Reciprocal scope ambiguity and scope marking

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joint work with Dag Haug, University of Oslo

Workshop ‘Cross-Linguistic Semantics of Reciprocals’
Utrecht, 7 October 2019
Plan

- Relational analysis of reciprocals
- Reciprocal scope and its analysis in Partial Plural Compositional DRT (Brasoveanu, 2007; Haug, 2014)
- Verbal affixes and reciprocal scope
Chris and Tracy saw each other.

a. Polyadic quantification (Dalrymple et al., 1998):
   \[
   \text{RECIP}\left(\{\text{CHRIS, TRACY}\}, \lambda x, y. \text{SEE}(x, y)\right)
   \]

b. Distribution (Heim et al., 1991):
   \[
   \forall x, y \in \{\text{CHRIS, TRACY}\}. y \neq x \rightarrow \text{SEE}(x, y)
   \]
Chris and Tracy thought that they saw each other.

a. Chris and Tracy thought: “We saw each other.” ("narrow scope")
b. Chris and Tracy thought: “I saw her (= the other).” ("wide scope")

Seems to provide good motivation for treating the reciprocal as a quantificational/distributive operator which can take wide or narrow scope.
Reciprocal scope ambiguity and scope marking

The reciprocal as a quantificational/distributional operator

Scope ambiguity in an operator-based setting:

**Chris and Tracy thought that they saw each other.**

a. Narrow scope/“we” reading (C and T think: We saw each other):
   \[
   \text{THINK}\left(\{\text{CHRIS, TRACY}\}, \text{RECIP}\left(\{\text{CHRIS, TRACY}\}, \lambda x, y. \text{SEE}(x, y)\right)\right)
   \]

b. Wide scope/“I” reading (C thinks: I saw T, T thinks: I saw C):
   \[
   \text{RECIP}\left(\{\text{CHRIS, TRACY}\}, \lambda x, y. \text{THINK}(x, \text{SEE}(x, y))\right)
   \]
Problems for quantificational/distributional analyses

Many languages express reciprocals and reflexives by the same means (Murray 2008, on Cheyenne; Palmieri, this workshop):

Ka’èškóne-ho é-axeen-àhtse-o’o
child-PL.AN 3-scratch.AN-ahte-3PL.AN

a. Some children scratched themselves. [reflexive construal]
b. Some children scratched each other. [reciprocal construal]
c. Some of the children scratched each other while others scratched themselves. [mixed construal]

If the reciprocal is a distributive/quantificational operator, it shares no aspect of its meaning in common with the reflexive. Why do so many languages allow these underspecified readings?
Problems for quantificational/distributional analyses

Limits to scope relative to other quantifiers (Williams, 1991):

Someone or other has thought that Tracy and Chris like each other.

a. $\exists > each\ other$ available (Someone or other has thought: “Tracy and Chris like each other.”)

b. $each\ other > \exists$ unavailable (Each of Tracy and Chris is such that someone or other has thought that he likes the other.)

Why doesn’t the reciprocal operator scope like other operators?
Reciprocal scope ambiguity and scope marking

Problems for quantificational/distributional analyses

Collective readings for reciprocal antecedents (Dotlačil, 2013):

a. The sailors have worked together on each other’s ships.

b. They have rarely appeared together on each other’s social media accounts and in paparazzi shots.

How can the reciprocal be a distributive operator if the antecedent can have a collective reading?
More problems for quantificational/distributional analyses

- Limits to scope relative to modals (Asudeh, 1998)
- Multiple reciprocals: *The children gave each other pictures of each other.*
- Mixed individual/group readings: *The gravitational fields of the Earth, the Sun and the Moon cancel each other out.* (Dalrymple et al., 1998)
- Reciprocals pattern with plurals and unlike quantifiers in distributive and cumulative readings (Williams, 1991; Dotlačil, 2013)
- ... (see Haug & Dalrymple 2019 for discussion of additional problems)
A relational analysis fares better, as argued by Sternefeld (1998), Beck (2001), Murray (2008), and Dotlačil (2013).

But these analyses do not address the scope ambiguity that motivates the operator-based analysis.
Our analysis

- Compositional Discourse Representation Theory (Muskens, 1996)
- Plural CDRT and the relational analysis of reciprocity (Brasoveanu, 2007; Dotlačil, 2013)
- Shortcomings of the Plural CDRT analysis; Reciprocal scope and its analysis in Partial Plural Compositional DRT (Haug & Dalrymple, 2019)
**Compositional Discourse Representation Theory**

**A cat appeared.**

\[
\begin{array}{|c|}
\hline
x_1 \\
\hline
\end{array}
\]

**DRS:**

\[
\begin{align*}
\text{cat}(x_1) \\
\text{appear}(x_1)
\end{align*}
\]

is an abbreviation for:

\[
\lambda i. \lambda o. i[x_1] o \land \text{cat}(\nu(o)(x_1)) \land \text{appear}(\nu(o)(x_1))
\]

- \(i\) and \(o\) are information states
- \(x_1\) is a discourse referent
- \(i[x_1] o\): states \(i\) and \(o\) differ at most with respect to the individual assigned to \(x_1\)
- \(\nu\) is a non-logical constant which interprets discourse referents in particular states;
- so \(\nu(o)(x_1)\) denotes an individual cat who appeared
Plural Compositional DRT

- Van den Berg (1996), Plural DRT: DRSs are not relations between information states, but relations between sets of information states.

- Brasoveanu (2007): Plural DRT + Compositional DRT = Plural Compositional DRT

- In Plural (C)DRT, a single discourse referent can range over multiple individuals across the assignments in each state.
**Cats appeared in Plural CDRT**

a. **Cats appeared.**

\[
\begin{array}{|c|}
\hline
x_1 \\
\hline
\end{array}
\]

b. \[\text{cat}(x_1) \quad \text{appear}(x_1)\]

c. \[\lambda I. \lambda O. I[x_1]O \land \forall o \in O. \text{cat}(\nu(o)(x_1)) \land \text{appear}(\nu(o)(x_1))\]

- I and O are sets of information states
- In each output state \(o\) in \(O\), \(x_1\) is a cat that appeared (but possibly a different cat in different states).
Summing across assignments:

Two cats appeared in Plural CDRT

a. Two cats appeared.

<table>
<thead>
<tr>
<th>x₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>cat(x₁)</td>
</tr>
<tr>
<td>2-atoms(∪x₁)</td>
</tr>
<tr>
<td>appear(x₁)</td>
</tr>
</tbody>
</table>

b.  
λI.λO.[x₁]O ∧ ∀o ∈ O.cat(ν(o)(x₁))
   ∧ 2-atoms(∪o∈O ν(o)(x₁))
   ∧ appear(ν(o)(x₁))

In each output state o in O, x₁ is a cat that appeared; and when we sum over the values of x₁ across assignments (2-atoms(∪x₁)), we get two cats.
Reciprocals in Plural CDRT


a. **Two girls**\(^1\) **saw each other**\(^2\).

\[
\begin{array}{c|c|c}
 x_1 & x_2 \\
\hline
 2-\text{atoms}(\cup x_1) \\
 \text{girl}(x_1) \\
 \cup x_1 = \cup x_2 \\
 x_1 \neq x_2 \\
 \text{see}(x_1, x_2)
\end{array}
\]

b.
Reciprocals in Plural CDRT

Two girls saw each other.

- Coreference requirement: cumulative identity between each other and its antecedent across assignments
- Noncoreference requirement: Distinct individuals within each assignment

Sample output state:

<table>
<thead>
<tr>
<th></th>
<th>$x_1$</th>
<th>$x_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$o_1$</td>
<td>girl$_1$</td>
<td>girl$_2$</td>
</tr>
<tr>
<td>$o_2$</td>
<td>girl$_2$</td>
<td>girl$_1$</td>
</tr>
</tbody>
</table>
Reciprocal scope ambiguity and scope marking

Reciprocals in Plural CDRT

Two girls saw each other.

\[
\begin{array}{|c|c|}
\hline
x_1 & x_2 \\
\hline
\end{array}
\]

2-\textit{atoms}(\bigcup x_1)

girl(x_1)

\bigcup x_1 = \bigcup x_2

x_1 \neq x_2

see(x_1, x_2)

- Coreference requirement: cumulative identity between \textit{each other} and its antecedent across assignments

- Noncoreference requirement: Distinct individuals within each assignment

Sample output state:

\[
\begin{array}{|c|c|c|}
\hline
o & x_1 & x_2 \\
\hline
1 & \text{girl}_1 & \text{girl}_2 \\
2 & \text{girl}_2 & \text{girl}_1 \\
\hline
\end{array}
\]
Reciprocal scope ambiguity and scope marking

Reciprocals in Plural CDRT

Two girls saw each other.

<table>
<thead>
<tr>
<th>$x_1$</th>
<th>$x_2$</th>
</tr>
</thead>
</table>

2-atoms($\cup x_1$)
girl($x_1$)
$\cup x_1 = \cup x_2$
$x_1 \neq x_2$
see($x_1, x_2$)

- Coreference requirement: cumulative identity between each other and its antecedent across assignments

- Noncoreference requirement: Distinct individuals within each assignment

Sample output state:

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<tbody>
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<td>girl$_2$</td>
</tr>
<tr>
<td>$o_2$</td>
<td>girl$_2$</td>
<td>girl$_1$</td>
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Reciprocal scope ambiguity and scope marking

Reciprocals in Plural CDRT

Two girls saw each other.

\[
x_1, x_2
\]

- Coreference requirement: cumulative identity between each other and its antecedent across assignments
- Noncoreference requirement: Distinct individuals within each assignment

Sample output state:

<table>
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<tr>
<th></th>
<th>(x_1)</th>
<th>(x_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(o_1)</td>
<td>girl_1</td>
<td>girl_2</td>
</tr>
<tr>
<td>(o_2)</td>
<td>girl_2</td>
<td>girl_1</td>
</tr>
</tbody>
</table>
Reciprocal/reflexive underspecification solved

Many languages express reciprocals and reflexives by the same means and allow mixed/underspecified readings (Murray, 2008, on Cheyenne). Solution: Keep requirement for sum equality across assignments, remove requirement for distinctness within each assignment.

Underspecified \([\text{REFL}/\text{RECIP}^u_n] = \lambda P.\]

\[
\begin{array}{|c|}
\hline
u_n \\
\hline
\end{array}
\]

\[
\bigcup u_m = \bigcup u_n \quad ; P(u_n)
\]

\[
\begin{array}{|c|}
\hline
u_n \\
\hline
\end{array}
\]

\[
\bigcup u_m = \bigcup u_n 
\]

\[
; P(u_n)
\]
Reciprocal/reflexive underspecification solved

Many languages express reciprocals and reflexives by the same means and allow mixed/underspecified readings (Murray, 2008, on Cheyenne). Solution: *Keep requirement for sum equality across assignments*, remove requirement for distinctness within each assignment.

\[
\text{Underspecified } \left[ REFL/RECIP_{u_m}^{u_n} \right] = \lambda P. \\
\text{ } \cup u_m = \cup u_n \\
\text{ } u_m \neq u_n \\
\text{ } ; P(u_n)
\]

\[
\text{ } u_n \\
\text{ } \cup u_m = \cup u_n \\
\text{ } ; P(u_n)
\]
Many languages express reciprocals and reflexives by the same means and allow mixed/underspecified readings (Murray, 2008, on Cheyenne).
Solution: Keep requirement for sum equality across assignments, remove requirement for distinctness within each assignment.

\[ \text{Reciprocals: } \left[ \text{RECIP}_{u_m}^{u_n} \right] = \lambda P. \]
\[ \bigcup u_m = \bigcup u_n \quad ; \quad P(u_n) \]
\[ u_m \neq u_n \]

\[ \text{Underspecified: } \left[ \text{REFL/RECIP}_{u_m}^{u_n} \right] = \lambda P. \]
\[ \bigcup u_m = \bigcup u_n \quad ; \quad P(u_n) \]
Collective readings solved

Collective readings for reciprocal antecedents (Dotlačil, 2013):

The sailors have worked together on each other’s ships.

\[ \begin{array}{ccc}
  x_1 & x_2 & x_3 \\
  \hline \\
  \text{sailor}(x_1) \\
  \text{work.together}(\bigcup x_1) \\
  \text{on}(x_1, x_2) \\
  \text{ship.of}(x_2, x_3) \\
  \bigcup x_1 = \bigcup x_3 \\
  x_1 \neq x_3 \\
\end{array} \]

\(x_1\) and \(x_3\) are distinct in each assignment, but because \(x_1\) is interpreted collectively, we correctly predict that this does not matter.
How to handle scope ambiguities?

- Plural CDRT models anaphoric relations through identification of discourse referents.

- Input to semantics contains (co)indexing:
  Two girls$^1$ said that they$_1$ saw each other$_2$.

- *Two girls* and *they* are both associated with the index 1 ⇒
  No way to distinguish narrow and wide scope readings.

- Need a more fine-grained theory of anaphora.
Partial Compositional Discourse Representation Theory

Haug (2014): **Chris**\(^1\) was happy. **He**\(^2\) had won.

<table>
<thead>
<tr>
<th>(x_1)</th>
<th>(\bar{x}_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chris((x_1))</td>
<td>(\lambda i.\lambda o.\partial(i[x_1 x_2]o)\land Chris(\nu(o)(x_1))\land)</td>
</tr>
<tr>
<td>happy((x_1))</td>
<td>happy((\nu(o)(x_1))\land)</td>
</tr>
<tr>
<td>had.won((x_2))</td>
<td>had.won((\nu(o)(x_2))\land)</td>
</tr>
<tr>
<td>(, A(x_2) = x_1)</td>
<td>(\partial(\nu(o)(x_2) = \nu(o)(A(x_2))))</td>
</tr>
</tbody>
</table>

**Different discourse referents** for the pronoun (*he*) and its antecedent (*Chris*). Anaphora resolution is presupposed, but anaphoric relation is specified “on the side”, via \(A\).
Partial Compositional Discourse Representation Theory

- For our purposes, it is sufficient to distinguish the discourse referent of the anaphor and its antecedent; we are not concerned with underspecification or the pragmatics of anaphoric relations.
- From now on, we provide abbreviated/simplified DRSs: $x_2 = x_1$ in the DRS represents the anaphoric relation $A(x_1, x_2)$.

Chris$^1$ was happy. He$^2_1$ had won.

Abbreviated DRS with resolved anaphor:

<table>
<thead>
<tr>
<th>$x_1$</th>
<th>$x_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chris($x_1$)</td>
<td>had.won($x_2$)</td>
</tr>
<tr>
<td>happy($x_1$)</td>
<td>$x_2 = x_1$</td>
</tr>
</tbody>
</table>
Partial Plural Compositional Discourse Representation Theory

Move to Plural setting, with sets of input and output states: Partial Plural CDRT.

Tracy and Chris\(^1\) were happy. They\(^2\) had won:

<table>
<thead>
<tr>
<th>(x_1)</th>
<th>(x_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(tracy\text{-}and\text{-}chris(\bigcup x_1))</td>
<td></td>
</tr>
<tr>
<td>(happy(x_1))</td>
<td></td>
</tr>
<tr>
<td>(had\text{-}won(x_2))</td>
<td></td>
</tr>
<tr>
<td>(x_2 = x_1)</td>
<td></td>
</tr>
</tbody>
</table>
Attractive analogy due to Williams (1991): The ambiguity in (1) is like the ambiguity in (2).

(1) Two girls\textsuperscript{1} thought that they\textsuperscript{2} saw each other\textsuperscript{3}.

a. Both girls thought: “We saw each other.” (“narrow scope”)
b. Both girls thought: “I saw her (= the other).” (“wide scope”)

(2) Two girls\textsuperscript{1} thought that they\textsuperscript{2} would win.

a. Both girls thought: “We will win.” (“narrow scope”)
b. Both girls thought: “I will win.” (“wide scope”)

"We" and "I" readings
Reciprocal scope ambiguity and scope marking

Narrow scope/“we” reading

Ignoring intensionality (see Haug & Dalrymple 2019 for the full treatment):

Two girls thought that they would win.

(= Both girls thought: “We will win.”)

Cumulative coreference between girls and they:

\[
\begin{align*}
\text{think} & \left( x_1, \begin{array}{c}
\text{girl}(x_1) \\
\text{2-atoms}(\bigcup x_1)
\end{array} \right) \\
\bigcup x_2 & = \bigcup x_1 \\
\text{win}(x_2)
\end{align*}
\]

\[
\begin{array}{|c|c|c|}
\hline
\text{s}_{1a} & \text{girl}_1 & \text{girl}_1 \\
\text{s}_{1b} & \text{girl}_1 & \text{girl}_2 \\
\text{s}_{2a} & \text{girl}_2 & \text{girl}_1 \\
\text{s}_{2b} & \text{girl}_2 & \text{girl}_2 \\
\hline
\end{array}
\]
Narrow scope/“we” reading

Ignoring intensionality (see Haug & Dalrymple 2019 for the full treatment):

Two girls thought that they would win.

(= Both girls thought: “We will win.”)

Cumulative coreference between girls and they:

\[
\begin{array}{|c|cc|}
\hline
& x_1 & x_2 \\
\hline
girl(x_1) & & \\
2-atoms(\bigcup x_1) & & \\
think(x_1, ) & & \\
\hline
\end{array}
\]

\[
\begin{array}{|c|cc|}
\hline
s_{1a} & girl_{1} & girl_{1} \\
\hline
s_{1b} & girl_{1} & girl_{2} \\
\hline
s_{2a} & girl_{2} & girl_{1} \\
\hline
s_{2b} & girl_{2} & girl_{2} \\
\hline
\end{array}
\]

\[
\bigcup x_2 = \bigcup x_1 \\
\text{win}(x_2)
\]

Reciprocal scope ambiguity and scope marking
Narrow scope/"we" reading

Ignoring intensionality (see Haug & Dalrymple 2019 for the full treatment):

Two girls thought that they would win.

(= Both girls thought: "We will win.")

Cumulative coreference between girls and they:

\[
\begin{array}{c|cc}
\text{think(} x_1, \text{ } \forall x_2 \text{ } \bigcup x_2 = \bigcup x_1 \text{ } \forall x_2 \text{ } \text{win(} x_2 \text{)} \bigcup x_2 = \bigcup x_1 \\
\hline
x_1 & x_1 & x_2 \\
\text{girl(} x_1 \text{)} & \text{girl}_1 & \text{girl}_2 \\
\text{2-atoms(} \bigcup x_1 \text{)} & \text{girl}_1 & \text{girl}_2 \\
\end{array}
\]
Two girls thought that they would win.
(= Both girls thought: “I will win.”)
Individual coreference between girls and they:

\[
\begin{array}{c|cc}
\text{think}(x_1, \\
\text{girl}(x_1) \\
\text{2-atoms}(\bigcup x_1) \\
\text{win}(x_2) \\
x_2 = x_1 \\
x_1, x_2 \\
s_1 & \text{girl}_1 & \text{girl}_1 \\
s_2 & \text{girl}_2 & \text{girl}_1
\end{array}
\]
Two girls thought that they would win.

(= Both girls thought: “I will win.”)

Individual coreference between girls and they:

\[
\begin{array}{|c|c|c|}
\hline
s_1 & girl_1 & girl_1 \\
\hline
s_2 & girl_2 & girl_1 \\
\hline
\end{array}
\]
Wide scope/“I” reading

Two girls thought that they would win.
(= Both girls thought: “I will win.”)

Individual coreference between girls and they:

\[
\begin{array}{c|cc}
\text{think} \left( x_1, \begin{array}{c}
girl(x_1) \\
2-\text{atoms}(\bigcup x_1)
\end{array} \right) \\
\hline
x_2 = x_1 \\
\text{win}(x_2)
\end{array}
\]

<table>
<thead>
<tr>
<th></th>
<th>(x_1)</th>
<th>(x_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(s_1)</td>
<td>girl(_1)</td>
<td>girl(_1)</td>
</tr>
<tr>
<td>(s_2)</td>
<td>girl(_2)</td>
<td>girl(_1)</td>
</tr>
</tbody>
</table>
Reciprocals: Narrow scope/“we” reading

Two girls thought that they saw each other.
(＝ Both girls thought: “We saw each other.”)
Cumulative coreference between girls and they:

\[
\begin{array}{|c|c|c|}
\hline
s_{1a} & \text{girl}_1 & \text{girl}_1 & \text{girl}_2 \\
\hline
s_{1b} & \text{girl}_1 & \text{girl}_2 & \text{girl}_1 \\
\hline
s_{2a} & \text{girl}_2 & \text{girl}_1 & \text{girl}_2 \\
\hline
s_{2b} & \text{girl}_2 & \text{girl}_2 & \text{girl}_1 \\
\hline
\end{array}
\]
Reciprocals: Narrow scope/"we" reading

Two girls thought that they saw each other.
(＝ Both girls thought: “We saw each other.”)
Cumulative coreference between girls and they:

\[
girl(x_1) \\
2-atoms(\cup x_1) \\
think\left( x_1, \begin{array}{c} x_2 \\ \cup x_2 = \cup x_1 \\
\cup x_3 = \cup x_2 \\
x_3 \neq x_2 \\
see(x_2, x_3) \end{array} \right) \\
\]

<table>
<thead>
<tr>
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<th>(x_1)</th>
<th>(x_2)</th>
<th>(x_3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(s_{1a})</td>
<td>girl_1</td>
<td>girl_1</td>
<td>girl_2</td>
</tr>
<tr>
<td>(s_{1b})</td>
<td>girl_1</td>
<td>girl_2</td>
<td>girl_1</td>
</tr>
<tr>
<td>(s_{2a})</td>
<td>girl_2</td>
<td>girl_1</td>
<td>girl_2</td>
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<tr>
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<td>girl_2</td>
<td>girl_1</td>
</tr>
</tbody>
</table>
Reciprocals: Narrow scope/“we” reading

Two girls thought that they saw each other. 
(= Both girls thought: “We saw each other.”)
Cumulative coreference between girls and they:

\[
\begin{array}{c}
girl(x_1) \\
2\text{-atoms}(\cup x_1) \\
\text{think}\left( x_1, \begin{array}{c} x_2 \\ x_3 \end{array} \right) \\
\cup x_2 = \cup x_1 \\
\cup x_3 = \cup x_2 \\
x_3 \neq x_2 \\
see(x_2, x_3) \\
\end{array}
\]

<table>
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<th>$x_3$</th>
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<td>girl$_1$</td>
<td>girl$_1$</td>
<td>girl$_2$</td>
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<td>girl$_2$</td>
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Reciprocals: Narrow scope/"we" reading

Two girls thought that they saw each other. 
(= Both girls thought: “We saw each other.”)
Cumulative coreference between girls and they:

\[
\begin{array}{|c|c|c|c|}
\hline
& x_1 & x_2 & x_3 \\
\hline
s_{1a} & girl_1 & girl_1 & girl_2 \\
\hline
s_{1b} & girl_1 & girl_2 & girl_1 \\
\hline
s_{2a} & girl_2 & girl_1 & girl_2 \\
\hline
s_{2b} & girl_2 & girl_2 & girl_1 \\
\hline
\end{array}
\]
Reciprocal scope ambiguity and scope marking

Reciprocals: Wide scope/“I” reading

Two girls thought that they saw each other. (= Both girls thought: “I saw her (= the other).”)

NOT THIS:

On the wide scope reading, each girl’s thought is only about herself; no reciprocal meaning is involved in the thought. Williams’s analogy does not quite hold up.
Reciprocals: Wide scope/“I” reading

Two girls thought that they saw each other.
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**NOT THIS:**

<table>
<thead>
<tr>
<th>x₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>girl(x₁)</td>
</tr>
<tr>
<td>2-atoms(∪x₁)</td>
</tr>
<tr>
<td>think(x₁, )</td>
</tr>
<tr>
<td>x₂ x₃</td>
</tr>
<tr>
<td>x₂ = x₁</td>
</tr>
<tr>
<td>Ux₃ = Ux₂</td>
</tr>
<tr>
<td>x₃ ≠ x₂</td>
</tr>
<tr>
<td>see(x₂, x₃)</td>
</tr>
</tbody>
</table>

On the wide scope reading, each girl’s thought is only about herself; no reciprocal meaning is involved in the thought. Williams’s analogy does not quite hold up.
Reciprocals: Wide scope/“I” reading

Two girls thought that they saw each other.
(＝ Both girls thought: “I saw her (= the other).”)

We must lift the coreference/noncoreference conditions to the main clause: reminiscent of scope approach, but without adopting an operator-based analysis.

\[
\begin{array}{c}
\text{girl}(x_1) \\
\text{2-atoms}(\cup x_1) \\
x_2 = x_1 \\
\cup x_3 = \cup x_2 \\
x_3 \neq x_2 \\
\text{think}(x_1, \text{see}(x_2, x_3))
\end{array}
\]
Reciprocals: Wide scope/“I” reading

Two girls thought that they saw each other.
(= Both girls thought: “I saw her (= the other).”)

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We must lift the coreference/noncoreference conditions to the main clause: reminiscent of scope approach, but without adopting an operator-based analysis.
Summary so far

- Problems with quantificational/distributional analyses
- A better approach: Relational analysis of reciprocity
- Plural Compositional DRT + Partial Compositional DRT = Advantages of relational approach, and an account of scope ambiguities.
Our Partial Plural Compositional Discourse Representation Theory analysis provides an account of other phenomena as well, including:

- Reciprocals with quantified antecedents: *Most boys know each other*, whose analysis has been problematic for operator-based approaches; see Dag’s poster.

- Locus for variation in strength of the reciprocal meaning: *The boys know each other* means that every boy knows every other boy, but *The boys gave measles to each other* means that every boy contracted measles from some other boy.
Summary: Scope ambiguity

Two girls thought that they saw each other.

Narrow scope, cumulative coreference between girls and they:

\[
\text{think}(x_1, x_2, x_3) \\
\text{girl}(x_1) \\
\text{2-atoms}(\bigcup x_1)
\]
Two girls thought that they saw each other.

Wide scope, individual coreference between girls and they:
Reciprocal scope ambiguity and scope marking

Summary: Scope ambiguity

Two girls thought that they saw each other.

Narrow scope:

<table>
<thead>
<tr>
<th>$x_1$</th>
</tr>
</thead>
</table>

$\text{girl}(x_1) \at \bigcup x_1$

$\text{think}(x_1, \bigcup x_2, \bigcup x_3)$

- **Reciprocal predicate**: the predicate whose arguments are required to be noncoreferent in each assignment (here, ‘see’)
- **Reciprocal scope**: the DRS where the coreference/noncoreference conditions appear
- **Basic assumption**: Reciprocal scope must contain the reciprocal predicate. This follows from quantifier raising or whatever the equivalent is in your favourite framework.
Summary: Scope ambiguity

Two girls thought that they saw each other.

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Reciprocal scope ambiguity and scope marking

Summary: Scope ambiguity

Two girls thought that they saw each other.

Wide scope:

\[
\begin{array}{c}
\text{girl}(x_1) \\
2-\text{atoms}(\cup x_1) \\
x_2 = x_1 \\
\cup x_3 = \cup x_2 \\
x_3 \neq x_2
\end{array}
\]

- **Reciprocal predicate**: the predicate whose arguments are required to be noncoreferent in each assignment (here, ‘see’)
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Reciprocal scope ambiguity and scope marking

Summary: Scope ambiguity

Two girls thought that they saw each other.

- **Reciprocal predicate**: the predicate whose arguments are required to be noncoreferent in each assignment (here, 'see')
- **Reciprocal scope**: the DRS where the coreference/noncoreference conditions appear
- **Basic assumption**: Reciprocal scope must contain the reciprocal predicate. This follows from quantifier raising or whatever the equivalent is in your favourite framework.
Reciprocal expression

English *each other*: No explicit scope marking.

- One argument of the *reciprocal predicate* is filled by *each other*, and the other is filled by its antecedent.
- **Reciprocal scope** is not syntactically fixed: any DRS containing the reciprocal predicate
Question 1: When the reciprocal is expressed by a verbal affix, how is the reciprocal predicate determined?

Question 2: When the reciprocal is expressed by a verbal affix, is the scope of the reciprocal fixed, or can it vary?

Claim: The reciprocal verbal affix fixes the reciprocal predicate, the reciprocal scope, or both.
Question 1: When the reciprocal is expressed by a verbal affix, how is the reciprocal predicate determined?

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Claim: The reciprocal verbal affix fixes the reciprocal predicate, the reciprocal scope, or both.
Reciprocal expression by verbal affix

- **Question 1**: When the reciprocal is expressed by a verbal affix, how is the reciprocal predicate determined?
- **Question 2**: When the reciprocal is expressed by a verbal affix, is the scope of the reciprocal fixed, or can it vary?
- **Claim**: The reciprocal verbal affix fixes the reciprocal predicate, the reciprocal scope, or both.
Verbal reciprocals

- **Balinese *ma***: Reciprocal predicate and scope are both fixed. In subordinate clauses, only narrow scope reading available.

- **Passamaquoddy *-utu***: Reciprocal predicate is fixed, but not reciprocal scope. In subordinate clauses, wide or narrow scope reading available.

- **Japanese *-aw***: Reciprocal scope is fixed, but not reciprocal predicate. Wide or narrow scope reading available, depending on where the affix appears.
Reciprocal scope ambiguity and scope marking

Balinese middle voice marker *ma* (Satyawati 2014; I Wayan Arka, p.c.):

Nyoman ajak Ketut *ma*-diman.

and  

MID-kiss

‘Nyoman and Ketut kissed (each other).’

(OR: ‘Nyoman and Ketut kissed themselves.’)

- Kissing must be mutual and simultaneous; we cannot say this if Nyoman kissed Ketut on the hand, and Ketut kissed Nyoman on the forehead.
Transitivity of *ma*-marked verbs

- The *ma*-marked verb is syntactically intransitive (Arka, 2004).
- Object comparison reading marginal but possible $\rightarrow$ semantically transitive, not argument-reducing (Sells et al., 1987)

[Wayan ajak Ketut] pepesan matepuk tekan [Nyoman ajak Made].
and often.COMPAR MID.see with and

‘Wayan and Ketut saw each other more than Nyoman and Made.’

Subject comparison reading available: W and K saw each other more than N and M saw each other.

Object comparison reading marginally available (but difficult): W and K saw each other more than they saw N and M.
Reciprocal scope ambiguity and scope marking

Balinese

Nyoman ajak Ketut ma-diman.
Nyoman and Ketut RECIP-kiss
‘Nyoman and Ketut kissed each other.’

<table>
<thead>
<tr>
<th>$x_1$</th>
<th>$x_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$Nyoman$-and-$Ketut(\bigcup x_1)$
$\bigcup x_2 = \bigcup x_1$
$x_2 \neq x_1$
$kiss(x_1, x_2)$

- The reciprocal relation ($kiss$) is contributed by the verb marked with $ma$-.
Reciprocal scope ambiguity and scope marking

Balinese

Nyoman ajak Ketut \textit{ma-diman}.
Nyoman and Ketut RECIP-kiss
‘Nyoman and Ketut kissed each other.’

\begin{center}
\begin{tabular}{|c|c|}
\hline
$x_1$ & $x_2$ \\
\hline
\end{tabular}
\end{center}

\textit{Nyoman-and-Ketut}($\cup x_1$)
$\cup x_2 = \cup x_1$
$x_2 \neq x_1$
\textit{kiss}(x_1, x_2)

- The reciprocal \textit{relation} (\textit{kiss}) is contributed by the verb marked with \textit{ma-}.
Reciprocal scope ambiguity and scope marking

Verbal morphology and scope: Balinese

Nyoman ajak Ketut ngorahang ma-tepuk.
    and       AV.say       MID-see

‘Nyoman and Ketut said that they saw each other.’

Narrow scope/“we” reading only.

Both reciprocal predicate and reciprocal scope are fixed by ma-:
Reciprocal scope is the DRS immediately containing the reciprocal predicate.
Verbal morphology and scope: Balinese

Nyoman ajak Ketut ngorahang ma-tepuk. Nyoman and Ketut AV.say RECIP-see ‘Nyoman and Ketut said that they saw each other.’

Narrow scope only:

\[
\begin{align*}
&\text{think}\left(\mathbf{x}_1,\right) \\
&\text{Nyoman-and-Ketut}\left(\bigcup\mathbf{x}_1\right)
\end{align*}
\]

- \( \bigcup\mathbf{x}_2 = \bigcup\mathbf{x}_1 \)
- \( \bigcup\mathbf{x}_3 = \bigcup\mathbf{x}_2 \)
- \( x_3 \neq x_2 \)
- \( \text{see}(x_2, x_3) \)
Verbal morphology and scope: Balinese

Nyoman ajak Ketut ngorahang *ma-tepuk*.
Nyoman and Ketut AV.say RECIP-see
‘Nyoman and Ketut said that they saw each other.’

Narrow scope only:

\[
\text{think} \left( x_1, \begin{array}{c} x_2 \ x_3 \\ \cup x_2 = \cup x_1 \\ \cup x_3 = \cup x_2 \\ x_3 \neq x_2 \\ \text{see}(x_2, x_3) \end{array} \right) \]
Reciprocal scope ambiguity and scope marking

Verbal morphology and scope: Balinese

Nyoman ajak Ketut ngorahang ma-tepuk.

and AV.say MID-see

‘Nyoman and Ketut said that they saw each other.’

Cannot mark matrix verb ‘say’:

- Reciprocal ma- marking for ngorahang ‘say’ is not possible; we cannot get a wide scope reciprocal reading by marking the matrix verb.
- Similarly for kaden/pineh ‘think’.
- munyi ‘make noises/say words’ has a ma- form mamunyi, but it means ‘say words’ and not ‘say to each other’, and does not yield a wide scope reciprocal reading.
Passamoquody

Passamoquody -\textit{utu} (Bruening, 2004, 2006):

\begin{center}
\begin{tabular}{|c|c|}
\hline
$x_1$ & $x_2$ \\
\hline
\end{tabular}
\end{center}

$koti$-\textit{nehpuh-utu}-wok.
FUT-kill-RECIP-3PL

‘They’ll kill each other.’

- Passamoquody transitive subject agreement is prefixal, agreement with transitive objects and intransitive subjects is suffixal.
- Suffixal agreement with reciprocal-marked verbs $\rightarrow$ verbs with reciprocal morphology are syntactically intransitive.
Reciprocal scope ambiguity and scope marking

Passamoquody

Piyel naka Susehp toqi=te litahasuw-ok kisi-tomh-utu-wok. and both=EMPH think-3PL PFV-defeat-RECIP-3PL

‘Peter and Joseph both think that they defeated each other.’

Narrow scope/“we” reading: Peter and Joseph both think: Peter defeated Joseph and Joseph defeated Peter.

Wide scope/“I” reading: Peter thinks Peter defeated Joseph and Joseph thinks Joseph defeated Peter.
Passamoquody

Piyel naka Susehp toqite litahasuw-ok *kisi-tomh-utu-wok*. Peter and Joseph both=EMPH think-3PL PFV-defeat-RECIP-3PL

Narrow scope/“we” reading:

\[
\begin{align*}
&x_1 \\
&\text{think}(x_1, \\
&\quad \text{Peter-and-Joseph}(\bigcup x_1)) \\
&\quad \begin{array}{c}
\begin{array}{c}
\bigcup x_2 = \bigcup x_1 \\
\bigcup x_3 = \bigcup x_2 \\
x_3 \neq x_2 \\
defeat(x_2, x_3)
\end{array}
\end{array}
\end{align*}
\]
Piyel naka Susehp toqi=te litahasuw-ok kisi-tomh-utu-wok.
Peter and Joseph both=EMPH think-3PL PFV-defeat-RECIP-3PL
Wide scope/“I” reading:

\[
\begin{array}{c}
\begin{array}{c}
\times_1 \times_2 \times_3
\end{array}
\end{array}
\]

\[
\begin{array}{c}
\begin{array}{c}
Peter-and-Joseph(\bigcup x_1)
\end{array}
\end{array}
\]

\[
\begin{array}{c}
\begin{array}{c}
x_2 = x_1 \\
\bigcup x_3 = \bigcup x_2 \\
x_3 \neq x_2
\end{array}
\end{array}
\]

\[
\begin{array}{c}
\begin{array}{c}
\text{think}\left(\begin{array}{c}
x_1, \\
\text{defeat}(x_2, x_3)
\end{array}\right)
\end{array}
\end{array}
\]

- Reciprocal predicate is contributed by the predicate marked with -\textit{utu}-. 
- Reciprocal scope is not fixed (similar to the English pronominal reciprocal).
Japanese


John to Mary ga ai-si-aw-te iru (koto) and NOM love-do-RECIP-PTCP be that

‘John and Mary love each other.’
Japanese

John to Mary ga ai-si-aw-te iru (koto).
John and Mary NOM love-do-RECIPI-PTCP be that

\[
\begin{array}{c|c}
  x_1 & x_2 \\
\end{array}
\]

\[
John-and-Mary(\bigcup x_1)
\]
\[
\bigcup x_2 = \bigcup x_1
\]
\[
x_2 \neq x_1
\]
\[
love(x_1, x_2)
\]
Reciprocal scope ambiguity and scope marking

Japanese

illusion-do-PST

‘John and Mary had the illusion that [selves each hurt the other].’ (Nishigauchi, 1992)

-aw- on subordinate verb: Narrow scope/“we” reading only.
Reciprocal scope ambiguity and scope marking

Japanese

and Nom self NOM hurt-PST that illusion-do-RECIP-PST

‘John and Mary had the illusion that [self each hurt the other].’
(Nishigauchi, 1992)

- **-aw-** on matrix verb: *Wide scope/“I” reading only.*


- Reciprocal **scope** is fixed by -aw-.

- Reciprocal **predicate** is not fixed by -aw-: the reciprocal predicate need not correspond to the -aw- marked verb.
Reciprocal scope ambiguity and scope marking

Japanese

Narrow scope:

John and Mary NOM self-PL NOM hurt-RECIP-PST that illusion-do-PST

\[
\begin{array}{|c|}
\hline
x_1 \\
\hline
\end{array}
\]

\[
\begin{array}{|c|c|}
\hline
John-and-Mary(\bigcup x_1) \\
\hline
\end{array}
\]

\[
\begin{array}{|c|c|}
\hline
x_2 & x_3 \\
\hline
\end{array}
\]

\[
\begin{array}{c}
\bigcup x_2 = \bigcup x_1 \\
\bigcup x_3 = \bigcup x_2 \\
x_3 \neq x_2 \\
hurt(x_2, x_3)
\end{array}
\]
Japanese

Wide scope:

John and Mary NOM self NOM hurt-PST that illusion-do-RECIP-PST

- Reciprocal scope is determined by the placement of the affix.
- Reciprocal predicate is NOT determined by the placement of the affix, but must appear within the domain of reciprocal scope.
Reciprocal scope ambiguity and scope marking

Japanese

Wide scope:

John and Mary NOM self NOM hurt-PST that illusion-do-RECIP-PST

<table>
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- **Reciprocal scope** is determined by the placement of the affix.
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Summary: Verbal reciprocals and scope marking

- Narrow scope only: Balinese *ma-*.
Summary: Verbal reciprocals and scope marking

- Narrow scope only: Balinese *ma*-
- Narrow or wide scope, uncorrelated with verbal marking: Passamoquody *-utu*.
Summary: Verbal reciprocals and scope marking

- Narrow scope only: Balinese *ma*-
- Narrow or wide scope, uncorrelated with verbal marking: Passamoquody *-utu*-
- Scope correlated with verbal marking: Japanese *-aw*-
Further research questions and future work

Verbal reciprocals, narrow scope only:

- Malagasy -if-: Keenan and Ralalaohrivony, this workshop.
- Chinese verbal prefixes hu-/xiang-: Kobayashi, this workshop.
- Are these semantically transitive (like Balinese) or intransitive?

Other means of reciprocal expression:

- Adverbial reciprocals: Data are complicated, generalizations are not so clear.
  - Chinese huxiang in subordinate clause: Conflicting claims in literature about scope possibilities.
  - Balinese saling in subordinate clause: Sometimes only narrow scope, sometimes either wide or narrow scope.

- Other possibilities?


Bruening, Benjamin. 2006. The morphosyntax and semantics of verbal reciprocals. Unpublished manuscript, University of Delaware.

