Ojibwe Agreement in Lexical-Realizational Functional Grammar

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Abstract

Lexical-Realizational Functional Grammar (L_RFG) is a novel theoretical framework that incorporates the realizational, morpheme-based approach to word-formation of Distributed Morphology into the declarative, modular framework of LFG. L_RFG differs from standard LFG in that terminal nodes of c-structure are not words, but are bundles of features that are realized in a separate, linearized v-structure. The mapping from c- to v-structure is many-to-one, using the mechanism of Spanning. In this paper we demonstrate L_RFG with an account of a part of the Ojibwe (Algonquian) verbal agreement system. We provide descriptions of the relevant templates and vocabulary items and discussion of some relevant examples.

1   Our project

We are developing a theoretical framework that couples Lexical-Functional Grammar (LFG; Bresnan et al. 2016) with the realizational, morpheme-based approach to word-formation of Distributed Morphology (DM; Halle and Marantz 1993). The resulting framework, which we call Lexical-Realizational Functional Grammar (L_RFG), is particularly well-suited to modelling Canadian Indigenous languages, which are characterized by *polysynthesis* and *nonconfigurationality*. In this paper we summarize the framework, and demonstrate it with an analysis of the inflectional system of Ojibwe, a language showing these properties. Note that the intent of the paper is not to make new claims about Ojibwe, but instead to take existing descriptions (e.g., Jones 1977, Nichols 1980, Valentine 2001) and analyses (e.g., Oxford 2019) of the language and adapt them to the present formalism as a demonstration of the framework. The paper is structured as follows: Section 2 outlines the L_RFG framework, comparing and contrasting it to standard LFG and providing details on the exponence function. Section 3 provides a brief introduction to Ojibwe, and a background on relevant aspects of the language's morphosyntax. Section 4 provides

a demonstration of our analysis, including a presentation and discussion of the templates used and specifications of the Vocabulary Items needed for animate agreement in Ojibwe, as well as the structure and discussion of some representative example sentences. Section 5 is a brief conclusion.

2 The framework

2.1 Comparison with standard LFG

L$_R$FG is similar to standard LFG, with changes to the c-structure and its relationship with words/morphemes.[1] The terminal nodes of c-structures are not words, but instead are f-descriptions (sets of f-structure equations and constraints). The c-structure is mapped to a v(ocabulary)-structure, a linearized structure in which vocabulary items (VIs) *expone* (i.e., realize) the features in the terminal nodes, via a correspondence function, ν. The relationship between terminal nodes and VIs is many-to-one, using the mechanism of *Spanning* (Haugen and Siddiqi 2016, Merchant 2015, Ramchand 2008, Svenonius 2016); i.e. one VI may realize features of multiple terminal nodes. The result is similar to the Lexical Sharing model of Wescoat (2002, 2005), but maintains the complex internal structures of words as part of syntax.

Formally, v-structure is a list, each member of which is a feature structure defining morphophonological properties relevant to the linear placement and metrical properties of the item. This includes the phonemes/segments, as well as the metrical frame which determines syllable structure, affix/clitic status, and so on. Thus, the v-structure roughly corresponds to the p(honological)-form portion of a lexical entry in the metrical theory of Bögel (2015).[2] In this paper, only the strings themselves are relevant, so we make some simplifying assumptions: (i) We represent the output of the exponence function, ν, simply as a string, not a full VI structure; (ii) We show alignment informally using the standard notational convention of adding a dash to the left or right of the string; (iii) We do not show the mapping to prosody and phonology (see Figure 1 below), but instead let the phonological forms stand in for the VI strings (i.e., we conflate the two for simplicity/presentational purposes).

Vocabulary structure is a morphophonological structure that maps to phonological form via prosodic structure. We capture this by introducing a new

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[1]We do not have space to rehearse the debate on word-based versus morpheme-based views of morphology. This literature is vast, but for representative discussion see Stump (2001: chapter 1) and Siddiqi (2019a,b).

[2]We would like to thank Tina Bögel for her insightful comments on this point at the LFG20 conference itself, and in extensive discussion afterwards. The details of the interaction between v-structure and the phonological string, in particular the effects of the metrical properties of VIs on mismatches in ordering between c-structure and the p-string, are currently being worked out and will be presented in future work in the L$_R$FG framework.

phonological correspondence function, o, which maps from prosodic structure to phonological strings, and treating the ρ mapping as a mapping from vocabulary items to prosodic structures. In other words, the output of ρ is the prosodic structure and the output of o is the final result of phonological processes, a set of strings that are based on the prosodic well-formedness conditions of VIs. The morphology is responsible for the input to phonology, but phonology does whatever phonology does to create the output, which is not part of morphology per se. Given the set of VIs, V, and a set of prosodic structures, P:

(1) $\rho : V \to P$

The o correspondence function takes the output of this ρ correspondence function as its input and thus maps to the phonological string (o's output) from the prosodic structure that corresponds to the vocabulary item. In sum, in L_RFG, v-structure precedes the phonological string in the Correspondence Architecture (see, e.g., Asudeh 2012: 53), resulting in the architecture in Figure 1.

Form
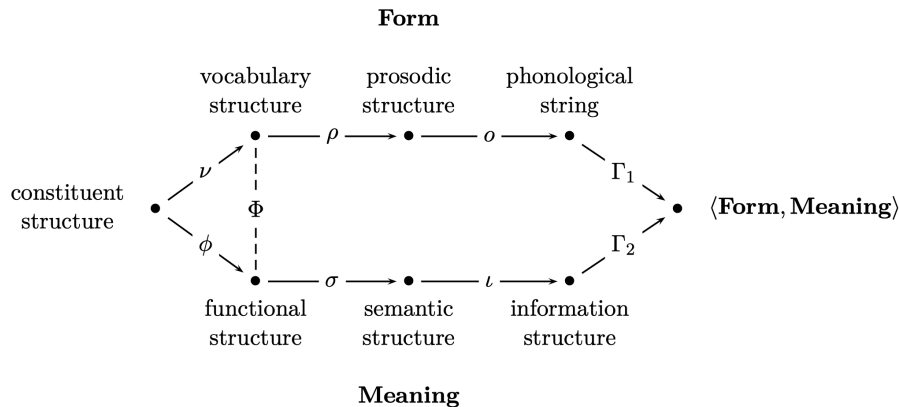
Figure 1: L_RFG Correspondence Architecture

We assume that the morphological structure of Butt et al. (1996) is no longer necessary, given vocabulary structure, and that the Φ function would allow us to address the concerns of Frank and Zaenen (2002) regarding Butt et al. (1996). The Φ function, which is discussed in detail in Section 2.2, is not strictly a correspondence function, but it captures a relationship between vocabulary structure and functional structure. Let us call this kind of function a *bridge function*, as it bridges the form/meaning branches of the architecture. Further details remain to be worked out, including the necessity of another bridge function from prosodic structure to information structure.[3] We have eliminated the independent level of argument structure based on the proposal that this information is best captured at sem(antic)-structure (Asudeh and Giorgolo 2012). The output

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[3]We thank Tina Bögel (p.c.) for drawing our attention to this issue.

of the grammar consists of a form–meaning pair, where the form incorporates prosody (still fed by constituent structure) and the meaning incorporates information structure (still fed by semantic structure).

The L$_R$FG architecture in Figure 1 is both similar to and yet noticeably distinct from an LFG architecture, due to the differing understanding of c-structure. Here are some salient points of comparison. First, the Vocabulary Items of L$_R$FG contain much the same information as LFG's lexical entries, but without the commitment that morphophonological form is bundled as part of the c-structure terminal node. Second, L$_R$FG could be considered to be offering a morphological theory that uses the foundational formal assumptions of LFG, in particular its notion of linguistic modularity and correspondence, and adopts most of its assumptions about semantics, information structure, and prosody. Since LFG is no longer just a theory of syntax but seeks to offer a theory of the broader grammatical system, it owes some kind of theory of word structure. L$_R$FG can be viewed as part of recent attempts to remedy this (see, e.g., Dalrymple 2015, Dalrymple et al. 2019). One could view L$_R$FG as offering a microscopic view of the structure of "words", in particular major categories like verb and noun. For example, consider the TP node in Figure 4 ('they saw us(incl)') on the final page of the paper, after the references. In some sense, this just *is* the verb, but the L$_R$FG c-structure shows its internal structure. A standard LFG c-structure for this example would instead look like the following (setting the f-description aside), which is not fully illuminating about structure.

(2)
$$
\begin{array}{c}
\text{S} \\
| \\
\uparrow = \downarrow \\
\text{V} \\
| \\
\textit{gigiiwaabamigwnaanag}
\end{array}
$$
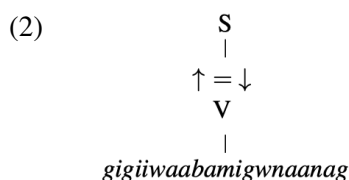
2.2 The exponence function ν

The exponence function ν maps from a pair of arguments to a VI, the exponent of the arguments. The first argument is a list of pre-terminal categories, typically of length 1, which are taken in the linear order in which they appear in the tree. The second argument is itself a function, Φ, which maps an f-description to the set of f-structures that satisfy the description; i.e. $\Phi(d \in D) = \{f \in F \mid f \models d\}$, where D is the set of valid f-descriptions and F is the set of f-structures.[4] In sum, ν maps *from* a pair whose first argument is a list of c-structure pre-terminal categories and whose second argument is a set of f-structures *to* a structured expression as described above.

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[4]We thank Ron Kaplan (p.c.) for discussion of this point. Any remaining errors are our own.

A key condition on exponence can then be defined as follows. Let V be the range of the exponence function ν, the set of VIs (structured expressions); then the following condition on exponence holds.

(3)   Given $\alpha \in A$ and $\beta \in B$, where $A, B \subseteq V$, and a function $[\![\ ]\!]_p$ that returns the conventionalized presuppositions of a given expression,

If $\bigcup\limits_{a \in A} [\![a]\!]_p = \bigcup\limits_{b \in B} [\![b]\!]_p$

Then **MostInformative**(α, β)

The conventionalized presuppositions of an expression are the set of presuppositions lexically triggered by the expression (Keenan 1971, Beaver 2001, Beaver and Geurts 2014). Presuppositions are propositions. Propositions are sets of possible worlds. So $[\![\ ]\!]_p$ returns a set of sets of possible worlds. The antecedent of the conditional in (3) therefore collects the conventionalized presuppositions of its arguments in two sets and tests whether the sets are equal. **MostInformative**(α, β) returns whichever of α,β has the most specific f-structure in the set of f-structures returned by Φ applied to the unions of α/β's collected f-descriptions. Formally:

$$\textbf{MostInformative}(\alpha, \beta) = \begin{cases} \alpha \textbf{ if } \exists f \forall g. f \in \pi_2(\nu^{-1}(\alpha)) \wedge g \in \pi_2(\nu^{-1}(\beta)) \wedge g \sqsubset f \\ \beta \textbf{ if } \exists f \forall g. f \in \pi_2(\nu^{-1}(\beta)) \wedge g \in \pi_2(\nu^{-1}(\alpha)) \wedge g \sqsubset f \\ \bot \textbf{ otherwise} \end{cases}$$

Thus, the condition in (3) amounts to a combination of the elsewhere condition/subset principle and an economy constraint that enforces spanning when possible.

3   Ojibwe: Background

Ojibwe exhibits many of the features that we hope to be able to model: *Nonconfigurationality* – word order is very free;[5] *polysynthesis* – complex verb morphology with extensive head-marking; a *direct-inverse-based agreement system* cross-referencing all core arguments; and *various morphological processes*, including verbal reflexives, noun incorporation, applicatives, various kinds of (anti)passives, and more, providing a rich testing ground for a theory of morphosyntax.

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[5]When we say that Ojibwe is "nonconfigurational", we do not intend to claim that word order is completely free. We are using the term in the LFG sense (Bresnan et al. 2016), meaning that word order and phrase structure are not used to distinguish grammatical functions like subject and object. Instead, word order is determined by a combination of factors, including obviation and information structure, i.e., determined by discourse and pragmatic factors more so than grammatical function. See Dahlstrom (2017) for extensive discussion and references, with special focus on the context of Algonquian.

3.1 Dialects and data

Ojibwe can be classified either as a group of dialects or as a closely-related subfamily of languages in the Central Algonquian group. The data and analysis in this talk is meant to be widely applicable across the different varieties of Ojibwe, including the Nishnaabemwin (such as Ottawa) and Anishinaabemowin dialects (such as Southwestern Ojibwe and Algonquin). The data are taken mainly from Nichols's (1980) grammar of Southwestern Ojibwe, corroborated with the paradigms in Jones (1977) (Algonquin) and Valentine (2001) (Nishnaabemwin).

3.2 Prominence and direction marking

The distribution of agreement affixes, and the choice of direct or inverse morphology, is based on arguments' relative positions in a *prominence/person hierarchy*, which ranks arguments in terms of person, obviation and animacy.[6] The hierarchy is characterized as follows (adapted from Valentine 2001: 268; abbreviations largely follow common Algonquianist practice):

(4) *Prominence Hierarchy*
    2   2nd person
    1   1st person
    3   3rd person animate proximate
    3′   3rd person animate obviative
    0   3rd person inanimate

In transitive clauses, the relationship between the two arguments' relative ranking in the prominence hierarchy and their thematic roles is tracked by the *direct/inverse* morpheme, known traditionally as a Theme Sign (analyzed as Voice; e.g., Oxford 2014, 2019). When the agent is the higher-ranked argument and the patient is lower, the verb is marked as *direct*.[7] When the patient is the higher-ranked argument and the agent is lower, the verb is marked as *inverse*.

This contrast is illustrated in (5) (adapted from Rhodes 1994: 434; note that *mitig* 'tree' is grammatically animate). In both, *nJohn* 'John' is proximate and thus outranks *mitig-oon* 'tree-OBV', which is obviative. Therefore, in the direct example in (5a) the proximate argument is the agent and the obviative argument is the patient, and vice versa in the inverse example (5b).

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[6]In Ojibwe and other Algonquian languages, grammatical animacy is a form of gender marking, which does not always match with semantic gender; specifically, all notionally animate entities are of animate gender, but notionally inanimate entities may be of either gender.

[7]Following common practice, we are using the term *agent* to refer to agent-like roles, including causes and many experiencers – i.e., the agent proto-role in the sense of Dowty (1991). Similarly, the term *patient* is used for the proto-role that includes patients, recipients, themes, and so on.

(5) a. o-gii-miigishkaw-aa-an   mitig-oon nJohn.
         3-PST-hit-DIR.3OBJ-OBV tree-OBV John
         'John hit the tree.'
     b. o-gii-miigishkaw-igw-an mitig-oon nJohn.
         3-PST-hit-INV-OBV   tree-OBV John
         'The tree hit John.'

The theoretical status of inversion in Ojibwe is still under debate. One question involves the relationship between inversion and the grammatical functions of subject and object. For some, the agent is always the subject and the patient is always the object (e.g., Valentine 2001, Dahlstrom 2014, Oxford 2019). In this analysis, the role of direction marking is to indicate the correspondence between grammatical function and prominence ranking.

(6) *GFs-as-θ-roles analysis*
     Direct: subject is higher-ranked, object is lower-ranked
     Inverse: subject is lower-ranked, object is higher-ranked

This can be represented as in Figure 2, where the solid lines represent the correspondences in a direct form, and the dashed lines the correspondences in inverse. For others, the higher-ranked argument is always the subject and the lower-ranked argument is always the object (e.g., Rhodes 1994, 2010, Bruening 2005). In this view, direction marking indicates the relationship between grammatical function and thematic role.

(7) *GFs-as-prominence analysis*
     Direct: subject is agent, object is patient
     Inverse: subject is patient, object is agent

This is represented in Figure 3, where the solid lines represent the correspondences in a direct form, and the dashed lines the correspondences in inverse.
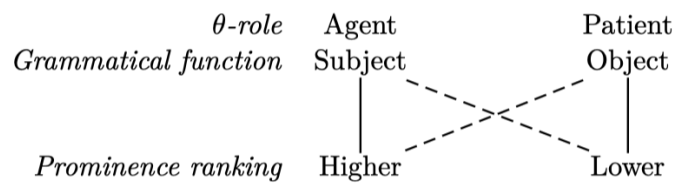

Figure 2: GFs-as-θ-roles analysis

There is syntactic evidence for both analyses (Rhodes 1994, 2010, Bruening 2005, Dahlstrom 2014, Alsina and Vigo 2017, Oxford 2019). However, on both sides the evidence largely relies on judgements that vary between Algonquian languages, and even between dialects or individual speakers of Ojibwe,
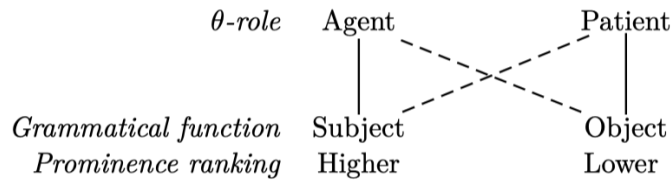
θ-*role*   Agent   Patient

Grammatical function   Subject   Object
Prominence ranking   Higher   Lower

Figure 3: GFs-as-prominence analysis

as pointed out by Rhodes (1994, 443).[8] Furthermore, as Rhodes (1994) emphasizes, from a theory-neutral standpoint it is not clear that many of the types of evidence and argumentation that are relied on constitute real evidence for subject or object; this is especially true in an LFG-style parallel architecture where various different structures are available to explain such things, not just the f-structural grammatical functions. It is also possible that languages differ as to which is the proper analysis, as is claimed by McGinnis (1999) and Alsina and Vigo (2017). For these reasons, we consider the empirical evidence to be somewhat inconclusive in determining which analysis is correct.

With that in mind, we adopt the *GFs-as-prominence analysis*, where the grammatical functions are defined in terms of the prominence hierarchy. This allows us to treat direct/inverse marking as determining the mapping between grammatical functions at f-structure and thematic/argument roles at semantic structure. It also means that the subject and object have more consistent (word-internal) c-structural positions, as with the clausal structure in configurational languages; the alternative would be to have specific positions for the higher- and lower-ranked arguments, which is more difficult to model. In other words, the analysis we chose allows for a more elegant formalization of both the templates and the VIs involved. Our formalization is presented in the next section.

4   Analysis

The analysis presented in this section accounts for a subset of the Ojibwe inflectional system, specifically that occurring in (most) matrix clauses and involving animate subjects and (primary) objects. The clausal context (matrix versus embedded) is relevant because Ojibwe, like most other Algonquian languages, has two separate verbal inflectional paradigms or verbal "orders": independent order, which occurs in most matrix clauses; and conjunct order, which occurs in embedded clauses and certain matrix clauses, including *wh*-questions and certain narrative contexts. The two differ in much of their inflectional morphology, and in the distribution of direct and inverse marking; in terms of the present analysis, this includes most of the VIs that realize c-structure terminal

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[8]Dahlstrom (nd: 3-21–3-23) notes that the proposal by Rhodes (1994) does not hold for Meskwaki, but this does not mean that it does not hold for Ojibwe (and she never claims this).

nodes occurring between (but excluding) TP and vP. We represent the contrast in templates, which are defined in Table 3, above Section 4.2. Here we focus on the independent order, although the conjunct order is discussed in connection with certain templates in Section 4.1. For further details of our analysis of Ojibwe agreement, see Melchin et al. (2020).

We do not present our full c-structure rules here but leave them to be reasonably inferred from the c-structures in Figures 4 and 5 at the end of the paper. Above the TP node, Ojibwe is highly nonconfigurational, so we assume this:

(8)   S   →   XP*   TP   XP*
                 @ANYGF   ↑ = ↓   @ANYGF

The template ANYGF := { (↑ GF − ADJ) = ↓ | ↓ ∈ (↑ ADJ) }; see the next section for details on LFG templates.

4.1   Templates

We make use of the LFG mechanism of *templates* (Dalrymple et al. 2004, Asudeh et al. 2008, 2013) to encode bundles of grammatical descriptions that get expressed in the language. The templates involved in our analysis can be divided into five groups: those encoding general constraints, those encoding the prominence hierarchy (person/gender), those encoding obviation and number, those encoding verb classes, and those encoding the mapping between grammatical function and argument structure (direction, argument suppression). For space reasons, we must omit more in-depth discussion and exemplification of the phenomena mentioned here; see Melchin et al. (2020) for further details.

The first set of templates define *constraints* that determine the distribution of animacy, person, and alignment across grammatical functions and contexts. The first two constraints hold in all contexts. The first constraint, which we call the *Transitive Subject Constraint*, ensures that the subject of a clause with an object (either OBJ or OBJ_θ, i.e. PLUSO, as per Findlay 2016) must be animate; inanimate subjects are possible only in intransitive clauses (Rhodes 1990, 2010, Valentine 2001):

(9)   *Transitive Subject Constraint*
       @TSC := [(↑ SUBJ) & (↑ PLUSO)] ⇒ [(↑ SUBJ ANIM) = +]

This ensures that transitives with an inanimate ARG_1 are inverse, regardless of context (independent or conjunct form).[9] It correctly ensures that verbs with a secondary object (OBJ_θ) must have an animate subject (in Algonquianist terms,

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[9]This is already ruled out in independent contexts by (12), but not in conjunct contexts with a participant ARG_1.

correctly predicts that there are AI+O verbs, but no II+O verbs).[10,11]

The second constraint, which we call the *Participant Argument Constraint*, ensures that 1st and 2nd person (i.e., participant) pronominals are possible only as subjects and (direct/primary) objects; secondary objects and obliques must be 3rd person (Rhodes 1990, 2010, Valentine 2001):

(10)   *Participant Argument Constraint*
        @PAC := ¬(↑ PLUSR PERS PART)

Since these two rules co-occur in every sentence, we assume they are grouped together in the following template, which is specified in the c-structure rule introducing the root node:

(11)   @ROOT   :=   @TSC
                       @PAC

The last constraints, the *Prominence Constraints*, capture the different distributions of direct and inverse Voice heads in the independent and conjunct orders:

(12)   *Independent Prominence Constraint*
        @IPC :=
        [(↑ SUBJ) & (↑ OBJ)] ⇒
        {[(↑ SUBJ PERS PART) = + & (↑ OBJ PERS PART) = +] |
        [(↑ OBJ PERS) ⊑ (↑ SUBJ PERS)]}

(13)   *Conjunct Prominence Constraint*
        @CPC :=
        [(↑ SUBJ) & (↑ OBJ)] ⇒
        {[(↑ {SUBJ|OBJ} PERS PART) = +] | [(↑ OBJ PERS) ⊑ (↑ SUBJ PERS)]}

Following Bejar and Rezac (2009) and Oxford (2014), among others, we assume that the person and animacy features are decomposed into a number of privative features. Instead of the feature geometries used by the above authors, in our system the implicational relationships between the features are encoded in a set of nested *prominence templates*, given in Table 1, providing a way to represent the prominence hierarchy without stipulating independent structures beyond those already provided by the LFG framework.

We use the *number and obviation templates* in Table 2 to encode singular

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[10]AI+O stands for "animate intransitive with secondary object" and II+O stands for "inanimate intransitive with secondary object".

[11]While this is true for Ojibwe, there are Algonquian languages that do allow II+O verbs, derived through morphology that changes the specification of the subject from animate to inanimate; this occurs in Cree and Meskwaki (Will Oxford, p.c.). For these languages, the antecedent of the constraint is specified as [(↑ SUBJ) & (↑ OBJ)] rather than [(↑ SUBJ) & (↑ PLUSO)], such that the constraint does not apply to clauses with only SUBJ and OBJ$_\theta$.

Table 1: Prominence hierarchy templates

Template	Description	Explanation
INCLUSIVE(f)	(f PERS SPEAK) = + (f PERS HEAR) = + @PARTICIPANT(f)	1st person inclusive
SPEAKER(f)	(f PERS SPEAK) = + @PARTICIPANT(f)	1st person
HEARER(f)	(f PERS HEAR) = + @PARTICIPANT(f)	2nd person
PARTICIPANT(f)	(f PERS PART) = + @PROXIMATE(f)	1 and/or 2
PROXIMATE(f)	(f PERS PROX) = + @ANIMATE(f)	3 and above
ANIMATE(f)	(f PERS ANIM) = + @ENTITY(f)	$3'$ and above
ENTITY(f)	(f PERS ENTITY) = +	All persons (0 and above)

and plural number, and combinations of number, animacy, and obviation that are encoded in the verbal agreement system.

Table 2: Number and obviation templates

Template	Description	Explanation
PLURAL(f)	(f NUM) = PL	
SINGULAR(f)	(f NUM) = SG	
INAN-PLURAL(f)	@PLURAL(f) ¬(f PERS ANIM)	Inanimate plurals
AN-PLURAL(f)	@PLURAL(f) @ANIMATE(f) ¬(f PERS PART)	Animate 3rd person plurals
OBVIATIVE(f)	(f OBV) = + @ANIMATE(f) {@SINGULAR(f) | @PLURAL(f)}	Animate obviatives Number is ambiguous

The *verb class and order templates* given in Table 3 define the properties of the four derivational verb classes and the two verbal orders, which are integral to the inflectional morphology in the language. The names of the verb class templates come from traditional Algonquianist verb class terminology: VTA means transitive, animate object; VTI means transitive, inanimate object; VAI means intransitive, animate subject; VII means intransitive, inanimate subject.

The *argument structure templates* in Table 4 determine the mapping between grammatical functions (in the f-structure) and argument roles (in the

Table 3: Verb class and order templates

Template	Description	Explanation
VTA	$(\uparrow_\sigma \text{ ARG}_1)$	Two semantic arguments
	$(\uparrow_\sigma \text{ ARG}_2)$	
VTI	$(\uparrow_\sigma \text{ ARG}_1)$	Two semantic arguments
	$(\uparrow_\sigma \text{ ARG}_2)$	
	$\neg(\uparrow \text{ OBJ PERS ANIM})$	Object is inanimate
VAI	$(\uparrow_\sigma \text{ ARG}_1)$	At least one semantic argument
VII	$(\uparrow_\sigma \text{ ARG}_1)$	At least one semantic argument
	$\neg(\uparrow \text{ SUBJ PERS ANIM})$	Subject is inanimate
INDEP-ORDER(f)	@IPC	Indep. Prominence Constraint
	$\neg(\text{GF } f)$	Cannot be embedded
CONJ-ORDER(f)	@CPC	Conj. Prominence Constraint
	$(\text{GF } f)$	Must be embedded

sem-structure). We adopt certain templates from the account of lexical mapping in Findlay (2016, 2020) (building on Kibort 2007, Asudeh and Giorgolo 2012); their effects are summarized in the table. In addition to the templates in the table, we use the templates @PLUSR, @MINUSR, @PLUSO, and @MINUSO in the sense of Findlay (2016), which is based on the [±r] and [±o] features of standard Lexical Mapping Theory (Bresnan and Kanerva 1989).

Table 4: Templates for argument mapping

Template	Description	Explanation
DIRECT	@MAP(SUBJ,ARG$_1$)	Subject $\mapsto$ agent
	@MAP(OBJ,ARG$_2$)	Object $\mapsto$ patient
INVERSE	@MAP(SUBJ,ARG$_2$)	Subject $\mapsto$ patient
	@MAP(OBJ,ARG$_1$)	Object $\mapsto$ agent
REFLEXIVE	@SUPPRESS(ARG$_2$,BIND(ARG$_1$))	Patient reflexively bound
SHORT-PASSIVE	@SUPPRESS(ARG$_1$,CLOSE-OFF)	Agent existentially bound

4.2 Vocabulary items

Here we list the agreement VIs present in forms involving animate subjects and (primary) objects (i.e., SUBJ and OBJ) in the independent order. These fall into four syntactic categories: Voice heads, indicating the mapping between grammatical functions (in the f-structure) and thematic roles (in the sem-structure); Agr heads, which indicate agreement with one or both (or neither) of the core grammatical functions; person prefixes, which index the person of the higher-ranked of the two core grammatical functions; and number suffixes, which index the presence of a third-person plural or obviative object (in transitives) or subject (in intransitives). We also provide VIs for items outside the agree-

ment system that appear in the example sentences provided. See Melchin et al. (2020) for further discussion.

With the exception of the reflexive morpheme (which is traditionally considered part of the verb stem), the *Voice heads* are traditionally referred to as "theme signs". The main Voice heads involved in this area of the agreement system are given in Table 5. The form *-aa* is underspecified, showing up as a direct form when the object is 3rd-person animate (i.e., either agent is participant and patient is 3rd-person proximate, or agent is 3rd-person proximate and patient is obviative), and a passive form when the subject is 3rd-person animate. These two roles have in common that the grammatical function that maps to ARG$_2$ is animate (object in direct voice contexts, subject in the passive).

Table 5: Voice heads

$$\langle\,[\text{Voice}],\quad \Phi\left\{\begin{array}{l}@\text{DIRECT}\\@\text{ADDRESSEE}(\uparrow\ \text{OBJ})\end{array}\right\}\,\rangle \qquad \overset{\nu}{\rightarrow}\quad \textit{-in}$$

$$\langle\,[\text{Voice}],\quad \Phi\left\{\begin{array}{l}@\text{DIRECT}\\@\text{PARTICIPANT}(\uparrow\ \text{OBJ})\end{array}\right\}\,\rangle \qquad \overset{\nu}{\rightarrow}\quad \textit{-i}$$

$$\langle\,[\text{Voice}],\quad \Phi\left\{\ @\text{ANIMATE}((\uparrow_\sigma\ \text{ARG}_2)_{\sigma\text{-1}})\ \right\}\,\rangle \qquad \overset{\nu}{\rightarrow}\quad \textit{-aa}$$

$$\langle\,[\text{Voice}],\quad \Phi\left\{\ @\text{INVERSE}\ \right\}\,\rangle \qquad \overset{\nu}{\rightarrow}\quad \textit{-igw}$$

$$\langle\,[\text{Voice}],\quad \Phi\left\{\begin{array}{l}@\text{SHORT-PASSIVE}\\@\text{PARTICIPANT}(\uparrow\ \text{SUBJ})\end{array}\right\}\,\rangle \qquad \overset{\nu}{\rightarrow}\quad \textit{-igoo}$$

$$\langle\,[\text{Voice}],\quad \Phi\left\{\ @\text{REFLEXIVE}\ \right\}\,\rangle \qquad \overset{\nu}{\rightarrow}\quad \textit{-idizo}$$

The *Agr heads* are traditionally referred to as "central agreement suffixes". They are divided into two sets: one found in independent-order contexts, and one found in conjunct-order contexts. Here we analyze only the independent-order Agr heads, given in Table 6.[12]

The *person prefixes* (category Pers), given in Table 7, are introduced in Spec-TP in a node annotated $(\uparrow \text{MINUSR}) = \downarrow$; they index the person of either SUBJ or OBJ, whichever is higher on the relevant prominence hierarchy (here using the feature HEAR rather than SPEAK for the highest point in the hierarchy, meaning 2nd person outranks 1st person). Note that the 3rd-person prefix *o-* does not appear in intransitive forms (forms with neither OBJ nor OBJ$_\theta$, i.e.,

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[12]Many of the independent Agr forms have separate allomorphs that arise when (a) there is a PLUSO element present, but (b) there is no animate OBJ present, a phenomenon known as "n-registration" (Rhodes 1990). However, we do not address these forms here.

Table 6: Independent Agr heads

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}(\uparrow \text{MINUSR}) = \%\text{GF}\\ @\text{SPEAKER}(\%\text{GF})\\ @\text{PLURAL}(\%\text{GF})\\ \{(\uparrow \text{OBJ PERS PART})\,|\,\neg(\uparrow \text{OBJ})\}\end{array}\right\}\,\rangle\quad\xrightarrow{\nu}\quad\textit{-min}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}(\uparrow \text{MINUSR}) = \%\text{GF}\\ @\text{PARTICIPANT}(\%\text{GF})\\ @\text{PLURAL}(\%\text{GF})\\ \{(\uparrow \text{OBJ PERS PART})\,|\,\neg(\uparrow \text{OBJ})\}\end{array}\right\}\,\rangle\quad\xrightarrow{\nu}\quad\textit{-m}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}\neg(\uparrow \text{SUBJ PERS PART})\\ \neg(\uparrow \text{PLUSO})\end{array}\right\}\,\rangle\quad\xrightarrow{\nu}\quad\textit{-w}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}@\text{SPEAKER}(\uparrow \text{SUBJ})\\ @\text{PLURAL}(\uparrow \text{SUBJ})\end{array}\right\}\,\rangle\quad\xrightarrow{\nu}\quad\textit{-naan}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}@\text{PROXIMATE}(\uparrow \text{SUBJ})\\ @\text{PLURAL}(\uparrow \text{SUBJ})\end{array}\right\}\,\rangle\quad\xrightarrow{\nu}\quad\textit{-waa}$$

$$\langle\,[\text{Agr}],\quad \Phi\{\ @\text{SHORT-PASSIVE}\ \}\,\rangle\quad\xrightarrow{\nu}\quad\textit{-m}$$

without PLUSO); there the Agr suffix *-w* appears instead.

Table 7: Person prefixes

$$\langle\,[\text{Pers}],\quad \Phi\{\ @\text{HEARER}(\uparrow)\ \}\,\rangle\quad\xrightarrow{\nu}\quad\textit{gi-}$$

$$\langle\,[\text{Pers}],\quad \Phi\{\ @\text{PARTICIPANT}(\uparrow)\ \}\,\rangle\quad\xrightarrow{\nu}\quad\textit{ni-}$$

$$\langle\,[\text{Pers}],\quad \Phi\left\{\begin{array}{l}@\text{ANIMATE}(\uparrow)\\ ((\text{SUBJ}\ \uparrow)\ \text{PLUSO})\end{array}\right\}\,\rangle\quad\xrightarrow{\nu}\quad\textit{o-}$$

The *number suffixes* (category Num), given in Table 8, appear on a node in the specifier of AgrP,[13] which is annotated ↑=↓; the @NUMSUFF template indicates which grammatical function's features are being specified, as defined in (14). These morphemes mark number/obviation of OBJ if there is an OBJ present; of OBJ$_\theta$ if there is an OBJ$_\theta$ but no OBJ; and of SUBJ if there is neither PLUSO function present. This is encoded in the @NUMSUFF template, defined as follows:

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[13]In a fuller exposition of Ojibwe verbal inflection, which includes negation and modality, this will be revised so that these suffixes appear in spec-ModP, as they follow the modal suffixes. However, since we are omitting modal suffixes in this analysis, we will leave them here for now.

(14)   @NUMSUFF(template)   := $\{[(\uparrow \text{OBJ}) \, \& \, @\text{template}(\uparrow \text{OBJ})] \, | $
$[\neg(\uparrow \text{OBJ}) \, \& \, @\text{template}(\uparrow \text{OBJ}_\theta)] \, | $
$[\neg(\uparrow \text{PLUSO}) \, \& \, @\text{template}(\uparrow \text{SUBJ})]\}$

Table 8: Number/obviation suffixes

$\langle \, [\text{Num}], \quad \Phi\{ \quad @\text{NUMSUFF(AN-PLURAL)} \quad \} \, \rangle \quad \overset{\nu}{\rightarrow} \quad \textit{-ag}$

$\langle \, [\text{Num}], \quad \Phi\{ \quad @\text{NUMSUFF(OBVIATIVE)} \quad \} \, \rangle \quad \overset{\nu}{\rightarrow} \quad \textit{-an}$

Other VIs that are used in the examples in Section 4.3 are given in Table 9. This includes the past tense prefix *gii-*, the root and verb final (v) in the verb *waab-am* 'see-VTA', and the animate-intransitive verb *wiisini* 'eat', which is lexically specified as a span of the $\sqrt{}$ and v heads.

4.3   Examples and discussion

Figures 4 and 5, which are at the end of the paper, provide glosses, c-, f-, and v-structures for two representative inflected verbs. The semantic structures are omitted for reasons of space. Here we walk through the examples, focusing on the exponence of the terminal nodes in Figure 4 and the instances of spanning in Figure 5. However, it should first be noted that these examples show only the internal structure of the verb, which we analyze as TP; this is assumed to be embedded in a larger structure corresponding to the sentence as a whole. While we have not attempted to analyze the c-structure of multi-word sentences, it would have to take into account the fact that word order is largely based on discourse factors as mentioned in Footnote 5 (see Dahlstrom 2017), as well as the presence of second-position discourse markers.

The example in Figure 4 exhibits no spanning (i.e., each VI realizes a single terminal node), and shows all of the syntactic categories described in Section 4.2. It has the Voice template @INVERSE (Table 4), which indicates that the agent is the object and the patient is the subject. The c-structure itself is

Table 9: Other VIs

$\langle \, [\text{T}], \qquad \Phi\{ \quad (\uparrow \text{TENSE}) = \text{PST} \quad \} \, \rangle \quad \overset{\nu}{\rightarrow} \quad \textit{gii-}$

$\langle \, [\sqrt{}], \qquad \Phi\{ \quad (\uparrow \text{PRED}) = \text{'see'} \quad \} \, \rangle \quad \overset{\nu}{\rightarrow} \quad \textit{waab}$

$\langle \, [\text{v}], \qquad \Phi\{ \quad @\text{VTA} \quad \} \, \rangle \qquad\qquad \overset{\nu}{\rightarrow} \quad \textit{-am}$

$\langle \, [\sqrt{}, \text{v}], \quad \Phi\left\{ \begin{array}{l} (\uparrow \text{PRED}) = \text{'eat'} \\ @\text{VAI} \end{array} \right\} \, \rangle \quad \overset{\nu}{\rightarrow} \quad \textit{wiisini}$

generated by c-structure rules that are not discussed in this paper. The root ($\sqrt{}$) head provides the PRED feature for the verbal f-structure, here 'see'. It is realized by the VI *waab* (Table 9); this realization is trivial since this is (presumably) the only VI that realizes this PRED feature. The v head supplies the verb class template @VTA (Table 3), which indicates that ARG_1 and ARG_2 are present in the sem-structure. Again, given the VIs in Table 9, this is trivial.

The exponence of the other two heads is non-trivial. The Agr head hosts the PRED, NUM, and PERS features of the subject and object. Both have the PRED value 'pro', and plural number. The subject is 1st-person inclusive, with the following PERS features: ENT, ANIM, PROX, PART, HEAR, and SPEAK; these are called by the template @INCLUSIVE. The object is 3rd-person proximate, @PROXIMATE, with the PERS features ENT, ANIM, and PROX. Of the Agr heads in Table 6, two are compatible with this feature bundle: *-waa* and *-naan*.[14] Of these two, *-naan* specifies a greater subset of the subject's PERS features than *-waa*, matching five of the six PERS features, while *-waa* matches only three. Of the Pers heads in Table 7, all three are compatible with the set of PERS features encoded in @INCLUSIVE. It is *gi-* that is inserted, since it realizes five of the six PERS features; *ni-* realizes only four and *o-* realizes only two.

For the sentence in Figure 5, the exponence of the Pers and T heads proceeds as above. However, note that the VI *wiisini* spans/expones three heads: $\sqrt{}$, v, and Agr. This exemplifies two separate spanning phenomena. As specified in Table 9, the VI *wiisini* is specified as realizing the two c-structure categories $\sqrt{}$ and v. This means that in an instance where the $\sqrt{}$ head specifies the PRED value 'eat' and there is an adjacent v head specifying @VAI, this VI expones both heads.[15]

This bears a superficial similarity to lexical sharing (Wescoat 2002, 2005, 2007). One key difference between our overall proposal and lexical sharing is the notion, which we'll call *Pac-Man Spanning*, that VIs can span any number of adjacent preterminal nodes, so long as the presuppositions of the exponed/realized expressions are held constant. Note that the Agr head is specified for a 1st-person singular subject, while none of the Agr heads in Table 6 are compatible with a singular participant (i.e., 1st or 2nd person) subject. Thus, the Agr head undergoes Pac-Man Spanning, being realized by the same VI that realizes an adjacent head, in this case *wiisini*. In sum, Figure 5 exemplifies both lexically-specified and Pac-Man Spanning.

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[14]The heads *-min* and *-m* are ruled out by the constraining equation $\{(\uparrow$ OBJ PERS PART$) \mid \neg(\uparrow$ OBJ$)\}$, which specifies that if an object is present, it must have the PART feature, which is lacking in the object here.

[15]The language also has two other VIs specified for the PRED value 'eat': *amw*, which spans the root and a v specified as @VTA, and *miiji*, which spans the root, a v specified @VAI, and a Voice head marking @DIRECT and specified for an inanimate object (i.e., *amw* occurs in transitive animate contexts, *miiji* occurs in transitive inanimate contexts).

5 Conclusion

The analysis of Ojibwe inflection given here is a part of a project to provide a larger, more complete analysis that includes inflection for inanimate arguments, OBJ_θ, and inflectional affixes found in the conjunct order. While the results of the larger study have not yet been published, the analyses involved are along the same lines as those given here. The fact that the complex agreement morphology of a polysynthetic language like Ojibwe can be succinctly and (we believe) insightfully accounted for in an L_RFG formalism lends credence to the overall project of developing a theoretical framework well-suited to capturing the properties of North American Indigenous languages that elude elegant analysis in more mainstream frameworks.

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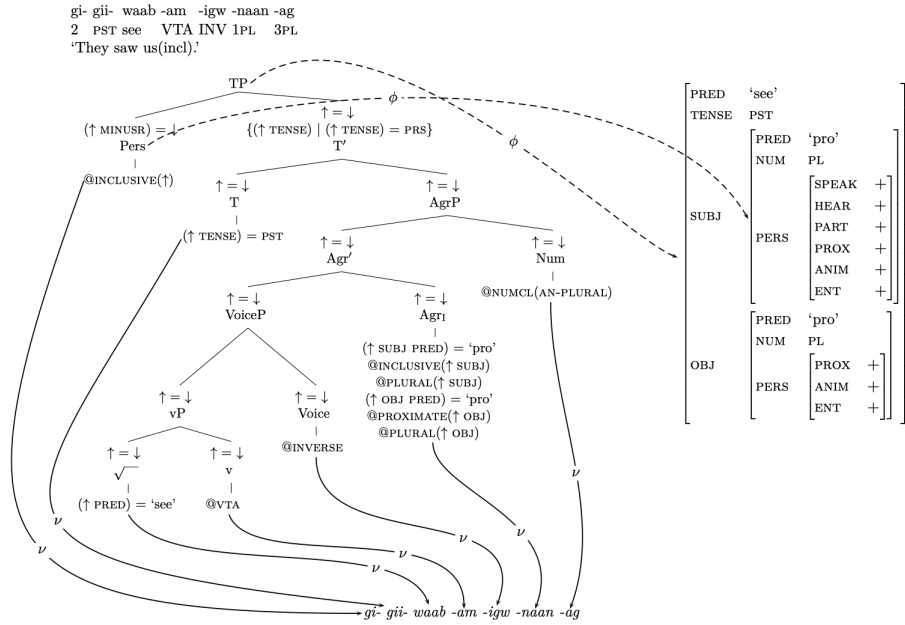
gi- gii- waab -am -igw -naan -ag
2 PST see VTA INV 1PL 3PL
'They saw us(incl).'

TP

φ

(↑ MINUSR) = ↓
Pers
@INCLUSIVE(↑)

↑ = ↓
{(↑ TENSE) | (↑ TENSE) = PRS}
T′

φ

↑ = ↓
T
(↑ TENSE) = PST

↑ = ↓
AgrP

↑ = ↓
Agr′

↑ = ↓
Num
@NUMCL(AN-PLURAL)

↑ = ↓
VoiceP

↑ = ↓
Agr_I
(↑ SUBJ PRED) = 'pro'
@INCLUSIVE(↑ SUBJ)
@PLURAL(↑ SUBJ)
(↑ OBJ PRED) = 'pro'
@PROXIMATE(↑ OBJ)
@PLURAL(↑ OBJ)

↑ = ↓
vP

↑ = ↓
Voice
@INVERSE

↑ = ↓
√
(↑ PRED) = 'see'

↑ = ↓
v
@VTA

ν
ν
ν
ν
ν
ν

gi- gii- waab -am -igw -naan -ag

$$\begin{bmatrix} \text{PRED} & \text{'see'} \\ \text{TENSE} & \text{PST} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'pro'} \\ \text{NUM} & \text{PL} \\ \text{PERS} & \begin{bmatrix} \text{SPEAK} & + \\ \text{HEAR} & + \\ \text{PART} & + \\ \text{PROX} & + \\ \text{ANIM} & + \\ \text{ENT} & + \end{bmatrix} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'pro'} \\ \text{NUM} & \text{PL} \\ \text{PERS} & \begin{bmatrix} \text{PROX} & + \\ \text{ANIM} & + \\ \text{ENT} & + \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 4: c-, f-, and v-structures for *gigiiwaabamigwnaanag* 'they saw us(incl)'

ni- gii- wiisini
1 PST eat.VAI
'I ate.'

TP

φ

(↑ MINUSR) = ↓
Pers
@SPEAKER(↑)

↑ = ↓
{(↑ TENSE) | (↑ TENSE) = PRS}
T′

↑ = ↓
T
(↑ TENSE) = PST

↑ = ↓
AgrP

↑ = ↓
VoiceP

↑ = ↓
Agr
(↑ SUBJ PRED) = 'pro'
@SPEAKER(↑ SUBJ)
@SINGULAR(↑ SUBJ)

↑ = ↓
vP

↑ = ↓
√
(↑ PRED) = 'eat'

↑ = ↓
v
@VAI

ν
ν
ν
ν
ν

ni- gii- wiisini

$$\begin{bmatrix} \text{PRED} & \text{'eat'} \\ \text{TENSE} & \text{PST} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'pro'} \\ \text{NUM} & \text{SG} \\ \text{PERS} & \begin{bmatrix} \text{SPEAK} & + \\ \text{PART} & + \\ \text{PROX} & + \\ \text{ANIM} & + \\ \text{ENT} & + \end{bmatrix} \end{bmatrix} \end{bmatrix}$$
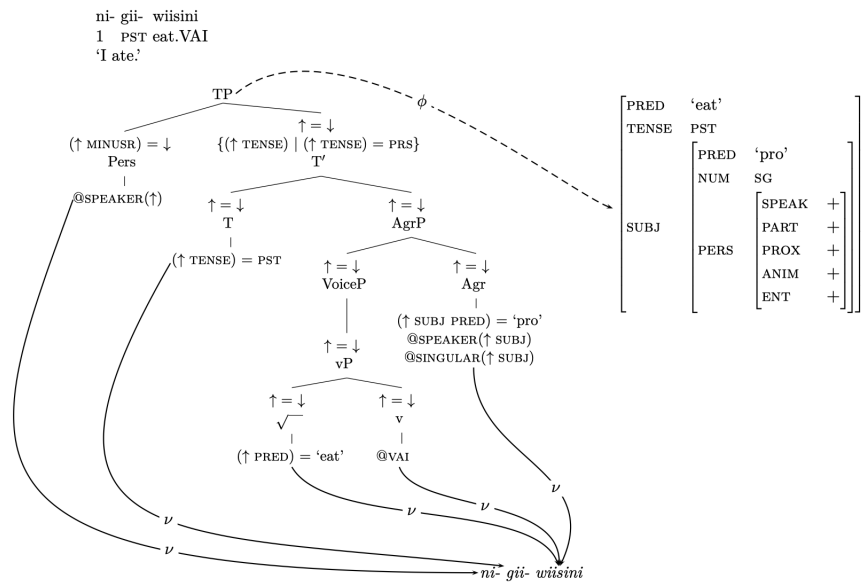
Figure 5: c-, f-, and v-structures for *nigiiwiisini* 'I ate'