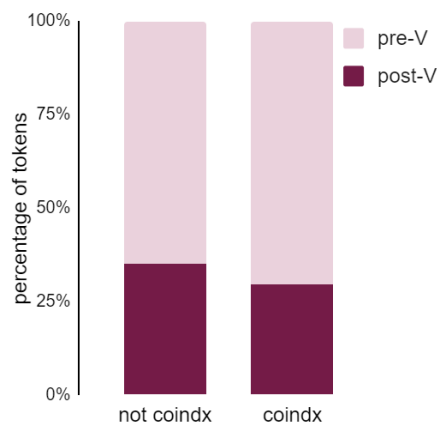


Figure 2: Percentage of preverbal vs. postverbal placement of theme NPs, by coindexation status.

Although animacy is not found by Hsu & Frey (2024) to be an independent factor affecting the preferred placement of an NP, we use it as a second control variable, given its important role in determining whether an argument is coindexed. As shown in Figure 3, 59% (39/66) of NPs referring to humans are indexed by the pronominal prefix, 49% (35/71) of NPs referring to non-human animate beings are coindexed, and 3% (5/153) of NPs referring to inanimate entities are coindexed. This is consistent with the expectation that the more animate argument of a transitive verb is preferentially coindexed. This distinction is also statistically significant ($\chi^2 = 170.01$, $df = 2$, $p < 2.2e-16$).

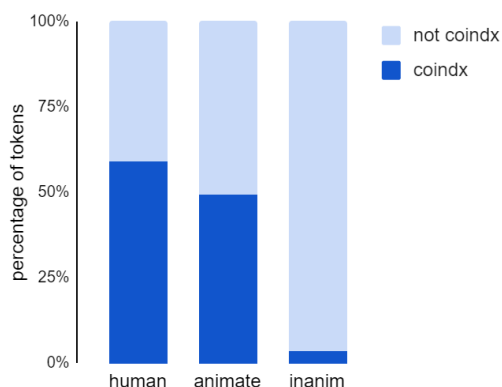


Figure 3: Percentage of coindexed vs. non-coindexed argument, by animacy.

Figure 4 shows the placement of animate NPs depending on whether they are coindexed. Among non-human animate NPs, 58% (21/36) of coindexed arguments are preverbal, while 63% (22/35) of non-coindexed arguments are preverbal. This difference is not statistically significant ($\chi^2 = 0.021634$, $df = 1$, $p = 0.8831$). This holds true for both human NPs ($\chi^2 = 4.5427e-31$, $df = 1$, $p = 1$) and inanimate NPs ($\chi^2 = 1.4481$, $df = 1$, $p = 0.2288$; not graphed here). Thus, when controlling for the factors that significantly affect coindexation of the NP argument, we see that there is no significant effect of coindexation on NP position to the verb.

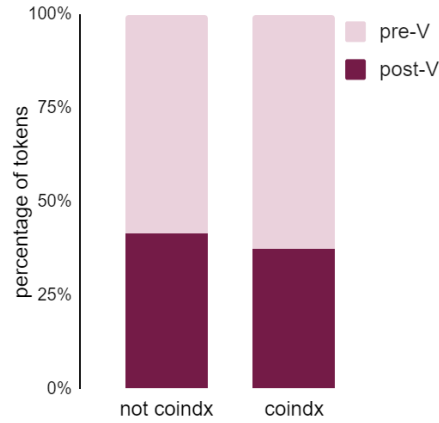


Figure 4: Percentage of preverbal vs. postverbal placement of animate NPs, by coindexation status.

We examine referential accessibility as the final control variable. Like thematic role, referential accessibility contrasts are significant predictors of word order preference; discourse-new NPs are likelier to be preverbal than discourse-given NPs (Hsu & Frey 2024). However, we do not expect the discourse status of an argument to directly influence whether it is coindexed. This is borne out in our sample. 31% (50/162) of discourse-given NPs are indexed by the pronominal prefix, while 25% (20/79) of discourse-new NPs are coindexed. The difference is not statistically significant ($\chi^2 = 0.5467$, $df = 1$, $p = 0.4597$).

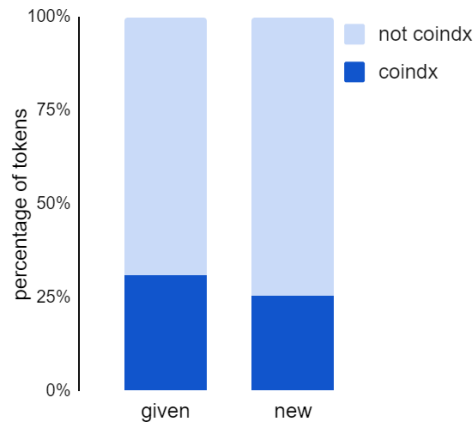


Figure 5: Percentage of coindexed vs. non-coindexed argument, new and given NPs.

As shown in Figure 6, among given-information NPs, 60% (30/50) of coindexed arguments are preverbal, while 58% (65/112) of non-coindexed arguments are preverbal. There is again no significant effect of coindexation on NP position for discourse-given NPs ($\chi^2 = 0.0038223$, $df = 1$, $p = 0.9507$), and the same follows for discourse new NP's ($\chi^2 = 1.6101$, $df = 1$, $p = 0.2045$; not graphed here).

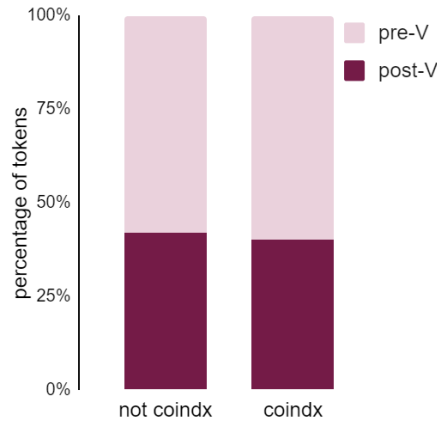


Figure 6: Percentage of preverbal vs. postverbal placement of discourse-given NPs, by coindexation status.

In sum, we have found no evidence that the visible coindexation of an NP argument on a transitive verb has an effect on its preferred placement relative to the verb, while controlling for grammatical properties known to influence NP placement (thematic role, referential accessibility) and agreement morphology (thematic role, animacy). While we cannot claim to have exhaustively examined all possible confounds, our findings are uniformly consistent with the claim that all argument NPs, regardless of whether they are visibly coindexed, have the same structural representation in the clause (i.e. dislocated constituents that can be freely ordered).

4 Implications & Conclusions

Despite the relatively small number of NPs coindexed via verbal morphology, Cherokee does not show less word order freedom than other polysynthetic languages. Within the framework of Baker (1996), these findings provide further evidence that the Morphological Visibility Condition can be satisfied as long as there is sufficient evidence that a verbal agreement system makes reference to properties of multiple arguments, even when a significant number of argument features are not overtly expressed. An interpretation of this in Minimalist terms is that obligatory Multiple Agree between verbs and their arguments in the syntactic representation gives rise to the systematic dislocation of non-pronominal arguments, even if a number of argument features obtained via Agreement have no phonological exponents in the language.

Although our results provide new evidence to support the notion that the Morphological Visibility Condition can be satisfied by abstract polypersonal agreement, the precise threshold of overt argument coindexation needed for learners to acquire and maintain such a system remains to be discovered. It may also turn out that not all aspects of nonconfigurationality depend on the same criteria of morphological visibility, in line with previous critiques of macroparametric conceptions to polysynthesis (Legate 2002, Adger et al. 2009, Mithun 2017). Nonetheless, we suggest that the type of quantitative analysis that we have used can provide a useful tool for studying the relation between visible argument coindexation and word order preferences, particularly when the latter are probabilistic in nature. Generally, we invite more quantitative analyses of word order predictors in polysynthetic languages and/or languages with flexible clausal word order.

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