

Complex Case Phenomena in the Grammar Matrix

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The LinGO Grammar Matrix (Bender et al., 2002)

- ▶ Distill the wisdom of existing broad-coverage grammars
- ▶ Provide a typologically-informed foundation for building grammars of natural languages in software
- ▶ Syntax-semantics interface consistent with HPSG and Minimal Recursion Semantics (Copestake et al., 2005)
- ▶ Today I'll describe the implementation of case and verbal argument marking in the Matrix
- ▶ I'll discuss in detail direct-inverse languages, which have an argument-marking strategy particularly challenging to analyze with the tools we use

Matrix Libraries

- ▶ Matrix intended to cover all languages, but there exist phenomena that are widespread but not universal
- ▶ If not universal, do they belong in the Matrix?
- ▶ Solution: divide the Matrix into:
 - ▶ The universal or “core” Matrix
 - ▶ Matrix “libraries” covering non-universal phenomena
- ▶ Libraries are exposed to the user-linguist via a typological questionnaire:
<http://www.delph-in.net/matrix/customize/matrix.cgi>
- ▶ Based on answers, we customize an HPSG grammar expressed in TDL (type description language) and compatible with the LKB (Copestake, 2002)

Case

- ▶ Part of my recent work has been a library for case
- ▶ CASE is “a system of marking dependent nouns for the type of relationship they bear to their heads.” (Blake, 2001)
- ▶ A little broader: marked on noun phrases, on one or more of: nouns, pronouns, determiners, adjectives
- ▶ I also take it to include NPs marked by adpositions, though not everyone does
- ▶ Extremely complex phenomenon; this library only covers case-marking on the selected arguments of verbs, up to two per verb
 - ▶ Narrowing the range of phenomena simplifies the implementation
 - ▶ Excludes, e.g., noun-modifier case concord, oblique case, and possessive cases (unless used to mark a verbal argument)

Morphosyntactic Alignment

- ▶ Covering verbal arguments means dealing with morphosyntactic alignment
- ▶ That is, how a language marks three key roles:
 - ▶ **Subject**, the sole argument of intransitives (S)
 - ▶ **Agent**, the actor argument of transitives (A)
 - ▶ **Patient**, the acted upon argument of transitives (O or P)
- ▶ There are many different patterns cross-linguistically

Cross-linguistic Variation

- ▶ (Using the terminology of Dixon (1994))
- ▶ **Nominative-accusative**: S marked like A, O different
ex: English, Japanese
- ▶ **Ergative-absolutive**: S marked like O, A different
ex: (almost) Dyirbal (Australian, Pama-Nyungan)
- ▶ **Tripartite**: S, A, and O all marked differently
ex: Wangkumara (Australian, Pama-Nyungan)
- ▶ **Split-S**: S is marked like A for some intransitives, like O for others
ex: Mandan (Siouan)
- ▶ **Fluid-S**: S is marked like A for some intransitives, like O for others, and like either A or O for still others
ex: Tsova-Tush (N.E. Caucasian)

Cross-linguistic Variation

- ▶ Pure ergative-absolutive languages are very rare; most show **split ergativity**
- ▶ One part of the grammar shows a nominative-accusative pattern, while another shows an ergative-absolutive pattern
- ▶ Two major kinds: (my abbreviations)
 - ▶ **Split-N**: Some nominals have nominative-accusative marking, while others have ergative-absolutive
ex: Dyirbal (nom-acc in 1st and 2nd persons)
 - ▶ **Split-V**: Based on some feature (e.g. tense, aspect, mood, main/subordinate status) of the verb, arguments take either ergative-absolutive or nominative-accusative arguments
ex: many Indo-Iranian languages, inc. Hindi/Urdu

Scale-sensitive Marking

- ▶ Other kinds of argument marking exist
- ▶ In **direct-inverse languages** (e.g. Algonquian languages), marking is sensitive to a scale
- ▶ NPs are ranked according to their naturalness as an agent
 - ▶ If A outranks O, verb in **direct** form
 - ▶ If O outranks A, verb in **inverse** form
- ▶ Other languages (e.g. Fore, Papuan) have case marking that's scale-sensitive
- ▶ Not generally analyzed as direct-inverse, but I show here that the same analysis can be used for both

Case Questionnaire

► (Demo)

Direct-inverse Languages

- ▶ Marks arguments, but is it case?
- ▶ When I started, I intended to treat it as case, but that's wrong
- ▶ Languages can have case and inverse marking in various combinations:
 - ▶ Direct-inverse verbs and case (Sahaptin, Penutian)
 - ▶ Direct-inverse verbs but no case (Algonquian)
 - ▶ Case-marking that's sensitive to a scale, but no overt marking of direct or inverse (Fore)
- ▶ So direct-inverse isn't case, but still falls under the slightly broader umbrella of verbal argument marking

A Challenge

- ▶ The LKB implements HPSG with multiple inheritance and unification
- ▶ Direct-inverse languages present a challenge
- ▶ It would be nice to do something like:

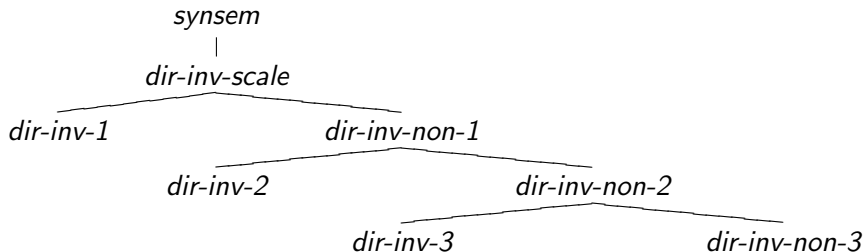
$$\left[\begin{array}{l} \textit{direct-verb-lex-rule} \\ \text{INPUT } \langle \boxed{1}, \dots \rangle \\ \text{OUTPUT } \langle F_{dv}(\boxed{1}), [\text{ARG-ST } \langle \boxed{2}, \boxed{3} \rangle] \rangle \end{array} \right] \& \boxed{2} > \boxed{3}$$

- ▶ However, no such mechanism is available
- ▶ How can we analyze the direct-inverse pattern without specifying n^2 rules for n scale entries?

My Analysis

- ▶ Consider the scale for the Algonquian languages:
2nd pers. > 1st pers. > 3rd pers. prox. > 3rd pers. obv.
- ▶ To implement such a scale, I use two mechanisms:
 - ▶ A binary-branching hierarchy encoding the scale
 - ▶ A set of mandatory lexical rules

Scale Hierarchy



- ▶ Types on the left specify the features for a scale entry
- ▶ Types on the right specify features covering the rest of the scale

Algonquian Scale

- So, for Algonquian:

$$\begin{bmatrix} \textit{dir-inv-1} \\ \dots\text{PER} \quad \textit{2nd} \end{bmatrix}$$

$$\begin{bmatrix} \textit{dir-inv-2} \\ \dots\text{PER} \quad \textit{1st} \end{bmatrix}$$

$$\begin{bmatrix} \textit{dir-inv-3} \\ \dots\text{PER} \quad \textit{3rd} \\ \dots\text{PROXIMITY} \quad \textit{proximate} \end{bmatrix}$$

$$\begin{bmatrix} \textit{dir-inv-non-1} \\ \dots\text{PER} \quad \textit{non-2nd} \end{bmatrix}$$

$$\begin{bmatrix} \textit{dir-inv-non-2} \\ \dots\text{PER} \quad \textit{3rd} \end{bmatrix}$$

$$\begin{bmatrix} \textit{dir-inv-non-3} \\ \dots\text{PER} \quad \textit{3rd} \\ \dots\text{PROXIMITY} \quad \textit{obviative} \end{bmatrix}$$

Lexical Rules

- ▶ For Algonquian, lexical rules for direct specifying:

ARG-ST $\langle \textit{dir-inv-1}, \textit{dir-inv-non-1} \rangle$

ARG-ST $\langle \textit{dir-inv-2}, \textit{dir-inv-non-2} \rangle$

ARG-ST $\langle \textit{dir-inv-3}, \textit{dir-inv-non-3} \rangle$

- ▶ ...and three rules for inverse:

ARG-ST $\langle \textit{dir-inv-non-1}, \textit{dir-inv-1} \rangle$

ARG-ST $\langle \textit{dir-inv-non-2}, \textit{dir-inv-2} \rangle$

ARG-ST $\langle \textit{dir-inv-non-3}, \textit{dir-inv-3} \rangle$

- ▶ (Hierarchy not strictly necessary—it's a sanity check on grammars)

Equal Agent and Patient

- ▶ What if agent and patient are ranked the same? Two possibilities:
 1. Impossible. Algonquian languages work this way. They have a reflexive form and proximate/obviative marking for 3rd.
 2. Possible. Fore works this way. Direct form is used, and then word order determines A and O.
- ▶ Analyzing languages of the second type requires only adjusting which *dir-inv-scale* subtypes appear in which rules:

ARG-ST $\langle \textit{dir-inv-1}, \textit{dir-inv-scale} \rangle$

ARG-ST $\langle \textit{dir-inv-2}, \textit{dir-inv-non-1} \rangle$

ARG-ST $\langle \textit{dir-inv-3}, \textit{dir-inv-non-2} \rangle$

ARG-ST $\langle \textit{dir-inv-non-3}, \textit{dir-inv-non-3} \rangle$

Example: Algonquian

- ▶ Group of North American languages with similar marking pattern
- ▶ Sensitive to the following scale (repeated):
2nd pers. > 1st pers. > 3rd pers. prox. > 3rd pers. obv.
- ▶ Obviation: one third person NP is proximate, the rest obviative
- ▶ The proximate NP is the topic of the discourse, usually the focus of the speaker's empathy, often the viewpoint character in a narrative (Dahlstrom, 1991, 91)
- ▶ The grammar shown here is simplified to focus on direct-inverse, and to have some ungrammatical examples:
 - ▶ Agent and patient agreement on the verb omitted
 - ▶ Word order fixed to SVO

Algonquian Results

- ▶ Results from a customized Algonquian grammar:
 - 2P tv-DIR 1P *2P tv-INV 1P
 - 2P tv-DIR 3P-PROX *2P tv-INV 3P-PROX
 - 2P tv-DIR 3P-OBV *2P tv-INV 3P-OBV
 - 1P tv-DIR 3P-PROX *1P tv-INV 3P-PROX
 - 1P tv-DIR 3P-OBV *1P tv-INV 3P-OBV
 - 3P-PROX tv-DIR 3P-OBV *3P-PROX tv-INV 3P-OBV

 - 3P-OBV tv-INV 3P-PROX *3P-OBV tv-DIR 3P-PROX
 - 3P-OBV tv-INV 1P *3P-OBV tv-DIR 1P
 - 3P-OBV tv-INV 2P *3P-OBV tv-DIR 2P
 - 3P-PROX tv-INV 1P *3P-PROX tv-DIR 1P
 - 3P-PROX tv-INV 2P *3P-PROX tv-DIR 2P
 - 1P tv-INV 2P *1P tv-DIR 2P

Algonquian Semantics (for “2P tv-DIR 1P”)

```
[ LTOP: h1
  INDEX: e2 [ SF: PROP-OR-QUES ... ]
  RELS <
    [ "_pronoun_n_rel"
      LBL: h3
      ARG0: x4 [ x SORT: SEMSORT PNG.PER: 2ND ... ] ]
    [ "unspec_q_rel"
      ... ]
    [ "_tv_v_rel"
      LBL: h1
      ARG0: e2
      ARG1: x4
      ARG2: x8 [ x SORT: SEMSORT PNG.PER 1ST ... ] ]
    [ "_pronoun_n_rel"
      LBL: h9
      ARG0: x8 ]
    [ "unspec_q_rel"
      ... ] >
  HCONS < h6 qeq h3 h11 qeq h9 > ]
```

Fore

- ▶ Fore (Papuan) is an interesting case: no direct or inverse form of the verb
- ▶ But has case marking sensitive to a hierarchy:
pronoun, personal name, kin term >
human > animate > inanimate
- ▶ When agent outranks patient, NPs are unmarked
- ▶ When patient outranks agent, agent is marked
- ▶ Case called “ergative” by (Blake, 2001, 122), but simply a “delineator” by Scott (1978)

Fore Results

- ▶ Results from a customized Fore grammar:

pro pro tv	*pro pro-ERG tv	*pro-ERG pro tv
pro human tv	pro human-ERG tv	*pro-ERG human tv
pro anim tv	pro anim-ERG tv	*pro-ERG anim tv
pro inanim tv	pro inanim-ERG tv	*pro-ERG inanim tv
human human tv	*human human-ERG tv	*human-ERG human tv
human anim tv	human anim-ERG tv	*human-ERG anim tv
human inanim tv	human inanim-ERG tv	*human-ERG inanim tv
anim anim tv	*anim anim-ERG tv	*anim-ERG anim tv
anim inanim tv	anim inanim-ERG tv	*anim-ERG inanim tv
inanim inanim tv	inanim inanim-ERG tv	*inanim-ERG inanim tv

Fore Semantics (for “inanim-ERG pro tv”)

```
[ LTOP: h1
  INDEX: e2 [ SF: PROP-OR-QUES ... ]
  RELS <
    [ "_inanim_n_rel"
      LBL: h3
      ARG0: x4 [ x SORT: SEMSORT ... ]]
    [ "unspec_q_rel"
      ... ]
    [ "_pronoun_n_rel"
      LBL: h8
      ARG0: x9 [ x SORT: ... ]]
    [ "unspec_q_rel"
      ... ]
    [ "_tv_v_rel"
      LBL: h1
      ARG0: e2
      ARG1: x4
      ARG2: x9 ]
```

HCONS < h6 qeq h3 h11 qeq h8 >]

Future Work

- ▶ Further argument-marking patterns, including word-order shifts
- ▶ Ditransitives
- ▶ Syntactic ergativity
- ▶ Huge variety of other non-argument-marking case phenomena
- ▶ Other features:
person and number are in, but need more elaborate treatment
- ▶ For all phenomena, factorable analyses

Summary

- ▶ Wide variety of argument-marking case patterns as a Matrix library
- ▶ Direct-inverse argument marking is a challenge to implement with only multiple inheritance and unification
- ▶ I've shown an analysis that works, but requires multiple rules rather than a simple rule or principle that can be stated once
- ▶ Just scratched the surface of the customization system. Either try it out online or ask me for a demo.

<http://www.delph-in.net/matrix/customize/matrix.cgi>

<http://students.washington.edu/sfd/>

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