A semantic model of switch reference in Koasati

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1 Introduction

- Switch reference (SR), a morphological phenomenon found in several languages in the world, is traditionally characterized as a way of indicating whether the subjects of two conjoined clauses are the same or different (Jacobsen 1993).
- Examples of SR in Koasati, a Muskogean language spoken in Louisiana and Texas, can be seen in (1).1

(1) Joe-ka room-ah itcokhali-hk
  Joe-SBJ room-OBJ enter-SS
  ‘Joe came into the room.’

a. Edkä hihcok cokko:lit
   Ed-ah hi:ca-k cokko:lit
   Ed-OBJ see-SS sat_down
   ‘saw Ed, and sat down.’

b. Edkä hihcan cokko:lit
   Ed-ah hi:ca-n cokko:lit
   Ed-OBJ see-DS sat_down
   ‘saw Ed, and he [Ed] sat down.’

- Consider the English equivalent of (1) in (2).

(2) Joe came into the room. He saw Ed. He sat down.

- He in the third sentence could refer to either Joe or Ed.
- The English is ambiguous where the Koasati is not.

1 Introduction to PLA

- Aside form accounting for the difference between English anaphora and Koasati SR, this account aims to explain the non-canonical use of SR in Koasati and other languages.
- In (3), the SS marker on pasá:kascok (‘she seemed dirty’) should mean that the following sentence has she again as the subject, but this is not the case.

(3) Ho:tinanná:hkoc k pasá:kascok,
    ho:ti-nanna-Vhco-k pasá:ka-isi-Vhco-k
    sores-NOTHING:BUT-HABIT-SS be:dirty-DIM-HABIT-SS
    ‘She was covered with sores, and she seemed dirty,’”
    ohimpalátka:sin. Á:ya:toho-k
    oh-im-palátka-si-n á:ya:toho-k
    DISTR-3DAT-be:cross-DIM-DS go:about-REALIS-SS

  “and people were quite cross with her. She went about,” (Kimball 2010: 271; 68)

Roadmap

§2 Koasati switch reference
§3 Introduction to PLA
§4 Initial PLA analysis: one-list system
§5 A problem & the two-list system
§6 Conclusion

2 Koasati switch reference

- Koasati word order is typically SOV.
- SR marking appears on the verb at the end of the clause.
- The verbal SS and DS morphemes are homophonous with the nominal SBJ and OBJ markings.

<table>
<thead>
<tr>
<th>Morpheme</th>
<th>Attached to Noun</th>
<th>Attached to Verb</th>
</tr>
</thead>
<tbody>
<tr>
<td>-k</td>
<td>subject (SBJ)</td>
<td>same subject (SS)</td>
</tr>
<tr>
<td>-n</td>
<td>object (OBJ)</td>
<td>different subject (DS)</td>
</tr>
</tbody>
</table>

Table 1: Subject, object, and switch reference morphemes

- The overlap in the form of the nominal subject and object marker with the SR markers suggests that there is an important connection between nominal reference and SR.

Gloss abbreviations: SS = SAME SUBJECT; DS = DIFFERENT SUBJECT; SBJ = SUBJECT; OBJ = OBJECT; FOC = FOCUS; NOTHING:BUT = NOTHING BUT; DIM = DIMINUTIVE; HABIT = HABITUAL; DISTR = DISTRIBUTIVE; REALIS = REALIS; DAT = DATIVE; 3 = THIRD PERSON

1 All data examples are copied unchanged from their sources except the third line of the gloss has been changed to use Leipzig glossing conventions.

2 Thanks to my committee members, Sarah Murray, Molly Diesing, Mats Rooth, the audience at NASSLI, and the Cornell Semantics Reading Group for all their valuable feedback. Special thanks to the Coushatta Heritage Center for the material they gave me access to.
Background on PLA

Predicate Logic with Anaphora (PLA; Dekker 1994) extends standard Predicate Logic in order to keep track of individuals in a discourse.

It has regular truth conditions, but a formula is interpreted as an update of an information state.

From these examples, it seems that there is a pattern to how individuals are introduced and referred back to.

Further, this pattern can be manipulated by the switch reference markers.

- The SS marker makes the subject and object of the SS marked clause the available subject and object, respectively, for the next clause.
- The DS marker makes the subject and object of the DS marked clause the available object and subject, respectively, for the next clause.

A system like PLA that can order individuals can be used to model this data.

4 PLA analysis

In English the ambiguity of he is represented in PLA by different pronoun terms: p₀ and p₁.

The lack of ambiguity in the Koasati data can be captured by translating the subject agreement marker as p₀ and object agreement marker as p₁.

The switch reference markers can be translated so that the DS marker swaps the order of the individuals in the p₀ and p₁ positions and the SS marker maintains the order.

a-SBJ: \( \exists x (z = a) \)

- intransitive verb: \( V_0 \)

- SS: \( \exists x (x = p_0 \land \exists y (y = p_1)) \)

b-OBJ: \( \exists x (x = p_0 \land \exists z (z = b)) \)

- transitive verb: \( V_0 p_1 \)

- DS: \( \exists y (y = p_1 \land \exists x (x = p_0)) \)

\[ s_n = \{ a, b, c \} \] SS

\[ s_{n+1} = \{ a, b, c, d \} \]

\[ s_n = \{ a, b, c \} \] DS

\[ s_{n+1} = \{ a, b, c, d, e \} \]
5 A problem and a proposed solution: The two list analysis

- The data in (7) cannot be accounted for using the one list system.

(7) Joe-k room- Edkã hihcok kokkoli:lit
Joe-SBJ room-OBJ enter-SS
‘Joe came into the room.’

(Rising 1992: 4)

Table 9: Breakdown of (7)

<table>
<thead>
<tr>
<th>Clause</th>
<th>Verb Gloss</th>
<th>Subject</th>
<th>Object</th>
<th>SR Marker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>enter</td>
<td>Joe</td>
<td>room</td>
<td>DS</td>
</tr>
<tr>
<td>2.</td>
<td>see</td>
<td>Ed</td>
<td>room</td>
<td>DS</td>
</tr>
<tr>
<td>3.</td>
<td>sat_down</td>
<td>Joe</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 10: Analysis of (7)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Joe-SBJ</td>
<td>z(x = j)</td>
<td>s1 = { (j) }</td>
</tr>
<tr>
<td>b.</td>
<td>room-OBJ</td>
<td>x(x = x0 &amp; z(x = r)</td>
<td>[x0]x1 = j</td>
</tr>
<tr>
<td>c.</td>
<td>enter</td>
<td>p0p1</td>
<td>[p0]x1 = r, [p0]x2 = j</td>
</tr>
<tr>
<td>d.</td>
<td>-SS</td>
<td>p0</td>
<td>p0 = j</td>
</tr>
</tbody>
</table>

Table 11: Analysis of (7a)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.</td>
<td>Ed-SBJ</td>
<td>z(x = e)</td>
<td>s5 = { (j, r, j, r, j, e, j) }</td>
</tr>
<tr>
<td>f.</td>
<td>see</td>
<td>H0p0</td>
<td>[p0]x1 = e, [p0]x2 = j</td>
</tr>
<tr>
<td>g.</td>
<td>-DS</td>
<td>y(y = p1 &amp; z(x = p0)</td>
<td>[p1]x6 = e, [p0]x6 = e</td>
</tr>
<tr>
<td>h.</td>
<td>sat_down</td>
<td>C0</td>
<td>p0 = j</td>
</tr>
</tbody>
</table>

5.1 Two list analysis

- I adapt PLA to be a two list system building on Bittner (2001) who proposes a two list system for anaphora and also applies it in an analysis of the obviative system in Kalallisut (West Greenlandic) (Bittner 2011).
- In other work, Little and Moroney (2016) use a two list system related to the one presented here in an analysis of obviation in Mi’gmaq.

A sample two list information state

\[ s = \{(a, b), (c, d)\} \]

\[ p_1 \quad p_0 \quad p_1 \quad p_0 \]

Table 6: Analysis of (1)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Joe-SBJ</td>
<td>z(x = j)</td>
<td>s1 = { (j) }</td>
</tr>
<tr>
<td>b.</td>
<td>room-OBJ</td>
<td>x(x = x0 &amp; z(x = r)</td>
<td>[x0]x1 = j</td>
</tr>
<tr>
<td>c.</td>
<td>enter</td>
<td>p0p1</td>
<td>[p0]x1 = r, [p0]x2 = j</td>
</tr>
<tr>
<td>d.</td>
<td>-SS</td>
<td>p0</td>
<td>p0 = j</td>
</tr>
</tbody>
</table>

Table 7: Analysis of (1a)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.</td>
<td>Ed-OBJ</td>
<td>y(x = x0 &amp; z(x = e))</td>
<td>[x0]x1 = j</td>
</tr>
<tr>
<td>f.</td>
<td>see</td>
<td>H0p0</td>
<td>[p0]x1 = e, [p0]x2 = j</td>
</tr>
<tr>
<td>g.</td>
<td>-SS</td>
<td>x(x = x0 &amp; z(x = p1))</td>
<td>[p0]x1 = e, [p0]x2 = j</td>
</tr>
<tr>
<td>h.</td>
<td>sat_down</td>
<td>C0</td>
<td>p0 = j</td>
</tr>
</tbody>
</table>

Table 8: Analysis of (1b)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.</td>
<td>Ed-OBJ</td>
<td>y(x = x0 &amp; z(x = e))</td>
<td>[x0]x1 = j</td>
</tr>
<tr>
<td>f.</td>
<td>see</td>
<td>H0p0</td>
<td>[p0]x1 = e, [p0]x2 = j</td>
</tr>
<tr>
<td>g.</td>
<td>-DS</td>
<td>y(y = p1 &amp; z(x = p0))</td>
<td>[p1]x6 = e, [p0]x6 = e</td>
</tr>
<tr>
<td>h.</td>
<td>sat_down</td>
<td>C0</td>
<td>p0 = j</td>
</tr>
</tbody>
</table>

- The different SR morpheme translations in (g) for Tables 7-8 generate distinct unambiguous interpretations.
5.2 Accounting for problematic data in (7)

- This system can account for the problematic data by keeping the available subject and object individuals separate:

<table>
<thead>
<tr>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Joe-SBJ ( \exists z (z = j) )</td>
<td>( p_0 )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_1 = { \langle j }, { \rangle } )</td>
</tr>
<tr>
<td>b. room-OBJ ( \exists z (z = r) )</td>
<td>( \exists z (z = r) )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_2 = { \langle j }, { \rangle } )</td>
</tr>
<tr>
<td>c. enter ( 0 \land \neg (x = p_0) ) &amp; ( x = j )</td>
<td>( p_0 )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_3 = { \langle j }, { \rangle } )</td>
</tr>
<tr>
<td>d. -DS ( \exists y (y = p_0) ) &amp; ( \exists x (x = p_0) )</td>
<td>( p_0 )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_4 = { \langle j }, { \rangle } )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. Ed-SBJ ( \exists z (z = e) )</td>
<td>( p_0 )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_5 = { \langle j }, { \rangle } )</td>
</tr>
<tr>
<td>f. see ( 0 \land \neg (x = p_0) ) &amp; ( x = j )</td>
<td>( p_0 )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_6 = { \langle j }, { \rangle } )</td>
</tr>
<tr>
<td>g. -DS ( \exists y (y = p_0) ) &amp; ( \exists x (x = p_0) )</td>
<td>( p_0 )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_7 = { \langle j }, { \rangle } )</td>
</tr>
<tr>
<td>h. sat_down ( C_0 )</td>
<td>( \exists z (z = j) )</td>
<td>( { \langle j }, { \rangle } )</td>
<td>( s_8 = { \langle j }, { \rangle } )</td>
</tr>
</tbody>
</table>

5.3 Examples from texts

- (12-13) show that both the one and two list system can account for non-canonical switch reference.
- (13) and (14) show that in addition to overt nouns, verbal morphology and incorporated nouns must be able to add individuals to the lists.
- (16) shows that it may also be necessary for verbal morphology to be able to pick out pronouns farther back than the \( p_0 \) on the list.

(11) Tayyí sínóhok ok átyathok:limpatš

- Tayyí sínóhok ok átyathok:limpatš
- Woman old-HABIT-SS go:about-REALIS-DEDUC-HEARSAY-PAST-PH:TR

“It is said that an elderly woman was going about.”

(2010: 271; 68)

<table>
<thead>
<tr>
<th>One list:</th>
<th>( \langle (w) \rangle )</th>
<th>( \langle (w) \rangle )</th>
<th>( \langle (w) \rangle )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two list:</td>
<td>( \langle (w) \rangle )</td>
<td>( \langle (w) \rangle )</td>
<td>( \langle (w) \rangle )</td>
</tr>
</tbody>
</table>
6 Conclusion

- I have presented basic data of switch reference in Koasati.
- I have discussed two PLA analyses for how to account for this data:
  - One account uses Dekker’s (1994) one-list system.
  - The other account modifies his system to two lists to separate subjects and objects.
- Both accounts can make the correct predictions for non-canonical cases of SR.
- For this analysis, it seems to be necessary for verbal morphology to be able to add individuals to the information state.
- If verbal morphology can also be used to identify the correct previously introduced individual in an information state, then the two list system works best for Koasati switch reference.
- If we do not want to allow the verbal morphology to do this, we would need to use animacy features—not overtly expressed in Koasati—to rule out unwanted predictions of the one list system.
- While these details still need to be worked out, it seems that a reference tracking analysis in the nominal domain can do a lot of work in accounting for Koasati switch reference, which is nice given the connection between verbal switch reference marking and nominal subject object marking.

References

B Two list fragment

- Additions to PLA are indicated with a *

**Definition 1.1** (Basic Expressions of PLA)

1. \( C = \{a, b, \ldots, n\} \) (entity) constants
2. \( V = \{x, y, z, x', y', z', \ldots\} \) (entity) variables
3. \( A = \{p_i^+ \mid i \in \mathcal{N}\} \) (entity) pronouns of list \( T \)
4. \( B = \{p_i^- \mid i \in \mathcal{N}\} \) (entity) pronouns of list \( \bot \)
5. \( T = C \cup V \cup A \cup B \) (entity) terms
6. \( R^n = \{A^1, \ldots, A^n, B^1, \ldots, B^n\} \) n-ary predicates

**Definition 1.2** (Syntax of PLA) The set \( L \) of PLA formulas is the smallest set such that:

1. if \( t_1, \ldots, t_n \in T \) and \( R \in R^n \), then \( R t_1 \ldots t_n \in L \)
2. if \( t_1, t_2 \in T \), then \( t_1 t_2 \in L \)
3. if \( \phi \in L \), then \( \neg \phi \in L \)
4. if \( \phi \in L \) and \( x \in V \), then \( \exists^x \phi \in L \)
5. if \( \phi \in L \) and \( x \in V \), then \( \exists^x \phi \in L \)
6. if \( \phi, \psi \in L \), then \( (\phi \wedge \psi) \in L \)

**Definition 2.1** (Information States)

1. \( S^n = \mathcal{P}(D^a \times D^b) \) the set of information states about \( n \) subjects, where \( a \) is the number of subject in the \( T \) list and \( b \) is the number of subjects in the \( \bot \) list and \( a + b = n \)
2. \( S = \cup_{n \in \mathbb{N}_\geq 0} S^n \) the set of information states
3. For a state \( s \in S^n \), where \( a = b = n \) and \( 0 < j \leq a \), and for any case \( e = \langle (d_i^+ \ldots d_j^+), (d_i^- \ldots d_j^-) \rangle \in s \), \( d_j^+ \) is a possible value for the \( j \)-th subject of \( s \), also indicated as \( e^+ \).
4. For a state \( s \in S^n \), where \( a = b = n \) and \( 0 < k \leq b \), and for any case \( e = \langle (d_i^+ \ldots d_k^+), (d_i^- \ldots d_k^-) \rangle \in s \), \( d_k^- \) is a possible value for the \( k \)-th subject of \( s \), also indicated as \( e^- \).
5. \( s_0 = \{\langle \varnothing, \varnothing \rangle\} \) (the initial state of information: \( D^a \times D^b \))
6. \( \mathbb{T}^n = D^a \times D^b \) (the minimal state of information about \( n \) subjects, where \( a + b = n \))
7. \( \{e\} \) for any \( e = \langle (d_i^+ \ldots d_a^+) \rangle \) \( D^a \times D^b \) (the maximal state of information about \( n \) subjects, where \( a + b = n \))
8. \( \bot^n = \{\} \) (the absurd information state about \( n \) subjects, where \( n > 0 \))

**Definition 2.2** (Notational Convention)

1. If \( e \in D^a \) and \( e' \in D^b \), then \( e \cdot e' = \langle e_1, \ldots, e_n, e'_1, \ldots, e'_m \rangle \in D^{a+b} \)
2. \( e' \) is an extension of \( e \), \( e \leq e' \), if \( \exists e'' : e' = e \cdot e'' \)
3. \( e' \) is an extension of \( e \), \( e \leq e' \), if \( \forall e^T \in e' \exists e^T \in e : e^T \leq e^T \) \& \( \forall e^T \in e' \exists e^T \in e : e^T \leq e^T \)
4. For \( s \in S^n \), \( N_i = n(=a+b) \), \( N_T = a \), \( N_\bot = b \), the number of subjects of \( s(i) \)

**Definition 2.3** (Information Update)

1. \( \mathfrak{S} \) is an update of state \( s, s, s' \leq s', \) if \( N_i \leq N_y \), and \( \forall e' \in s' \exists e \in s : e \leq e' \)

**Definition 3.1** (Interpretation of Terms)

1. \( \mathcal{C} \), \( \mathcal{S} \), \( \mathcal{G} \) = \( F(c) \) for all constants \( c \)
2. \( [x], \mathcal{S} \cdot \mathcal{G} \cdot \mathcal{G} = g(x) \) for all variables \( x \)
3. \( [p_i^+], \mathcal{S} \cdot \mathcal{G} \cdot \mathcal{E} = e_i^{\mathcal{T}^{-1}} \) for all pronouns \( p_i^+ \) and \( e \) and \( e^T \) and \( s \) such that \( e^T \in e \) and \( e \in s \) and \( N_T > i \)
4. \( [p_i^-], \mathcal{S} \cdot \mathcal{G} \cdot \mathcal{E} = e_i^{\bot^{-1}} \) for all pronouns \( p_i^- \) and \( e \) and \( e^\bot \) and \( s \) such that \( e^\bot \in e \) and \( e \in s \) and \( N_\bot > i \)

**Definition 3.2** (Semantics of PLA)

1. \( s[[t_1 \ldots t_n]], \mathcal{G} = \{e \in s \mid ([t_1], \mathcal{S} \cdot \mathcal{E} \cdot \mathcal{G}), \ldots, ([t_n], \mathcal{S} \cdot \mathcal{E} \cdot \mathcal{G}) \in F(R) \} \) (if \( N_i > h_1 \ldots h_n \))
2. \( s[[t_1], \mathcal{S} \cdot \mathcal{G} = \{e \in s \mid ([t_1], \mathcal{S} \cdot \mathcal{G} = \{[t_2], \mathcal{S} \cdot \mathcal{G} \}) \}
3. \( s[[\neg \phi], \mathcal{G} = \{e \in s \mid \exists e' : e \leq e' \land e' \in s [[\phi], \mathcal{G} \} \)
4. \( s[[\exists^x \phi], \mathcal{G} = \{e \in s \mid (e^T \cdot d, e') \in s[[\phi], \mathcal{G} \} \)
5. \( s[[\exists^x \phi], \mathcal{G} = \{e \in s \mid (e^T \cdot d) \in s[[\phi], \mathcal{G} \} \)
6. \( s[[\phi \wedge \psi], \mathcal{G} = s[[\phi], \mathcal{G} \} \)

**Definition 4.1** (Support and Entailment)

1. \( s \) supports \( \phi \) wrt \( \mathcal{M} \) and \( g, s \vdash_{\mathcal{M} \cdot \mathcal{G}} \phi \) iff \( \forall e \in s : e \leq e' \land e' \in s \mathcal{[}\phi], \mathcal{G} \) (if defined)
2. \( \phi_1, \ldots, \phi_n \) entail \( \psi, \phi_1, \ldots, \phi_n \vdash \psi \) iff \( \forall \mathcal{M}, \mathcal{G} \forall s : s[[\phi_1], \mathcal{G} \ldots [[\phi_n], \mathcal{G} \vdash \mathcal{G} \psi \) (if defined)