Modeling switch reference in Koasati

Mary Moroney, Cornell University
mrm366@cornell.edu
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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)

a. Edkã hihcok kokko:lit
  ‘saw Ed, and sat down.’ (Rising 1992: 4)

b. Edkã hi:ca-k kokko:lit
  ‘saw Ed, and he [Ed] sat down.’

- In (1a), the morpheme -k (SS) on the second verb hihcok (‘see’) indicates that its subject, Joe, is the same as the subject of the final verb kokko:lit (‘sat down’).
- In (1b), the -n (DS) on the second verb hihcan (‘see’) indicates that its subject, Joe, is not the subject of the final verb kokko:lit (‘sat down’), but instead the object of hihcan, Ed, is.
- Consider the English equivalent of (1) in (2).

(2)

He in the third sentence could refer to either Joe or Ed.

1 All data examples are copied unchanged from their sources except in the nasalization marker in examples from Kimball, which I changed from \( V \) to \( \acute{V} \) and in the third line of the gloss. The third line of the gloss has been changed to better fit the Leipzig glossing conventions.

Gloss abbreviations: SS = SAME SUBJECT; DS = DIFFERENT SUBJECT; SBJ = SUBJECT; OBJ = OBJECT

- The English is ambiguous where the Koasati is not.
- They analyze SR as tracking events or situations, but I pursue a reference tracking analysis for Koasati SR.
- I model this data on switch reference using Predicate Logic with Anaphora (PLA; Dekker 1994), a system that maintains an ordered list of individuals in a discourse.

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
§A Two list fragment

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 reference and SR.

Notation for tables:

- Bold items in the table indicate overt arguments.

(1a) Joekak roomkã itcokhalihkok Edkã hihcok kokko:lit
  ‘Joe came into the room, saw Ed, and sat down.’ (Rising 1992: 4)
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.

### 3 Background on PLA

- Predicate Logic with Anaphora (PLA; Dekker 1994) extends standard Predicate Logic in order to keep track of individuals in a discourse.
- Has regular truth conditions, but a formula is interpreted as an update of an information state.

#### (3) A sample PLA information state

\[
s = \{\langle a, b, c \rangle \}
\]

- \( p_i \): index the position of the pronoun
- \( \Xi \): introduces individuals to information state

#### (2) Joe\(_j\) came into the room. He\(_j\) saw Ed\(_k\). He\(_j/k\) sat down.

### 4 One list analysis

- In English the ambiguity of *he* is represented in PLA by different pronoun terms: \( p_0 \) and \( p_1 \).
- The lack of ambiguity in the Koasati data can be captured by translating the subject agreement marker as \( p_0 \) and object agreement marker as \( p_1 \).
- Further, the switch reference markers can be translated so that the DS marker swaps the order of the individuals in the \( p_0 \) and \( p_1 \) positions and the SS marker maintains the order.

#### (4) SS Marker

\[
s_0 = \{a, b, c\} \quad SS \quad s_{n+1} = \{\langle a, b, c, b, c \rangle\}
\]

#### (5) DS Marker

\[
s_0 = \{a, b, c\} \quad DS \quad s_{n+1} = \{\langle a, b, c, c, b \rangle\}
\]

### 5 Table 5: Analysis of other translation of (2)

<table>
<thead>
<tr>
<th>English</th>
<th>PLA</th>
<th>Pro. Interpr.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Joe(_j) came into the room.</td>
<td>( \exists x (x = j \land \exists y (y = r \land boy)) )</td>
<td>( s_0 = {} )</td>
<td>( s_1 = {(r, j)} )</td>
</tr>
<tr>
<td>b. Joe(_j) came into the room.</td>
<td>( \exists x (x = p_0 \land \exists z (z = b)) )</td>
<td>( p_0 \rangle s_1 = j )</td>
<td>( s_2 = {(r, j, e)} )</td>
</tr>
<tr>
<td>c. He(_j) saw Ed(_k).</td>
<td>( \exists y (y = e \land boy) )</td>
<td>( p_0 \rangle s_1 = j )</td>
<td>( s_2 = {(r, j, e)} )</td>
</tr>
<tr>
<td>d. He(_j) sat down.</td>
<td>( C_p )</td>
<td>( p_1 \rangle s_2 = c )</td>
<td>( s_3 = {(r, j, e)} )</td>
</tr>
</tbody>
</table>

### 6 Table 6: Analysis of (1)

<table>
<thead>
<tr>
<th>English</th>
<th>Gloss</th>
<th>PLA</th>
<th>Pronoun Interp.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Joe-SBJ</td>
<td>( \exists z (z = j) )</td>
<td></td>
<td>( s_1 = {(j)} )</td>
<td></td>
</tr>
<tr>
<td>b. room-OBJ</td>
<td></td>
<td>( \exists x (x = p_0 \land \exists z (z = r)) )</td>
<td></td>
<td>( s_2 = {(j, r, j)} )</td>
</tr>
<tr>
<td>c. enter</td>
<td>( l p_0 p_1 )</td>
<td></td>
<td>( p_1 \rangle s_2 = r, [p_0]_s_1 = j )</td>
<td>( s_3 = {(j, r, j)} )</td>
</tr>
<tr>
<td>d. (-SS)</td>
<td>( \exists x (x = p_0 \land \exists y (y = p_1)) )</td>
<td></td>
<td>( p_1 \rangle s_3 = r, [p_0]_s_1 = j )</td>
<td>( s_4 = {(j, r, j, r)} )</td>
</tr>
</tbody>
</table>

### 7 Table 3: Breakdown of (1b)

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

### 8 Table 4: Analysis of one translation of (2)

<table>
<thead>
<tr>
<th>English</th>
<th>PLA</th>
<th>Pro. Interpr.</th>
<th>Output State</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Joe(_j) came into the room.</td>
<td>( \exists x (x = j \land \exists y (y = r \land boy)) )</td>
<td></td>
<td>( s_0 = {} )</td>
</tr>
<tr>
<td>b. Joe(_j) came into the room.</td>
<td>( \exists x (x = p_0 \land \exists z (z = b)) )</td>
<td></td>
<td>( s_1 = {(r, j)} )</td>
</tr>
<tr>
<td>c. He(_j) saw Ed(_k).</td>
<td>( \exists y (y = e \land boy) )</td>
<td>( [p_0]_s_1 = j )</td>
<td>( s_2 = {(r, j, e)} )</td>
</tr>
<tr>
<td>d. He(_j) sat down.</td>
<td>( C_p )</td>
<td>( [p_1]_s_2 = c )</td>
<td>( s_3 = {(r, j, e)} )</td>
</tr>
</tbody>
</table>

- In (b), the narrow scope quantifier adds \( r \) to the information state first.
- Then the broad scope quantifier adds \( j \) to the information state.
5 A problem

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

5.1 Two list analysis

- I adapt PLA to be a two list system
- Bittner (2001) uses a two list system for anaphora and also applies it in an analysis of the obviative system in Kalallit (West Greenlandic) (Bittner 2011)
- Little and Moroney (2016) use a two list system related to the one presented here in an analysis of obviatiion in Mi'gmaq

(7) A sample two list information state

\[
\begin{align*}
\{(a, b), (c, d)\} \\
\end{align*}
\]

- a-SBJ: \(\exists z (z = a)\)
- b-OBJ: \(\exists z (z = b)\)
- trans. verb: \(V_{p_0} \top\)
- intrans. verb: \(V_{p_0} \top\)
- SS: \(\exists y (y = p_0)\)
- DS: \(\exists y (y = p_0)\)

(8) SS marker

\[
\begin{align*}
\{(a, b), (c, d)\} & \xrightarrow{SS} s_{n+1} = \{(a, b), (c, d, b, d)\} \\
\end{align*}
\]

(9) DS marker

\[
\begin{align*}
\{(a, b), (c, d)\} & \xrightarrow{DS} s_{n+1} = \{(a, b, d), (c, d, b)\} \\
\end{align*}
\]
5.2 Accounting for data

- The two list system can still account for the initial data:

Table 12: 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. Joe-SBJ</td>
<td>$\exists z (z = j)$</td>
<td></td>
<td>$s_1 = {(j, j)}$</td>
</tr>
<tr>
<td>b. room-OBJ</td>
<td>$\exists z (z = r)$</td>
<td></td>
<td>$s_2 = {(j, r)}$</td>
</tr>
<tr>
<td>c. enter</td>
<td>$l_p^0 p_0^+$</td>
<td></td>
<td>$s_3 = {(j, r)}$</td>
</tr>
<tr>
<td>d. -SS</td>
<td>$\exists x (x = p_0^+ \land \exists y (y = p_0^-))$</td>
<td>$[p_0^+]<em>{j_5} = j, [p_0^-]</em>{j_5} = r$</td>
<td>$s_4 = {(j, r, j, r)}$</td>
</tr>
</tbody>
</table>

Table 13: 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. Ed-OBJ</td>
<td>$\exists z (z = e)$</td>
<td></td>
<td>$s_5 = {(j, r, j, e)}$</td>
</tr>
<tr>
<td>f. see</td>
<td>$H_p^0 p_0$</td>
<td></td>
<td>$s_6 = {(j, r, j, e)}$</td>
</tr>
<tr>
<td>g. -SS</td>
<td>$\exists y (y = p_0^+) \land \exists x (x = p_0^-)$</td>
<td>$[p_0^+]<em>{j_6} = j, [p_0^-]</em>{j_6} = e$</td>
<td>$s_7 = {(j, r, j, e, j)}$</td>
</tr>
<tr>
<td>h. sat_down</td>
<td>$C_0^p$</td>
<td></td>
<td>$s_8 = {(j, r, j, e, j)}$</td>
</tr>
</tbody>
</table>

Table 14: 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. Ed-OBJ</td>
<td>$\exists z (z = e)$</td>
<td></td>
<td>$s_5 = {(j, r, j, e)}$</td>
</tr>
<tr>
<td>f. see</td>
<td>$H_p^0 p_0$</td>
<td></td>
<td>$s_6 = {(j, r, j, e)}$</td>
</tr>
<tr>
<td>g. -DS</td>
<td>$\exists y (y = p_0^+) \land \exists x (x = p_0^-)$</td>
<td>$[p_0^+]<em>{j_6} = j, [p_0^-]</em>{j_6} = e$</td>
<td>$s_7 = {(j, r, j, e, j)}$</td>
</tr>
<tr>
<td>h. sat_down</td>
<td>$C_0^p$</td>
<td></td>
<td>$s_8 = {(j, r, j, e, j)}$</td>
</tr>
</tbody>
</table>

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

Table 15: Analysis of (6)

<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</td>
<td>$\exists z (z = j)$</td>
<td></td>
<td>$s_1 = {(j, j)}$</td>
</tr>
<tr>
<td>b. room-OBJ</td>
<td>$\exists z (z = r)$</td>
<td></td>
<td>$s_2 = {(j, r)}$</td>
</tr>
<tr>
<td>c. enter</td>
<td>$l_p^0 p_0^+$</td>
<td></td>
<td>$s_3 = {(j, r)}$</td>
</tr>
<tr>
<td>d. -DS</td>
<td>$\exists y (y = p_0^+) \land \exists x (x = p_0^-)$</td>
<td>$[p_0^+]<em>{j_5} = j, [p_0^-]</em>{j_5} = j$</td>
<td>$s_4 = {(j, r, j, j)}$</td>
</tr>
</tbody>
</table>

Table 16: Analysis of (6a)

<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</td>
<td>$\exists z (z = e)$</td>
<td></td>
<td>$s_5 = {(j, r, e, j)}$</td>
</tr>
<tr>
<td>f. see</td>
<td>$H_p^0 p_0$</td>
<td></td>
<td>$s_6 = {(j, r, e, j)}$</td>
</tr>
<tr>
<td>g. -DS</td>
<td>$\exists y (y = p_0^+) \land \exists x (x = p_0^-)$</td>
<td>$[p_0^+]<em>{j_6} = j, [p_0^-]</em>{j_6} = j$</td>
<td>$s_7 = {(j, r, e, j, j)}$</td>
</tr>
<tr>
<td>h. sat_down</td>
<td>$C_0^p$</td>
<td></td>
<td>$s_8 = {(j, r, e, j, j, e)}$</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
- The two list analysis is better equipped to capture the data
- There is more work to be done to capture more complex data (plural, indexicals, ditransitives)

References


A  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. \[ A = \{p_i^T \mid i \in \mathcal{N}\} \] (entity) pronouns of list \( T \)
4. \[ B = \{p_i^\perp \mid i \in \mathcal{N}\} \] (entity) pronouns of list \( \perp \)
5. \[ T = C \cup V \cup A \cup B \] (entity) terms
6. \[ R^n = \{A^1,\ldots,A^n,B^1,\ldots,Z^n\} \] 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 \( Rt_1\ldots t_n \in L \)
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 \( \exists^T x \phi \in L \)
5. If \( \phi \in L \) and \( x \in V \), then \( \exists^\perp x \phi \in L \)
6. If \( \phi, \psi \in L \), then \( (\phi \land \psi) \in L \)

**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 \( \perp \) list and \( a + b = n \)
2. \[ S = \bigcup_{n \in \mathbb{N}} S^n \] 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 \( e = (d_1^j,\ldots,d_n^j) \in s, d_j^j \) is a possible value for the \( j \)-th subject of \( s \), also indicated as \( e_j^j \).
4. For a state \( s \in S^n \), where \( a + b = n \) and \( 0 < k \leq b \), and for any case \( e = (d_1^k,\ldots,d_n^k) \in s, d_k^j \) is a possible value for the \( k \)-th subject of \( s \), also indicated as \( e_k^j \).
5. \( s_0 = \{\langle \langle \rangle,\langle \rangle\rangle\} \) (the initial state of information: \( D^a \times D^b \))
6. \( \top^n = D^a \times D^b \) (the maximal state of information about \( n \) subjects, where \( a + b = n \))
7. \( \{e\} \) for any \( e = (d_1^1,\ldots,d_n^1) \in D^a \times D^b \) (the maximal state of information, where \( a + b = n \))
8. \( \perp^n = \{\} \) (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 \( e \cdot e' = (e_1,\ldots,e_n,e'_1,\ldots,e'_m) \in D^{a+m} \)
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 \( \forall e^+ \in e' \exists e'' : e'' \leq e \perp \perp e'' \)
4. For \( s \in S^n (i \in D^a) \), \( N_i = n(=a+b) \), \( N_a = a, N_b = b \), the number of subjects of \( s(i) \)

**DEFINITION 2.3** (Information Update)

1. State \( s' \) is an update of state \( s, s \leq s', \text{iff} N_i \leq N_{i'} \), and \( \forall e' \in s' \exists e \in s : e \leq e' \)

**DEFINITION 3.1** (Interpretation of Terms)

1. \([c]_{\mathfrak{A},s,e,g} = F(c) \) for all constants \( c \)
2. \([x]_{\mathfrak{A},s,e,g} = g(x) \) for all variables \( x \)
3. \( [p_i^T]_{\mathfrak{A},s,e,g} = e_{N_i-1} \) for all pronouns \( p_i^T \) and \( e \) and \( e^+ \) and \( s \) such that \( e^+ \in e \) and \( e \in s \) and \( N_i > i \)
4. \( [p_i^\perp]_{\mathfrak{A},s,e,g} = e_{N_i-1} \) for all pronouns \( p_i^\perp \) and \( e \) and \( e^+ \) and \( s \) such that \( e^+ \in e \) and \( e \in s \) and \( N_i > i \)

**DEFINITION 3.2** (Semantics of PLA)

1. \( s[R_{t_1\ldots t_n}]_{\mathfrak{A},s,e,g} = \{e \mid (t_1]_{\mathfrak{A},s,e,g},\ldots;[n]_{\mathfrak{A},s,e,g}) \in F(R) \} \) (if \( N_i > h_1,\ldots,h_n \))
2. \( s[t_1 = t_2]_{\mathfrak{A},s,e,g} = \{e \mid [t_1]_{\mathfrak{A},s,e,g} = [t_2]_{\mathfrak{A},s,e,g} \}
3. \( s[\neg \phi]_{\mathfrak{A},s,e,g} = \{e \mid \neg \exists e' : e \leq e' \perp e \in s[\phi]_{\mathfrak{A},s,e,g} \}
4. \( s[\exists^T x \phi]_{\mathfrak{A},s,e,g} = \{e \mid [e^+ \cdot d, e^+] \in s[\phi]_{\mathfrak{A},s,e,g}(x/d) \}
5. \( s[\exists^\perp x \phi]_{\mathfrak{A},s,e,g} = \{e \mid [e^+, e^+ \cdot d] \in s[\phi]_{\mathfrak{A},s,e,g}(x/d) \}
6. \( s[\phi \land \psi]_{\mathfrak{A},s,e,g} = s[\phi]_{\mathfrak{A},s,e,g}[\psi]_{\mathfrak{A},s,e,g} \)

**DEFINITION 4.1** (Support and Entailment)

1. \( \phi \) \emph{supports} \( \phi \) \emph{wrt} \( \mathfrak{A} \) and \( s \), \( s \vdash_{\mathfrak{A},s,e,g} \phi \) if \( \forall e \in s : \exists e' : e \leq e' \perp e \in s[\phi]_{\mathfrak{A},s,e,g} \)
2. \( \phi_1,\ldots,\phi_n \) \emph{entail} \( \psi \) \emph{wrt} \( \mathfrak{A},g \) \emph{wrt} \( v \in S : s[\phi_1]_{\mathfrak{A},s,e,g} \cdots [\phi_n]_{\mathfrak{A},s,e,g} \vdash_{\mathfrak{A},g} \psi \) (if defined)