Fixing LFG to Account for Direct-Inverse Agreement: The Case of Plains Cree

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Proceedings of the LFG'17 Conference

University of Konstanz

Miriam Butt, Tracy Holloway King (Editors)

2017

CSLI Publications

pages 24–44

http://csli-publications.stanford.edu/LFG/2017

Keywords: Plains Cree, direct-inverse agreement, Optimality Theory, person agreement

Alsina, Alex, & Vigo, Eugenio M. (2017). Fixing LFG to Account for Direct-Inverse Agreement: The Case of Plains Cree. In Butt, Miriam, & King, Tracy Holloway (Eds.): *Proceedings of the LFG'17 Conference, University of Konstanz* (pp. 24–44). Stanford, CA: CSLI Publications.

Abstract

The goal of this paper is to explain verbal agreement in Plains Cree (Algonquian), in which verb forms always agree with the most prominent argument with respect to person and other referential features, but adopt either direct or inverse morphology depending on which is the GF of the most prominent. Following Alsina & Vigo (2014), we adopt the AGR(EEMENT) bundle to represent person and other agreement features. We claim that direct agreement is an instance of subject agreement in this person-governed agreement system and that inverse agreement is an instance of object agreement. The complex facts of inflectional verbal morphology in Plains Cree argue for an approach to morphology in which inflectional affixes are the realization of the information found in the word-level f-structure.

1 Introduction

Our goal is to explain verbal agreement in a language with direct-inverse morphology, namely, a language in which morphology signals whether the verb agrees with its agent-like argument (direct) or its patient-like argument (inverse). For this, we have chosen Plains Cree (Algonquian) as the object of our analysis, which is proposed within an OT-LFG framework based on previous work of ours (Alsina & Vigo, 2014; Vigo, 2016), inspired by the works of Bresnan (2000) and Kuhn (2003). This choice is motivated because of the morphological complexity of the language and because there is evidence that direct-inverse morphology does not imply a change in the mapping of GFs to thematic roles in this language.

Our claim is that verbal agreement in Plains Cree provides further evidence for the need for AGR as the feature bundle that represents agreement features in a clause, as in Alsina & Vigo (2014, 2017). Under our analysis, Plains Cree direct forms signal subject-verb agreement, whereas inverse forms signal object-verb agreement. We assume a major division in agreement systems between case-governed systems and person-governed systems. In case-governed agreement systems the agreement trigger is required to be in a specific case (normally, the nominative), regardless of the GF that bears that case. Person-governed agreement systems choose the agreement trigger so that it is always the GF in the sentence that shows the most prominent person features. Both systems only differ in how agreement constraints are ranked in each one. This motivates the use of OT within a broader discussion of agreements systems.

Another claim of this paper is that verbal agreement in Plains Cree provides evidence that inflectional morphology is best analyzed as the realization of syntactic features rather than as the source of syntactic features. This implies a departure from the morpheme-based approach to morphology.

[†]The research presented in this paper is supported by research project *Highest Argument Agreement* (HAA), FFI2014-56735-P (Spanish Ministry of Economy and Competitiveness). We gratefully acknowledge the comments of two anonymous reviewers.

This paper is organized as follows. In section (2) we present what we mean by direct-inverse agreement. This concept requires further discussion before moving forward to section (3), where the syntax of Plains Cree verbal agreement is analyzed. There we provide the discussion on how AGR, in conjunction with the constraints proposed, predicts Plains Cree data. In section (4) we discuss the morphology of Plains Cree in order to explain why some forms, although syntactically expected to be possible, are ungrammatical. There we explain our proposal on how to treat inflectional morphology. Finally in the last section we provide a summary of our conclusions and claims.

2 The polysemy of the term *direct-inverse morphology*

Languages that are claimed to have direct-inverse morphology do not have a uniform analysis regarding the role or function (or syntactico-semantic correlate) of this morphology. In what follows, we show that there are two types of languages with direct-inverse morphology (subsection 2.1) and which type Plains Cree belongs to (subsection 2.2).

2.1 Two types of languages with direct-inverse morphology

In one type of language, direct-inverse morphology signals a difference in the GF-argument alignment that is sensitive to the referential features of the arguments involved. In the direct form, the most prominent argument at argument structure (a-structure)—the most agentive argument, or A, for simplicity—maps onto the subject, provided it is also the most prominent argument at the referential level (MAX); this is the argument that agrees with the verb. In the inverse form, what changes is that it is not the most prominent argument at a-structure that maps onto the subject, but a non-agentive—or P—argument, which is the most prominent argument at the referential level.

This type of language is illustrated by Mapudungun according to the analysis of Arnold (1997). We can refer to the direct-inverse morphology in this type of language as *role-inverting direction morphology*. The diagram in Figure 1 shows a schema of how a-structure maps to each level of information in both forms.

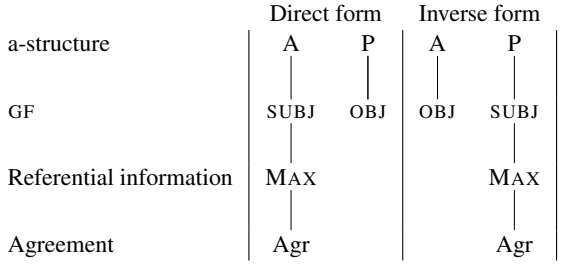

Figure 1: Mapping relations in Mapudungun (role-inverting direction morphology)

The second type of language is illustrated by Plains Cree following Dahlstrom (2014). We can refer to it as *agreement-inverting direction morphology*. The diagram in Figure 2 illustrates the mapping from a-structure to the rest of information levels.

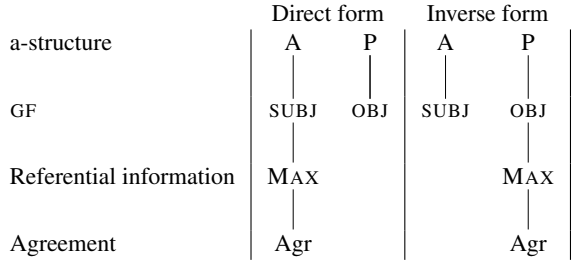

Figure 2: Mapping relations in Plains Cree (agreement-inverting direction morphology)

What is common to both types of languages with direct-inverse morphology is that agreement is with the MAX argument (maximally prominent at the referential level). They differ in that in languages with role-inverting direction morphology, the SUBJ is always assigned to the MAX argument, with the SUBJ mapping either to the A argument (direct) or to the P argument (inverse), and, in languages with agreement-inverting direction morphology, the SUBJ function is always assigned to the A argument (and the OBJ to the P), with agreement going with either the SUBJ or the OBJ depending on which is the MAX.

2.2 Arguments for an agreement-inversion analysis

In the remainder of this section we summarize the arguments in Dahlstrom (2014) in favor of the claim that direction morphology in Plains Cree does not affect the argument-GF mapping, but instead signals whether the agreeing GF is the SUBJ (direct) or the OBJ (inverse), i.e. as schematized in Figure 2.

As shown by Dahlstrom (2014), in Plains Cree there is a copy-to-object construction in which the main verb has an object which agrees in features with the subject of the embedded verb. This provides a test for the subjecthood of the embedded clause and another test for the objecthood of the matrix clause. Dahlstrom (2014) uses this construction as a means to prove that in Plains Cree the agent is the subject and the patient is the object, regardless whether the sentence is direct or inverse. Consider, for example, this case:

(1) nikiske:yima:w John e:kiwa:pamisk
know.dir.1→3 *John see*.perf.inv.3→2
'I know John saw you'

In (1) *John* is the patient of the matrix clause and the agent of the embedded clause. The copy-to-object construction requires *John* to be the object of the main

clause and the controller of the subject of the embedded clause. The fact that in the embedded clause inverse morphology is found does not prevent this, so it does not entail a realignment of the argument-to-GF mapping: *John* is the subject of the embedded clause.

The same construction also shows that the main clause patient is the object regardless of the direct or inverse morphology. Dahlstrom (2014) shows this with example (2); the subject of the embedded clause is controlled by the object of the main clause (a null pronoun) in spite of the inverse morphology (the distinction between proximate and obviative is explained later):

(2) namoya kiske:yimik o:hta:wiya e:sipwe:hte:t
not *know*.inv.obv→3 *his.father*.obv *leave*.3
'His father.OBV did not know that he.PROX had gone off'

There is a third test involving floating quantifiers, which are always oriented to the object; the argument targeted by the quantifiers does not change depending on whether the verb has direct or inverse morphology. The three tests show that direct-inverse morphology in Plains Cree is of the agreement-inverting type, and not of the role-inverting type. Therefore, the agent is always the subject of direct and inverse sentences in Plains Cree and the patient is always the object.

3 The syntax of verbal agreement in Plains Cree

Our analysis is restricted to Transitive Animate (TA) verbs in Plains Cree, i.e. verbs whose object is an animate entity. Intransitive verbs, both Animate and Inanimate, are not relevant to this paper, as they show agreement with their only argument. Transitive Inanimate verbs—those with an inanimate entity as their object—are subject to other rules that are not discussed here (see Dahlstrom, 2014). We also restrict our attention to forms in the *independent order*, roughly equivalent to the indicative mood in European languages.

TA verbs in Plains Cree are formed by a prefix that expresses person information, the stem, a *direction* suffix that signals whether the form is direct or inverse, and finally a suffix that expresses person and other referential information. The following examples illustrate this (Dahlstrom, 2014):

(3) a. ni- wa:pam -a: -na:n
1 *see* DIR 1.pl.excl
'We.EXCL see him'

b. ni- wa:pam -iko -na:n
1 *see* INV 1.pl.excl
'He sees us.EXCL'

The data in (3) shows that the person prefix *ni-* and the person-number suffix *-na:n* are used in both the direct and the inverse forms (note that in these examples

there is no affix signalling the 3rd person; see section 4 for the explanation of the distribution of affixes). In (3a) both refer to the subject of the sentence, whereas in (3b) the very same affixes refer to the object of the sentence. This situation shows that affixes in Plains Cree do not refer to a specific GF: the same affix can be used for either of the two core GFs (SUBJ and OBJ).

The affixes that are different between (3a) and (3b) are the direction affixes. The direct suffix signals that the SUBJ is more prominent than the OBJ in terms of referential features, where a 1st person plural, as a speech act participant (SAP), is more prominent than a 3rd person. The inverse suffix signals exactly the opposite: that the SUBJ is less prominent than the OBJ at the referential level.

Another aspect that must also be taken into account is that sometimes forms only express the features of only one GF, as in (3). In other occasions, the person prefix refers to one of the two core GFs while the person-number suffix refers to the other core GF, as explained in section 4. This is what we find in the paradigm that follows (from Dahlstrom, 2014), where the prefix is 2nd person and the person-number suffix is 3rd person:

(4) a. ki- se:kih -a: -w
2 *frighten* DIR 3.sg
'You.SG frighten him'

b. ki- se:kih -ikw -w
2 *frighten* INV 3.sg
'He frightens you.SG'

As we observed in (3), in paradigm (4) we find that the same affixes are associated to a different core GF depending on whether the construction is direct or inverse. The data in (4) also shows that the actual information of each GF is just partially provided by the morphology: notice that there is no explicit information signalling that the 2nd person is actually singular. The reason why it is singular is that if it was plural, *-w* would be excluded in favor of *-wa:w*, leaving the 3rd person GF morphologically unexpressed. The details on how this comes to be possible are discussed later in section 4.

The fact that affixes are not attributed to any GF, but express the features of one or another depending on the whole structure, is an argument for the claim that the AGR feature structure represents the agreement features of both the clause and its dependent GFs. AGR is a construct that resembles the INDEX feature in HPSG (Pollard & Sag, 1994) in that it groups under one single feature bundle the various features of GFs that are used in agreement, such as person, number, and gender (see also King & Dalrymple, 2004). However, our AGR also has the role of the AGR feature proposed by Kathol (1999) in HPSG and Haug & Nikitina (2012) in LFG, namely, to also represent the features of the clause (typically morphologically signalled by the verb). Our formalization of this construct is used in Alsina & Vigo (2014) and in Vigo (2016) for the facts of copular inversion in Romance languages.

As a first rule, we state that the AGR features of the clause must match those of an argument of the clause. This is captured by the OT constraint AGRSHARE, which has been argued to be necessary for the analysis of other languages (e.g. Icelandic, English; see Alsina & Vigo, 2014, 2017):

(5) AGRSHARE:
For an f-structure f that maps to a category V^0:
$$\begin{bmatrix} \text{AGR} & \boxed{1} \\ \text{GF} & \begin{bmatrix} \text{AGR} & \boxed{1} \end{bmatrix} \end{bmatrix}_f$$

All principles that refer to AGR in this paper refer to f-structures that map to a verb in the c-structure. For convenience, we refer to the GF where AGR unifies with AGR of the verbal GF (i.e. the GF in AGRSHARE) with the label GF_{AGR}.

As we are working within OT, this principle and all other principles that are presented in this work may be violated. In fact, the only conditions that we do not accept to be violable are the well-formedness conditions that define the concept of an f-structure, namely: Consistency, Completeness, and Coherence. In other languages, AGRSHARE may be violated by grammatical structures, resulting in structures that show no agreement (see Alsina & Vigo, 2017). However, lack of agreement is not found in Plains Cree, so we assume that AGRSHARE is always satisfied in the language. Therefore, we are not including this constraint in the OT tableaux that we provide in the discussion of the data that follows.

In section 1, we stated that we divide languages in two major groups regarding agreement: those in which agreement is governed by case and those in which agreement is governed by person features. In case-governed agreement systems, a high-ranking constraint bars AGR from unifying with any GF that has a case feature that is not the default case, usually the nominative or absolutive (i.e. *AGRCASE in Alsina & Vigo, 2017). Person-governed agreement systems, on the other hand, have a high-ranking constraint that must be satisfied by unifying the clausal AGR with the AGR of a GF that has a value for person that is prominent, usually an SAP argument. Plains Cree belongs to this latter group, in which AGRPERS is the relevant constraint:[1]

(6) AGRPERS:
$$\begin{bmatrix} \text{AGR} & \begin{bmatrix} \text{PERS1} & + \end{bmatrix} \vee \begin{bmatrix} \text{PERS2} & + \end{bmatrix} \end{bmatrix}$$

A word must be said about how person features work in Plains Cree before moving on, so that the formalization of AGRPERS above is correctly understood. In Plains Cree, it is best to represent person as a set of two boolean features PERS1 and PERS2, which represent whether the GF refers to the speaker (PERS1) or to the addressee (PERS2). We need this because the 1st person plural inclusive in

[1] AGRPERS has also been posited for the analysis of agreement facts in languages like Spanish and Catalan (Alsina & Vigo, 2014; Vigo, 2016), and Dargwa Belyaev (2013).

Plains Cree works in some ways as if it was a 2nd person plural in the morphology, as discussed in section 4. The combinations of all possible values for PERS1 and PERS2 gives this set of representations for each possible person:

(7) a. 1st excl.: $\begin{bmatrix} \text{PERS1} & + \\ \text{PERS2} & - \end{bmatrix}$

b. 1st incl.: $\begin{bmatrix} \text{PERS1} & + \\ \text{PERS2} & + \end{bmatrix}$

c. 2nd: $\begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & + \end{bmatrix}$

d. 3rd: $\begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \end{bmatrix}$

Number, on the other hand, is represented as usual making use of NUM.

Let us analyze a case of direct agreement like (8). The two most relevant candidates are represented by their respective f-structures shown in Figures 3 (GF_{AGR} = SUBJ) and 4 (GF_{AGR} = OBJ). Following Kuhn (2003) and Vigo (2016), candidates always have the same meaning, which is defined by the OT input. In this paper we only discuss the candidates that are differentiated by the GF whose AGR is shared with that of the clause.

(8) ki- se:kih -a: -w
2 *frighten* DIR 3
'You.SG frighten him'

$$\begin{bmatrix} \text{PRED} & \text{`}\textit{frighten}\ \langle\ \text{arg}_1\ \text{arg}_2\ \rangle\text{'} \\ \text{AGR} & \boxed{1} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \boxed{1}\begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & + \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}_1 \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}_2 \end{bmatrix}$$

Figure 3: SUBJ-agreeing candidate

$$\begin{bmatrix} \text{PRED} & \text{`}\textit{frighten}\ \langle\ \text{arg}_1\ \text{arg}_2\ \rangle\text{'} \\ \text{AGR} & \boxed{1} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & + \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}_1 \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \boxed{1}\begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}_2 \end{bmatrix}$$

Figure 4: OBJ-agreeing candidate

The subject-agreeing candidate is chosen, as it satisfies AGRPERS due to the PERS2 feature of the subject being +. The object-agreeing candidate violates this constraint.

The inverse counterpart of (8) is shown in (9). The candidates are those in Figures 5 and 6 but the optimization gives the opposite result, namely that the optimal candidate is in this case the one in which GF_{AGR} = OBJ. The object-agreeing candidate satisfies AGRPERS, whereas the subject-agreeing candidate does not.

(9) ki- se:kih -ikw -w
2 *frighten* INV 3.sg
'He frightens you.SG'

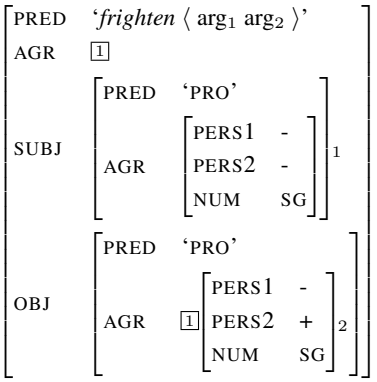

Figure 5: OBJ-agreeing candidate

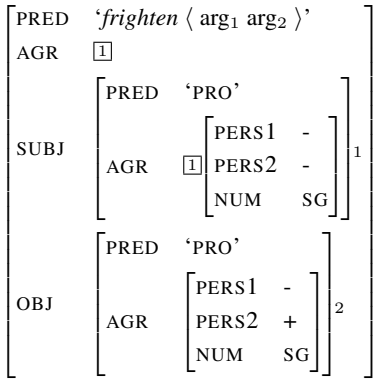

Figure 6: SUBJ-agreeing candidate

The conclusion that we draw here is that direct agreement is subject agreement and inverse agreement is object agreement.

The data that we have analyzed so far are cases of what is called in typological studies as *mixed scenarios* (Jacques & Antonov, 2014), i.e. sentences in which one of the core GFs is an SAP and the other one is not (a 3rd person). However, in our current state of affairs, our set of contraints assumes that 1st and 2nd persons rank equally for purposes of agreement (notice the logical disjunction in the definition of AGRPERS). Languages vary with respect to which of the two SAP arguments triggers verbal agreement in *local scenarios* (i.e. sentences in which both core GFs are SAPs). In some languages, SUBJ is invariably chosen (Chirag Dargwa: Belyaev, 2013). In other languages, the 1st person is always chosen as the agreement trigger (Nocte: Thompson, 1994; Japhug Rgyalrong: Jacques, 2010; Wobzi Lavrung: Lai, 2015). In yet other languages, the second person is always chosen as the agreement trigger (many Algonquian languages; Khaling Kiranti: Jacques & Antonov, 2014; Zúñiga, 2006). Plains Cree, as an Algonquian language, belongs to this latter group.

An example like (10a) includes the suffix *-iti*, which is assumed to be the inverse suffix specialized for local scenarios (LINV).

(10) a. ki- se:kih -iti -n
2 *frighten* LINV 1/2
'I frighten you.SG'

b. ki- se:kih -i -n
2 *frighten* LDIR 1/2
'You.SG frighten me'

A case like (10a) has two candidates, one in which GF_{AGR} = SUBJ, and another one in which GF_{AGR} = OBJ. Both candidates satisfy AGRPERS because both core GFs are SAPs. In order to capture why (10a) is an inverse sentence, we need a constraint like AGRPERS2, as defined below, which ranks equally to AGRPERS as there is no way to independently determine their relative ranking.

(11) AGRPERS2:
$$\begin{bmatrix} \text{AGR} & \begin{bmatrix} \text{PERS2} & + \end{bmatrix} \end{bmatrix}$$

Including AGRPERS2 into the picture allows us to analyze (10a) as an inverse sentence, i.e. GF_{AGR} = OBJ, as indicated in Tableau 1.

	AGRPERS	AGRPERS2
☞ GF_{AGR} = OBJ		
GF_{AGR} = SUBJ		*!

Tableau 1: Optimization for (10a)

Case (10b) is an instance of direct agreement, precisely because of the same reason. The candidate in which GF_{AGR} = SUBJ is chosen because the optimal candidate as the subject is the 2nd person.

The third possible scenario is the so-called *non-local scenario*, i.e. sentences in which both core GFs are 3rd persons. In Algonquian languages, 3rd persons are divided into two distinct forms: the proximate and obviative. In non-local scenarios only one of the arguments may be singled out as the proximate argument, which corresponds to the protagonist of the discourse. 3rd persons that are not the proximate are obviative. With respect to agreement, the proximate ranks higher than the obviative, so it is the former that always gets to be the agreement trigger.[2] The data in (12) illustrate these claims:

(12) a. se:kih -e: -w
3.*frighten* DIR 3
'He.PROX frightens him.OBV'

[2]However, there are cases in which the sentence has no proximate argument, as some modifiers (e.g. 3rd person possessives) require the NP to be obviative regardless of its discursive status; when this happens, the direct form is usually found. (Dahlstrom, 2014; Jacques & Antonov, 2014; Zúñiga, 2006, 2008). Dahlstrom (2014) states that sentences in which both GFs are obviative and take the inverse are possible, but are "very rare". Zúñiga (2006, 2008) only cites direct forms for sentences in which both GFs are obviative.

b. se:kih -ikw -w
3.*frighten* INV 3
'He.OBV frightens him.PROX'

In order to cover these cases, we need a new constraint that bars agreement with an AGR that is obviative *AGROBV. It also ranks equally to AGRPERS and AGRPERS2, as there is no way to independently determine their relative ranking.

(13) *AGROBV:

$$*\begin{bmatrix} \text{AGR} & \begin{bmatrix} \text{OBV} & + \end{bmatrix} \end{bmatrix}$$

The OBV feature is only available for 3rd persons. Therefore, *AGROBV is only relevant in non-local scenarios; SAP arguments, lacking the feature, trivially satisfy it.

For the direct case (14), the candidate f-structures are those shown in Figures 7 (GF_{AGR} = SUBJ) and 8 (GF_{AGR} = OBJ).

(14) se:kih -e: -w
3.*frighten* DIR 3.sg
'He.PROX frightens him.OBV'

$$\begin{bmatrix} \text{PRED} & \text{`}\textit{frighten}\ \langle\ \text{arg}_1\ \text{arg}_2\ \rangle\text{'} \\ \text{AGR} & \boxed{1} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \boxed{1}\begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \\ \text{OBV} & - \end{bmatrix} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \\ \text{OBV} & + \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 7: SUBJ-agreeing candidate

$$\begin{bmatrix} \text{PRED} & \text{`}\textit{frighten}\ \langle\ \text{arg}_1\ \text{arg}_2\ \rangle\text{'} \\ \text{AGR} & \boxed{1} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \\ \text{OBV} & - \end{bmatrix} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \boxed{1}\begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \\ \text{OBV} & + \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 8: OBJ-agreeing candidate

The optimization is shown in Tableau 2 below.

	AGRPERS	AGRPERS2	*AGROBV
☞ GF_{AGR} = SUBJ	*	*	
GF_{AGR} = OBJ	*	*	*!

Tableau 2: Optimization for (14)

As expected, the optimal candidate is the one in which GF_{AGR} is the proximate subject, as the sentence is a direct sentence. Both candidates violate AGRPERS and

AGRPERS2, as is expected in a non-local scenario where no SAPs are found. The object-agreeing candidate is discarded due to the violation of *AGROBV.

For the non-local inverse form (15), the candidates are given in Figures 9 and 10. The optimization chooses the candidate in which GF_{AGR} = OBJ candidate as the other candidate (GF_{AGR} = SUBJ) violates *AGROBV. Therefore, inverse agreement is satisfactorily predicted. Tableau 3 illustrates this.

(15) se:kih -ikw -w
3.*frighten* INV 3
'He.OBV frightens him.PROX'

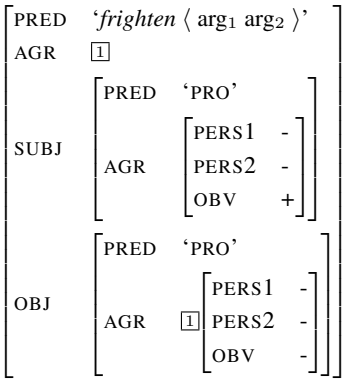

Figure 9: OBJ-agreeing candidate

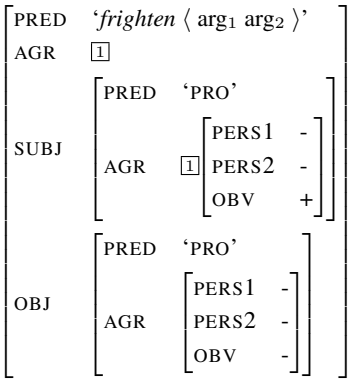

Figure 10: SUBJ-agreeing candidate

	AGRPERS	AGRPERS2	*AGROBV
☞ GF_{AGR} = OBJ	*	*	
GF_{AGR} = SUBJ	*	*	*!

Tableau 3: Optimization for (15)

In summary, we analyze direct agreement as subject agreement andinverse agreement as object agreement in Plains Cree. The correct form is determined by the OT constraints that we propose, so that the agreement trigger is always the SAP argument against any 3rd person argument, the 2nd person against any 1st person, and the proximate against the obviative among 3rd persons, regardless of the GFs involved.

4 The morphology of verbal agreement in Plains Cree

The syntactic analysis proposed in section 3 is not sufficient to give a complete picture of verbal agreement in Plains Cree. Otherwise, we would expect (16) to be

grammatical because its optimal f-structure is perfectly well-formed, as shown in Figure 11 (the candidate where GF_{AGR} = OBJ is discarded by AGRPERS).

(16) * ni- se:kih -a: -w
1 *frighten* DIR 3.sg
'We.EXCL/I frighten him'

$$\begin{bmatrix} \text{PRED} & \text{`}\textit{frighten}\ \langle\ \text{arg}_1\ \text{arg}_2\ \rangle\text{'} \\ \text{AGR} & \boxed{1} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \boxed{1}\begin{bmatrix} \text{PERS1} & + \\ \text{PERS2} & - \end{bmatrix} \end{bmatrix}_1 \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{AGR} & \begin{bmatrix} \text{PERS1} & - \\ \text{PERS2} & - \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}_2 \end{bmatrix}$$

Figure 11: Apparent f-structure of (16)

We would expect (16) to be grammatical, as *ni-* is a prefix expressing the 1st person singular or plural exclusive and *-w* a suffix expressing the 3rd person. The meaning of (16) should be the one provided above, given the presence of the direct suffix *-a:*.

The reason for the ungrammaticality of (16) is purely morphological. The distribution of inflectional affixes for TA verbs in Plains Cree can be described by reference to ordered lists—one for the person prefixes, another one for the direction suffixes, and another one for the person-number suffixes—according to which an affix is chosen from each list following a preference order. An affix higher in the list prevents the appearence of any that is lower. Figure 12 gives the person prefixes and person-number suffixes as ordered lists, based on Zúñiga (2008).[3]

PERSON PREFIXES	PERSON-NUMBER SUFFIXES
k(i)- '2nd sg./pl., 1st pl. incl.'	*-na:n* '1st pl. excl.'
n(i)- '1st sg, 1st pl. excl.'	*-naw* '1st pl. incl.'
	-wa:w '2nd pl.'
	-w '3rd sg.'
	-n '1st/2nd sg.'

Figure 12: Table based on Zúñiga (2008)

[3] As noted by a reviewer, the *o(t)-* 3rd person prefix that Zúñiga (2008) cites for sentences in the past tense is an archaic form that is no longer in use in normal speech. See the matrix verb form in (2) where both subject and object are 3rd person, and there is no prefix on the verb.

These facts are difficult to explain under a morpheme-based approach towards morphology, by which affixes are represented by lexical items akin to roots that provide syntactic information such as features of GFs. Under such an approach, *-w* would not just determine that "some GF is 3rd singular", but "one GF is 3rd singular and none is either 1st inclusive, 1st exclusive, or 2nd person plural". This complicates the lexical entries of each affix enormously.

We therefore adopt a realizational approach to inflectional morphology: inflectional affixes are the realization of syntactic features present in the word form, adapting the views of authors like Anderson (1992); Sells (2004); Spencer (2004); Stump (2001). As further developed in Alsina & Vigo (forthcoming), word forms are words understood as syntactic units (Spencer, 2013). Each word form includes, among other things, a phonological representation and a syntactic representation in the form of an f-structure (the word-level f-structure). Our morphological rules, which apply internally to the word form, check for the well-formed mapping of the word-level f-structure onto the phonological representation of the word form, potentially a morphologically complex form. Contrary to morpheme-based versions of LFG (Bresnan, 2001; Dalrymple, 2001; Falk, 2001), we assume that inflectional affixes do not have lexical entries akin to those of lexemes. This means that these affixes do not carry f-structure information. Instead, inflectional morphology is licensed on the basis of information at the word-level f-structure.

Unlike proposals like those by Dalrymple (2015); Sadler & Nordlinger (2004), we do not make use of m-features to represent morphological information.[4] M-features are necessary only for theory-internal reasons in order to constrain the set of available lexical entries (i.e. our word forms) for a given lexeme. These lexical entries contain, along with other information, a set of functional descriptions in the form of the functional annotations standard in LFG. A drawback of this approach is that the information encoded by m-features is mostly redundant with the information encoded by the f-descriptions: see, for instance, the correspondence between m-features and f-descriptions found in Dalrymple (2015, p. 79). This approach results in the positing of two intermediate steps in the mapping of a lexeme to its word form, namely the m-entry and the description function that maps the m-features onto a set of f-descriptions. Our approach, in contrast, allows us to dispense with these two intermediate steps, greatly simplifying the morphological component.

As a means to illustrate how our morphological rules look like and are used, let us briefly show how they can be used for explaining the formation of a regular English plural like *books*. The following rule adds the suffix *-s* to the base (represented as $\sqrt{}$) of any plural noun.

(17) For a nominal f-structure:
$$\left[\text{AGR} \quad \left[\text{NUM} \quad \text{PL}\right]\right] \rightarrow [_N \sqrt{}]\text{-}s$$

[4] Other realizational approaches to morphology are found in the computational literature, such as Butt et al. (1999); Karttunen (2003).

The lexeme BOOK, whose phonological representation is the base, corresponds to two word forms whose word-level f-structures are specified for the feature NUM. For the plural word form, the addition of the suffix *-s* is licensed. If the condition of rule (17) is not met (i.e. the noun is singular), no suffix is licensed. This renders a default rule or zero-morpheme unnecessary to predict the singular.

Morphological rules are checked in order within a block of rules from the first to the last, such that rule n is only applied if $n - 1$ cannot be applied. If a rule succesfully maps the features in the word-level f-structure to the phonological representation of the word form, evaluation of further rules stops at that point. Blocks of rules are independent to each other.

Let us now specify the rules for the inflectional affixes in Plains Cree, starting with the discussion of person prefixes. The rules that license them are listed below in (18). We assume that prefixes are licensed by the features of the top-level AGR.

(18) BLOCK P

i. $\left[\text{AGR} \quad \left[\text{PERS2} \quad +\right]\right] \rightarrow$ *ki-*$[_V \sqrt{}\,]$

ii. $\left[\text{AGR} \quad \left[\text{PERS1} \quad +\right]\right] \rightarrow$ *ni-*$[_V \sqrt{}\,]$

Rule (18i) licenses *ki-* whenever the verbal AGR is $\left[\text{PERS2} \quad +\right]$. Rule (18ii) licenses *ni-* whenever the verbal AGR is $\left[\text{PERS1} \quad +\right]$. In instances in which both rules are applicable (1st person inclusive), rule (18i) takes precedence over (18ii), *ki-* is licensed. There is no rule for 3rd person, i.e. no prefix is licensed.

In addition to the person-number affixes, Plains Cree has a set of direction suffixes which indicate whether the verb is direct or inverse. Their distribution is as follows:

(19) *Local suffixes (Both arguments are SAPs):*

a. DIRECT: 1st pers. object: *-i*

b. INVERSE: 1st pers. subject: *-iti*

(20) *Non-local and mixed suffixes:*

a. DIRECT: SAP subject, 3rd pers. object: *-a:* (mixed scenarios)

b. DIRECT: 3rd pers. obv. object: *-e:* (non-local scenarios)

c. INVERSE: 3rd pers. subject, 3rd pers. proximate or SAP object: *-ikw/iko* (common to mixed and non-local scenarios)

Block (21) provides the morphological rules for the set of direction suffixes.

(21) BLOCK DRCTN

i. $\text{GF}_{\text{AGR}} = \text{SUBJ}, \left[\text{OBJ} \quad \left[\text{AGR} \quad \begin{bmatrix}\text{PERS1} & + \\ \text{PERS2} & -\end{bmatrix}\right]\right] \rightarrow [_V \sqrt{}]$*-i*

ii. $\text{GF}_{\text{AGR}} = \text{OBJ}, \left[\text{SUBJ} \left[\text{AGR} \begin{bmatrix}\text{PERS1} & + \\ \text{PERS2} & -\end{bmatrix}\right]\right] \rightarrow [_V \sqrt{}]$-*iti*

iii. $\text{GF}_{\text{AGR}} = \text{SUBJ}, \left[\text{SUBJ} \left[\text{AGR} \left[\text{PERS1} \quad +\right] \vee \left[\text{PERS2} \quad +\right]\right]\right] \rightarrow [_V \sqrt{}]$-*a:*

iv. $\text{GF}_{\text{AGR}} = \text{SUBJ} \rightarrow [_V \sqrt{}]$-*e:*

v. $\text{GF}_{\text{AGR}} = \text{OBJ} \rightarrow [_V \sqrt{}]$-*ikw*/-*iko*

This theory states that direct morphology is nothing but affixes that spell out that GF_{AGR} = SUBJ. Conversely, the affixes that spell out GF_{AGR} = OBJ constitute inverse morphology in this theory.

The rules for the local direct and local inverse suffixes rank at the top of the block, namely (21i) and (21ii), respectively. These rules check whether the AGR unifies with the AGR of SUBJ (direct agreement) or of OBJ (inverse agreement). In the case of (21i), if the sentence is indeed a case of direct agreement, then the only way that the second condition (the object being a 1st plural exclusive) is met if the subject is 2nd person. The same mechanism, but switched around, is used in (21ii): if the sentence is a case of inverse agreement, then the only way the subject may be a 1st plural exclusive is for the object to be a 2nd person. If none of the rules for local scenarios can be applied, then (21iii) checks whether there is direct agreement and whether the subject is an SAP; as the local scenarios have already been discarded, the object cannot be an SAP, so this rule is applied only for mixed scenarios. Rule (21iv) covers the only other direct agreement case left, i.e. direct non-local scenarios. Finally, (21v) covers both mixed and non-local scenarios, which are the only cases left uncovered by all other higher ranking rules in the block.

The third and last block of rules considered here corresponds to the person-number suffixes. These rules are stated as follows; CGF is just a shorthand notation for any "core GF", i.e. SUBJ and OBJ. X represents the phonological representation of the direction suffix.

(22) BLOCK PN

i. $\left[\text{CGF} \left[\text{AGR} \begin{bmatrix}\text{PERS1} & + \\ \text{PERS2} & - \\ \text{NUM} & \text{PL}\end{bmatrix}\right]\right] \rightarrow [_V \sqrt{}][\text{X}]$-*na:n*

ii. $\left[\text{CGF} \left[\text{AGR} \begin{bmatrix}\text{PERS1} & + \\ \text{PERS2} & + \\ \text{NUM} & \text{PL}\end{bmatrix}\right]\right] \rightarrow [_V \sqrt{}][\text{X}]$-*naw*

iii. $\left[\text{CGF} \left[\text{AGR} \begin{bmatrix}\text{PERS2} & + \\ \text{NUM} & \text{PL}\end{bmatrix}\right]\right] \rightarrow [_V \sqrt{}][\text{X}]$-*wa:w*

iv. $\left[\text{CGF} \quad \left[\text{AGR} \quad \begin{bmatrix}\text{PERS1} & -\\ \text{PERS2} & -\end{bmatrix}\right]\right] \rightarrow [_V \surd][\text{X}]\text{-}w$

v. $[\,] \rightarrow [_V \surd][\text{X}]\text{-}n$

The elsewhere condition implies that the suffix *-n* is used when both subject and object are 1st and 2nd person singular.

In what follows, we illustrate how these rules apply to the morphology of a word like (23), whose word-level f-structure of which is shown in Figure 13.

(23) ni- se:kih -a: -na:n
1 *frighten* DIR 1.pl.excl
'We.EXCL frighten him'

$$\begin{bmatrix}\text{AGR} & \boxed{1} & & \\ \text{SUBJ} & \left[\text{AGR} \quad \boxed{1}\begin{bmatrix}\text{PERS1} & +\\ \text{PERS2} & -\\ \text{NUM} & \text{PL}\end{bmatrix}\right]_1 & & \\ \text{OBJ} & \left[\text{AGR} \quad \begin{bmatrix}\text{PERS1} & -\\ \text{PERS2} & -\\ \text{NUM} & \text{SG}\end{bmatrix}\right]_2 & & \end{bmatrix}$$

Figure 13: Word-level f-structure of (23)

The morphological rules check the information at the word-level f-structure in Figure 13. For the person prefix, the evaluation of rules is as follows:

(24) a. $\left[\text{AGR} \quad \left[\text{PERS2} \quad +\right]\right] \rightarrow$ *ki-*$[_V \surd]$ NOT SATISFIED

b. $\left[\text{AGR} \quad \left[\text{PERS1} \quad +\right]\right] \rightarrow$ *ni-*$[_V \surd]$ SATISFIED

(25) RESULT FOR BLOCK P: *ni-*

(24a) is not satisfied because the AGR of the verbal f-structure does not have the feature $\left[\text{PERS2} \quad +\right]$. (24b) is satisfied because the AGR of the verbal f-structure has the features $\left[\text{PERS1} \quad +\right]$. Evaluation stops here and *ni-* is licensed as the person prefix.

The direction suffix is determined as follows:

(26) a. $\text{GF}_{\text{AGR}} = \text{SUBJ}, \left[\text{OBJ} \quad \left[\text{AGR} \quad \begin{bmatrix}\text{PERS1} & +\\ \text{PERS2} & -\end{bmatrix}\right]\right] \rightarrow [_V \surd]$-*i* NOT SATISFIED

b. $\text{GF}_{\text{AGR}} = \text{OBJ}, \left[\text{SUBJ} \left[\text{AGR} \begin{bmatrix}\text{PERS1} & + \\ \text{PERS2} & -\end{bmatrix}\right]\right] \rightarrow [_V \surd]$-*iti* NOT SATISFIED

c. $\text{GF}_{\text{AGR}} = \text{SUBJ}, \left[\text{SUBJ} \left[\text{AGR} \left[\text{PERS1} \quad +\right] \vee \left[\text{PERS2} \quad +\right]\right]\right] \rightarrow [_V \surd]$-*a:* SATISFIED

(27) RESULT FOR BLOCK DRTCN: *-a:*

The first rule (26a) is not satisfied because the second condition (that the object be 1st person) is not met by the f-structure. (26b) is not either because the first condition (GF_{AGR} = OBJ) is not met. (26c) is met by the word-level f-structure: there is subject agreement and the subject is an SAP. Evaluation stops here and *-a:* is licensed as the direction suffix.

Finally, for the person-number suffix the very first rule in the block is satisfied, as there is a core GF that is 1st person plural exclusive, namely SUBJ. No further rules are evaluated.

(28) $\left[\text{CGF} \left[\text{AGR} \begin{bmatrix}\text{PERS1} & + \\ \text{PERS2} & - \\ \text{NUM} & \text{PL}\end{bmatrix}\right]\right] \rightarrow [_V \surd]$[X]-*na:n* SATISFIED

(29) RESULT FOR BLOCK PN: *-na:n*

In summary, the three results are *ni-*, *-a:*, and *-na:n*, thus correctly predicting the morphology of (23) (repeated below as (30)):

(30) ni- se:kih -a: -na:n
1 *frighten* DIR 1.pl.excl
'We.EXCL frighten him'

Finally, a word must be said about the existence of other affixes (mainly suffixes) that have not been taken into consideration in this discussion. These have been ignored because they are not involved in the distribution of the agreement affixes. Three of them are the so-called *strong direct* suffix *-im* and the *strong inverse* suffixes *-wa:* and *-iyi* (Dahlstrom, 2014; Haude & Zúñiga, 2016; Zúñiga, 2006). Another affix we have not discussed is the 3rd person plural suffix *-ak*, which is always added after the person-number suffix if any GF is 3rd person plural; its analysis would only require adding a fourth block of affixes consisting in only one rule that checks for those features to license *-ak*.

5 Conclusions

Our conclusions can be classified in two major groups: those referring to syntactic issues and those referring to morphological issues.

Regarding syntax, the most important conclusion is that by means of assuming an AGR-based theory of agreement and a set of OT constraints, we provide a way

for languages to be grouped into two basic types with respect to agreement: case-governed agreement systems and person-governed agreement systems. The former have a high-ranking constraint barring agreement in a non-default case, whereas the latter have a high-ranking constraint that must be satisfied by some set of prominent person and other referential features.

Plains Cree belongs to the group of languages with a person-governed agreement system. Instances of direct and inverse agreement are explained as particular instances of subject agreement and object agreement, respectively, under a person-governed agreement system.

Regarding morphology, we show the need for an approach towards inflectional morphology in which affixes are just the realization of information present in the word-level f-structure. In this framework, morphological rules place the phonology of word forms in correspondence their word-level f-structures, thus requiring us to accept that word forms include f-structures as part of their representation.

This approach is shown to allow for a simple analysis of direct and inverse morphology in a language like Plains Cree, in which direct morphology spells out word-level f-structures in which GF_{AGR} = SUBJ and inverse morphology, word-level f-structures in which GF_{AGR} = OBJ. By means of ordered morphological rules we are able to provide for an analysis of person prefixes and person-number suffixes in Plains Cree, as well, thus explaining why some forms are ungrammatical only due to morphological issues despite having a well-formed f-structure.

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