Reciprocal scope ambiguity and scope marking

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Workshop ‘Cross-Linguistic Semantics of Reciprocals’
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Plan

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

The reciprocal as a quantificational/distributional operator

Chris and Tracy saw each other.

a. Polyadic quantification (Dalrymple et al., 1998):
$\textsc{recip}(\{\textsc{chris},\textsc{tracy}\}, \lambda x, y.\textsc{see}(x, y))$

b. Distribution (Heim et al., 1991):
$\forall x, y \in \{\textsc{chris},\textsc{tracy}\}.y \neq x \rightarrow \textsc{see}(x, y)$

Wide and narrow scope readings

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.

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):
$\textsc{think}(\{\textsc{chris},\textsc{tracy}\}, \textsc{recip}(\{\textsc{chris},\textsc{tracy}\}, \lambda x, y.\textsc{see}(x, y)))$

b. Wide scope/"I" reading (C thinks: I saw T, T thinks: I saw C):
$\textsc{recip}(\{\textsc{chris},\textsc{tracy}\}, \lambda x, y.\textsc{think}(x, \textsc{see}(x, y)))$

Problems for quantificational/distributional analyses

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

Ka′ėškóne-ho é-axeen-ȧhtse-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?

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)

Relational analyses and scope

- 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.

DRS:

x_1
$cat(x_1)$ $appear(x_1)$

is an abbreviation for:

$$\lambda i.\lambda o.i[x_1]o \wedge cat(\nu(o)(x_1)) \wedge appear(\nu(o)(x_1))$$

- 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
- ν 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.**

b.

x_1
$cat(x_1)$ $appear(x_1)$

c. $\lambda I.\lambda O.I[x_1]O \wedge \forall o \in O.cat(\nu(o)(x_1)) \wedge appear(\nu(o)(x_1))$

- 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.**

b.

x_1
$cat(x_1)$ $2\text{-}atoms(\cup x_1)$ $appear(x_1)$

c. $\lambda I.\lambda O.I[x_1]O \wedge \forall o \in O.cat(\nu(o)(x_1))$
$\wedge 2\text{-}atoms(\bigcup_{o \in O} \nu(o)(x_1))$
$\wedge appear(\nu(o)(x_1))$

In each output state o in O, x_1 is a cat that appeared; and when we sum over the values of x_1 across assignments ($2\text{-}atoms(\cup x_1)$), we get two cats.

Reciprocals in Plural CDRT

Dotlačil (2013) (see also Sternefeld 1998, Beck 2001, Murray 2008 for similar relational analyses):

a. **Two girls^{1} saw each other$^{2}_{1}$.**

b.

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

Reciprocals in Plural CDRT

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

Sample output state:

	x_1	x_2
o_1	$girl_1$	$girl_2$
o_2	$girl_2$	$girl_1$

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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

$$[\![RECIP^{u_n}_{u_m}]\!] = \lambda P. \quad \begin{array}{|l} \hline u_n \\ \hline \cup u_m = \cup u_n \\ u_m \neq u_n \\ \hline \end{array} \; ; P(u_n)$$

$$\text{Underspecified } [\![REFL/RECIP^{u_n}_{u_m}]\!] = \lambda P. \quad \begin{array}{|l} \hline u_n \\ \hline \cup u_m = \cup u_n \\ \hline \end{array} \; ; P(u_n)$$

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Collective readings solved

Collective readings for reciprocal antecedents (Dotlačil, 2013):

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

x_1 x_2 x_3
$sailor(x_1)$ $work.together(\cup x_1)$ $on(x_1, x_2)$ $ship.of(x_2, x_3)$ $\cup x_1 = \cup x_3$ $x_1 \neq x_3$

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$^2_1$.
- *Two girls* and *they* are both associated with the index 1 $\Rightarrow$
  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$^2_1$ had won.**

x_1 $\bar{x}_2$
$Chris(x_1)$ $happy(x_1)$ $had.won(x_2)$

, $\mathcal{A}(x_2) = x_1$

$\lambda i.\lambda o.\partial(i[x_1\ x_2]o) \wedge Chris(\nu(o)(x_1)) \wedge$
$happy(\nu(o)(x_1)) \wedge$
$had.won(\nu(o)(x_2)) \wedge$
$\partial(\nu(o)(x_2) = \nu(o)(\mathcal{A}(x_2)))$

Different discourse referents for the pronoun (*he*) and its antecedent (*Chris*). Anaphora resolution is presupposed, but anaphoric relation is specified "on the side", via $\mathcal{A}$.

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 $\mathcal{A}(x_1, x_2)$.

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

Abbreviated DRS with resolved anaphor:

x_1 x_2
$Chris(x_1)$ $happy(x_1)$ $had.won(x_2)$ $x_2 = x_1$

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$^{2}_{1}$ had won:

x_1 x_2
$tracy\text{-}and\text{-}chris(\cup x_1)$ $happy(x_1)$ $had.won(x_2)$ $x_2 = x_1$

"We" and "I" readings

Attractive analogy due to Williams (1991): The ambiguity in (1) is like the ambiguity in (2).

(1) Two girls^{1} thought that they$^{2}_{1}$ saw each other$^{3}_{2}$.

a. Both girls thought: "We saw each other." ("narrow scope")

b. Both girls thought: "I saw her (= the other)." ("wide scope")

(2) Two girls^{1} thought that they$^{2}_{1}$ would win.

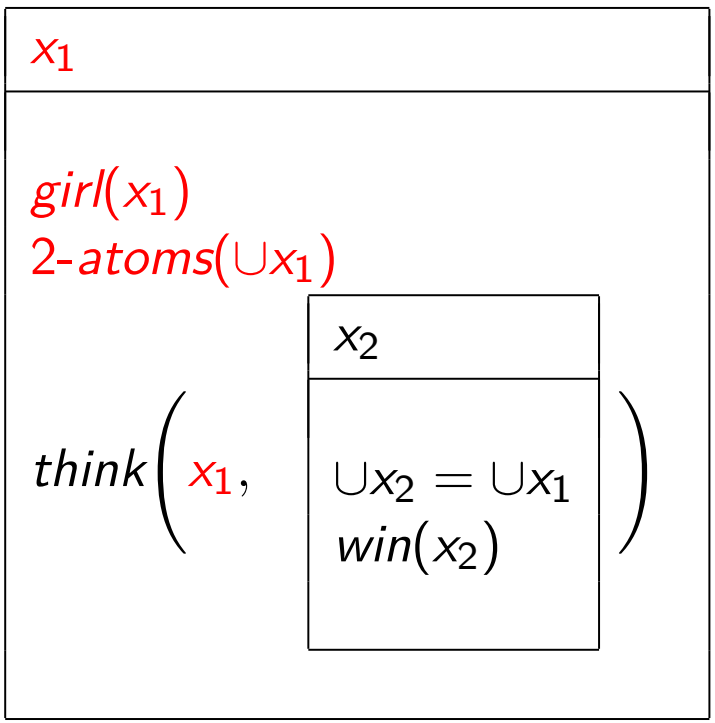
a. Both girls thought: "We will win." ("narrow scope")

b. Both girls thought: "I will win." ("wide scope")

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*:



	x_1	x_2
s_{1a}	$girl_1$	$girl_1$
s_{1b}	$girl_1$	$girl_2$
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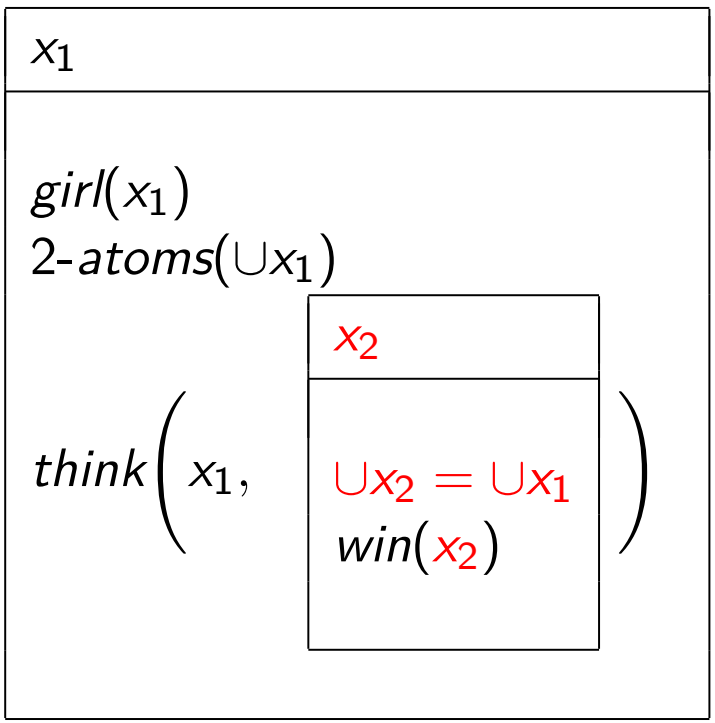

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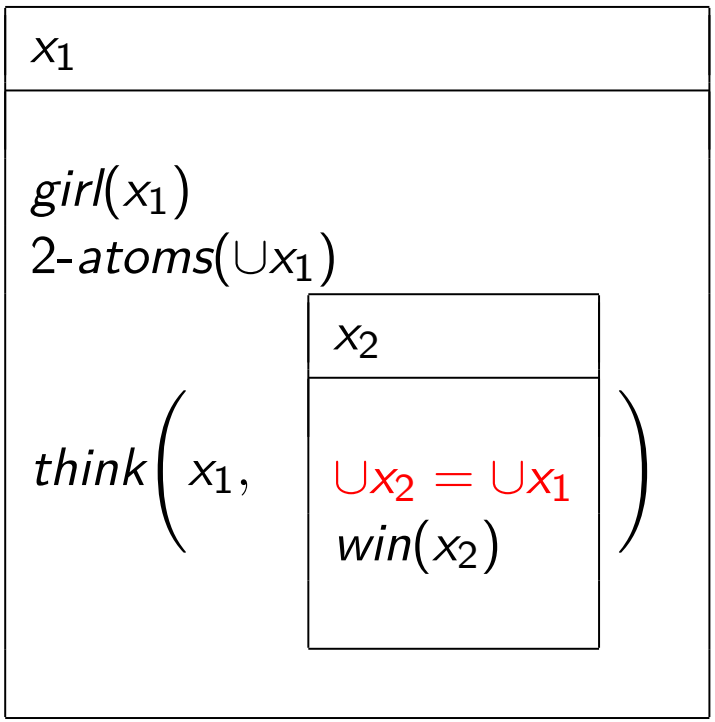

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Wide scope/"I" reading

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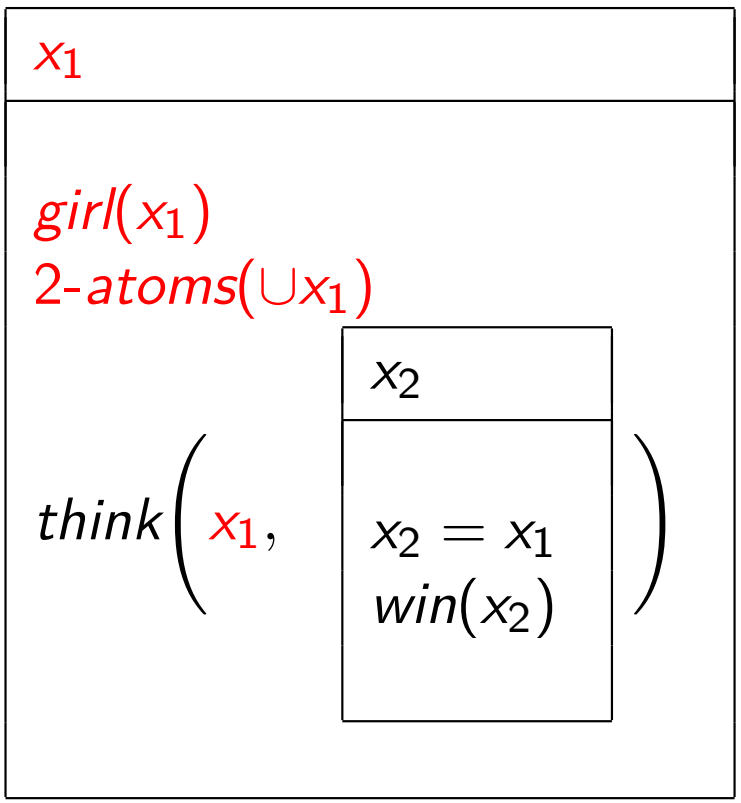
Individual coreference between *girls* and *they*:



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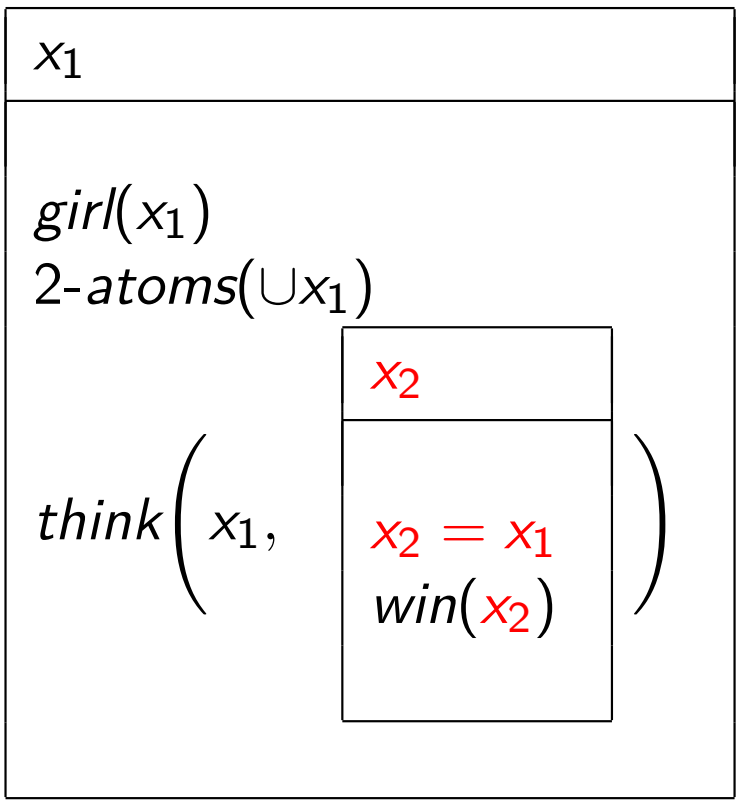

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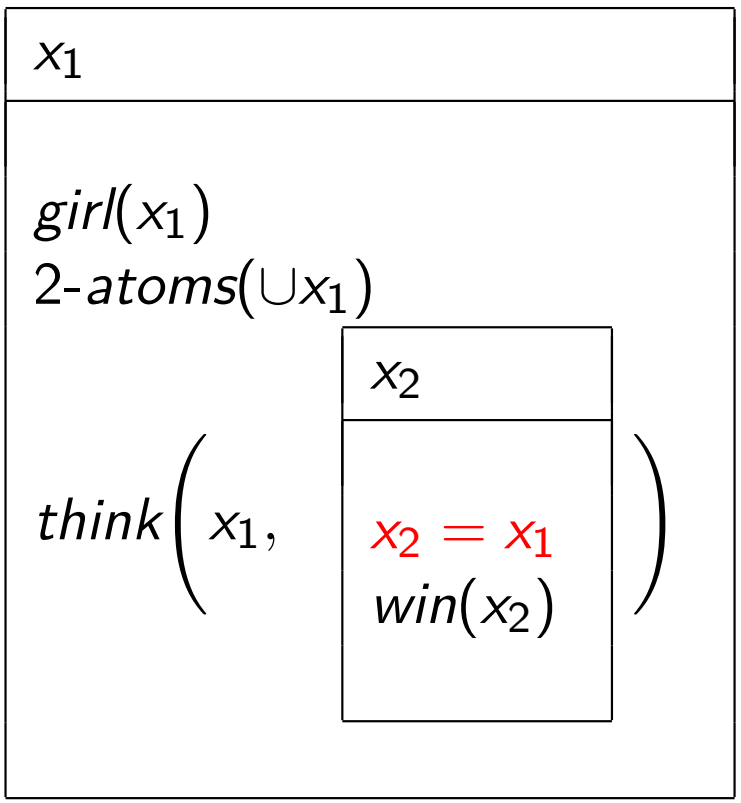

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Reciprocals: Narrow scope/"we" reading

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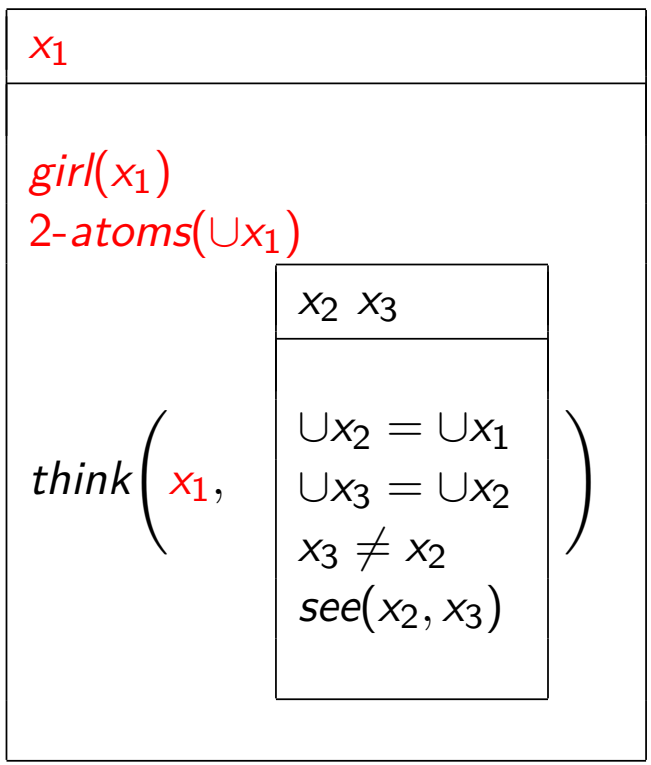

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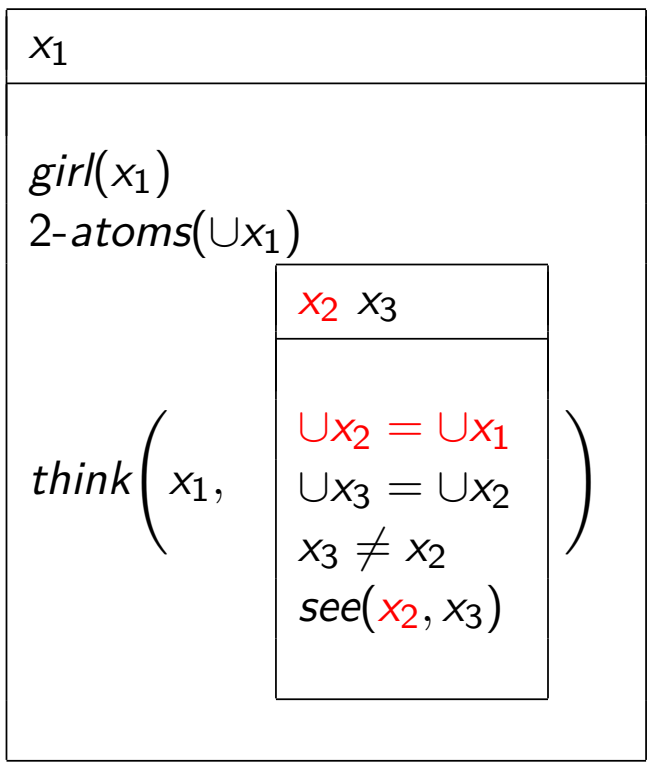

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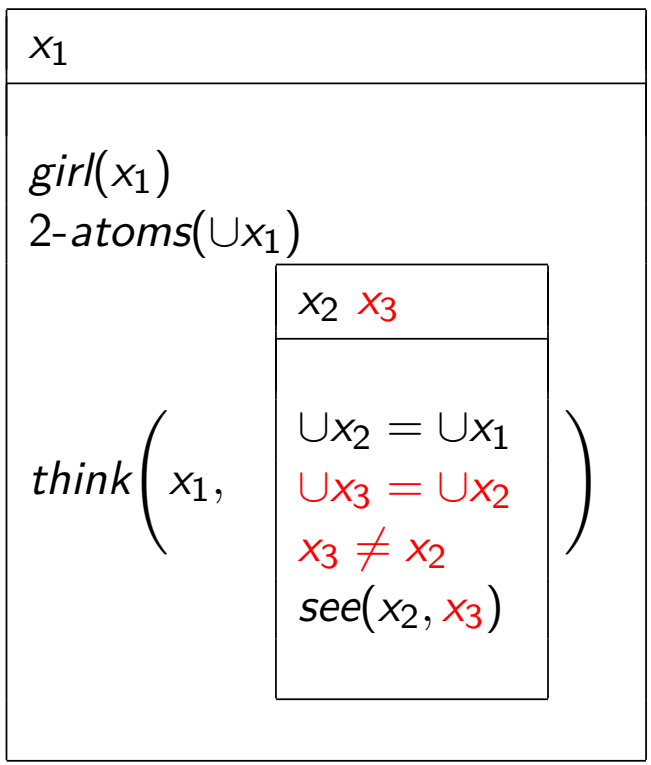

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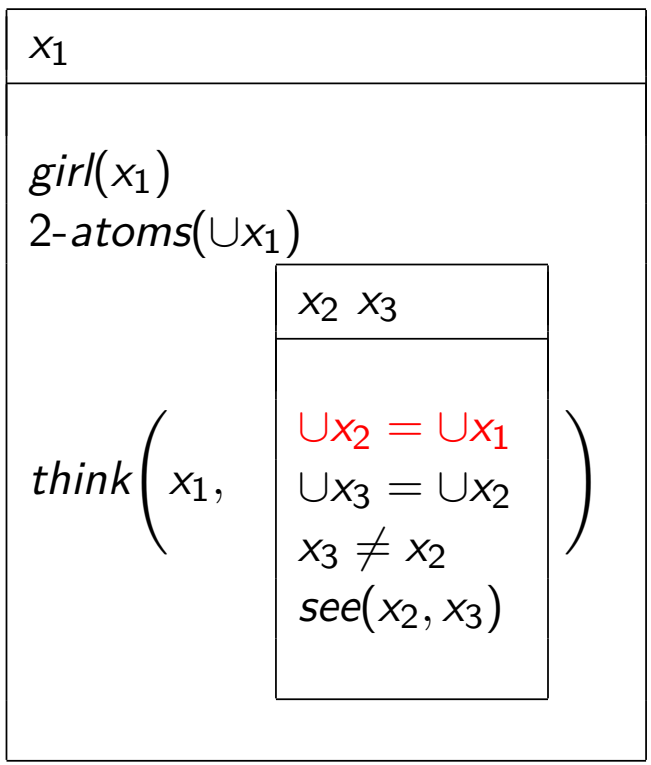

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Reciprocals: Wide scope/"I" reading

Two girls thought that they saw each other.
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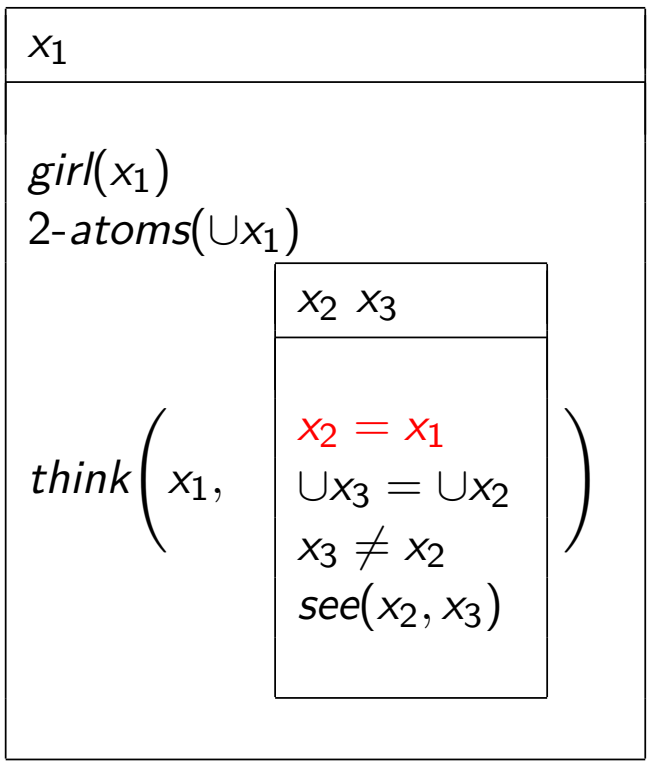

On the wide scope reading, each girl's thought is only about herself; no reciprocal meaning is involved in the thought. Williams's analogy does not quite hold up.

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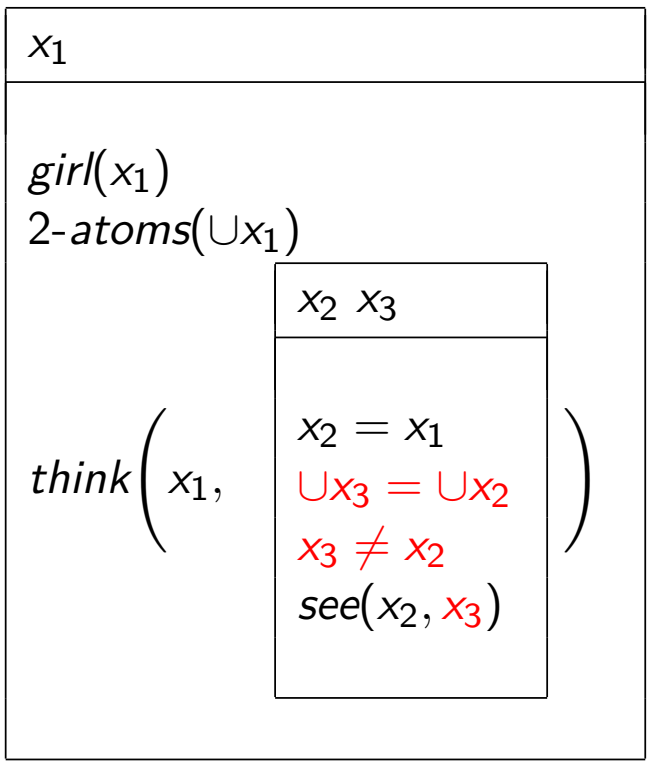

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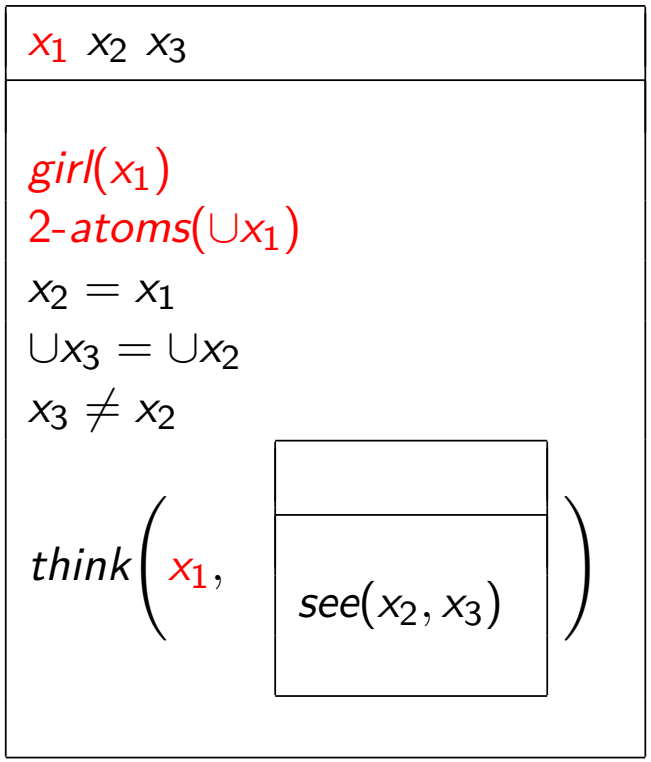

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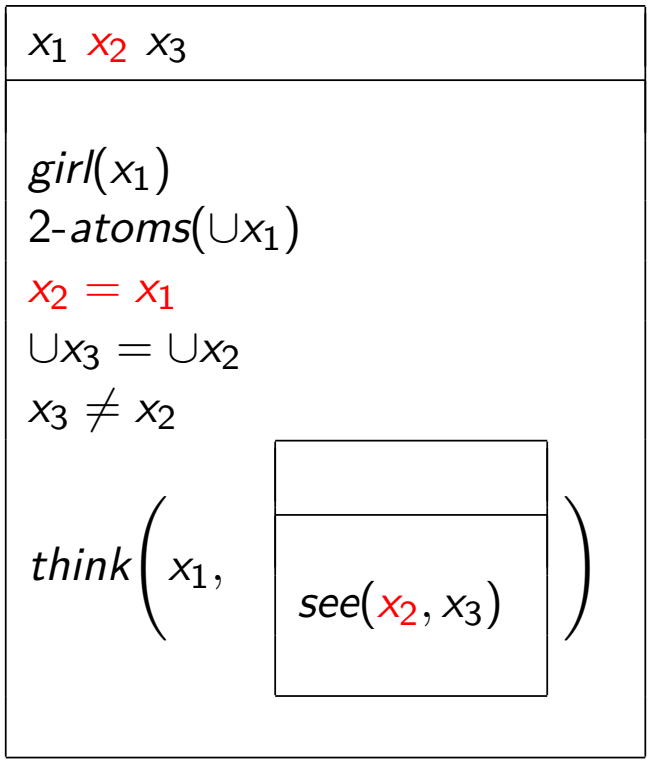

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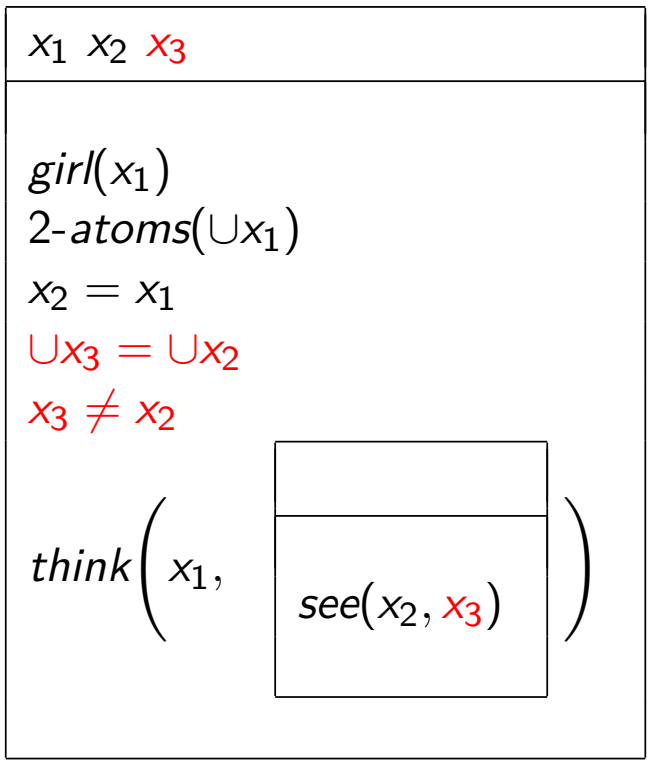

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Summary so far

- 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.

Other problems solved

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.

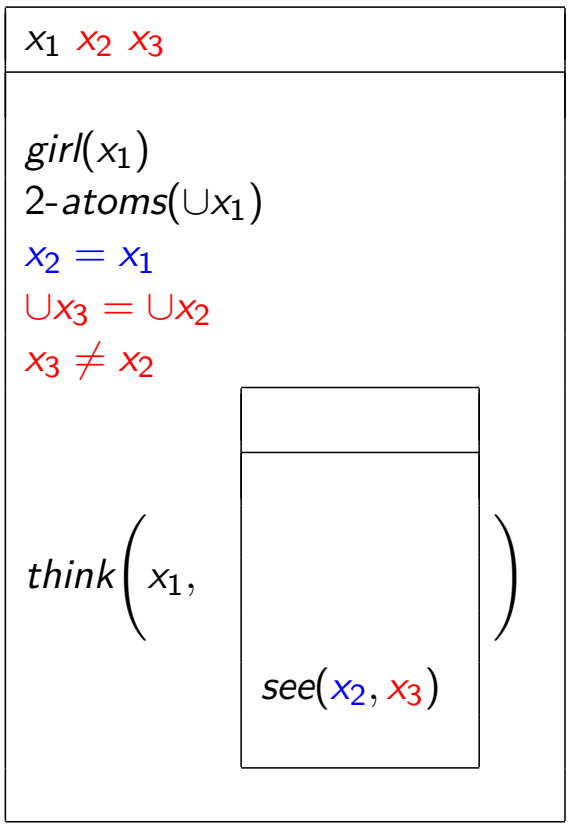
Narrow scope, cumulative coreference between *girls* and *they*:

$$
\begin{array}{|l}
\hline
x_1 \\
\hline
\textit{girl}(x_1) \\
2\text{-}\textit{atoms}(\cup x_1) \\
\\
\textit{think}\left(x_1, \quad \begin{array}{|l} \hline x_2\ x_3 \\ \hline \cup x_2 = \cup x_1 \\ \cup x_3 = \cup x_2 \\ x_3 \neq x_2 \\ \textit{see}(x_2, x_3) \\ \\ \hline \end{array} \right) \\
\hline
\end{array}
$$

Summary: Scope ambiguity

Two girls thought that they saw each other.

Wide scope, individual coreference between *girls* and *they*:



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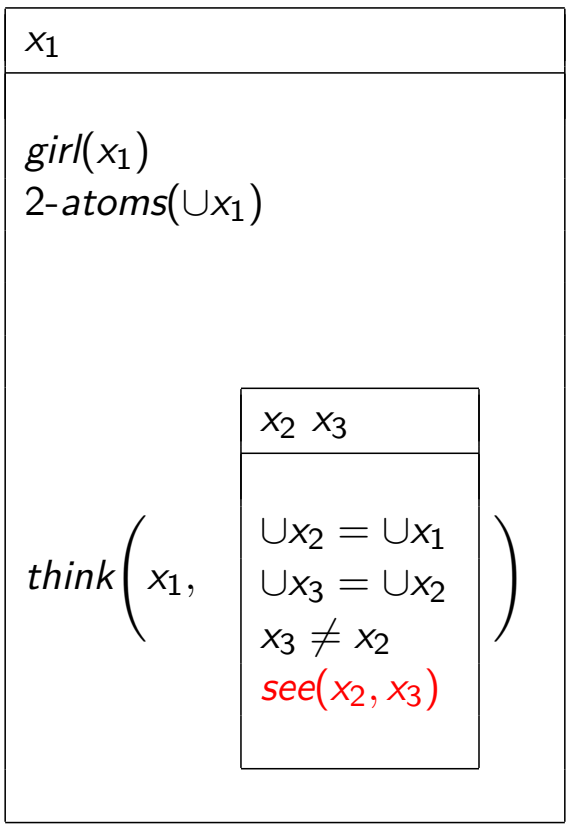

- **Reciprocal predicate**: the predicate whose arguments are required to be noncoreferent in each assignment (here, 'see')
- **Reciprocal scope**: the DRS where the coreference/noncoreference conditions appear
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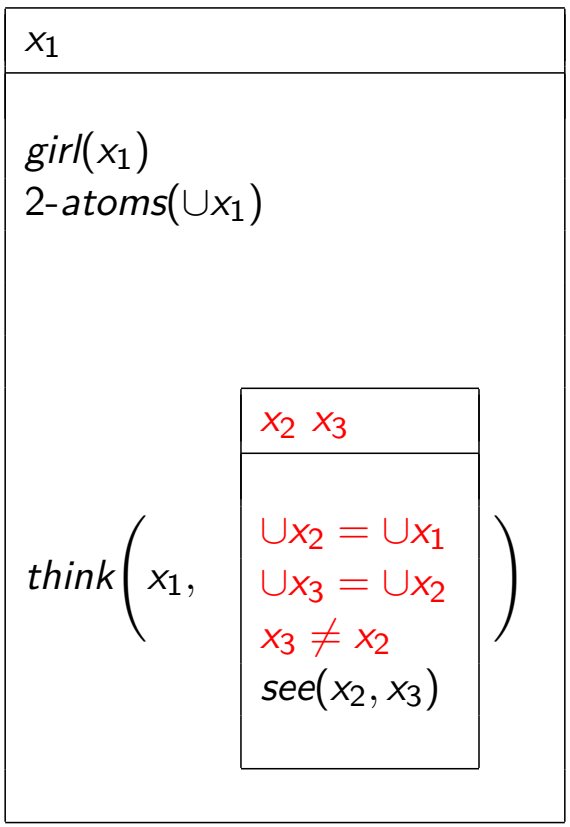

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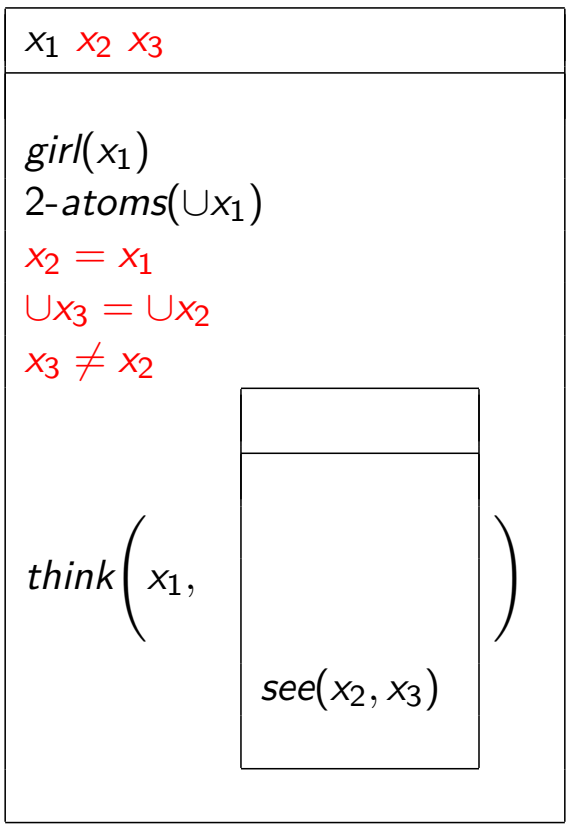

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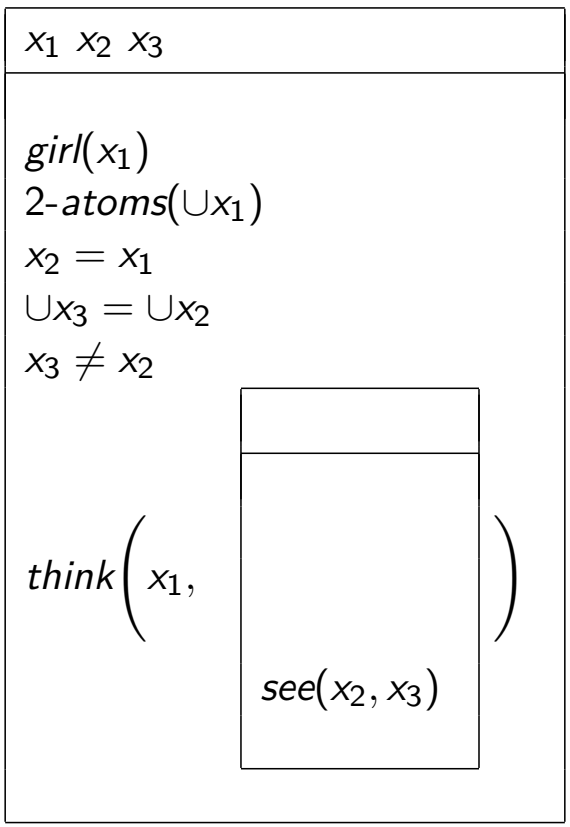

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Reciprocal expression

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

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?
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Verbal reciprocals

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

Balinese

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 → 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.

Balinese

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

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

- The reciprocal relation (*kiss*) is contributed by the verb marked with *ma-*.

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- The reciprocal relation (*kiss*) is contributed by the verb marked with *ma-*.

Verbal morphology and scope: Balinese

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

'Nyoman and Ketut said that they saw each other.'

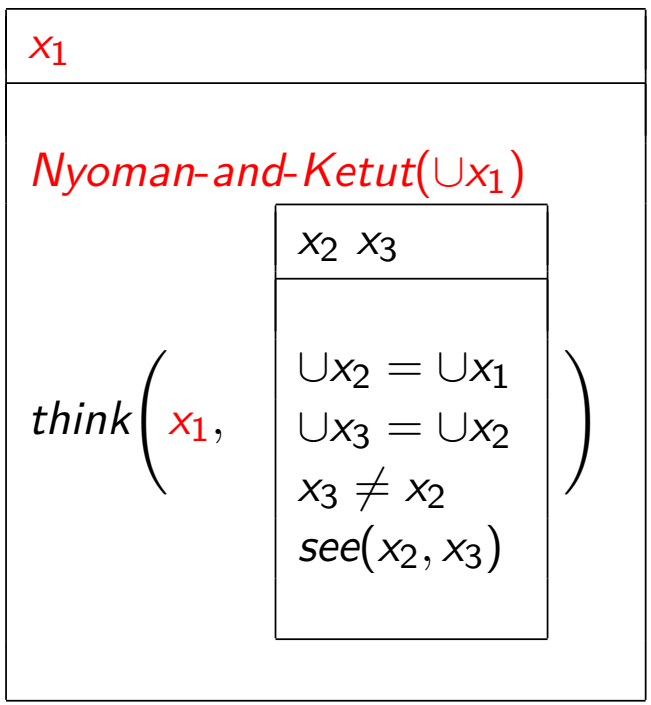
Narrow scope/"we" reading only.

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:



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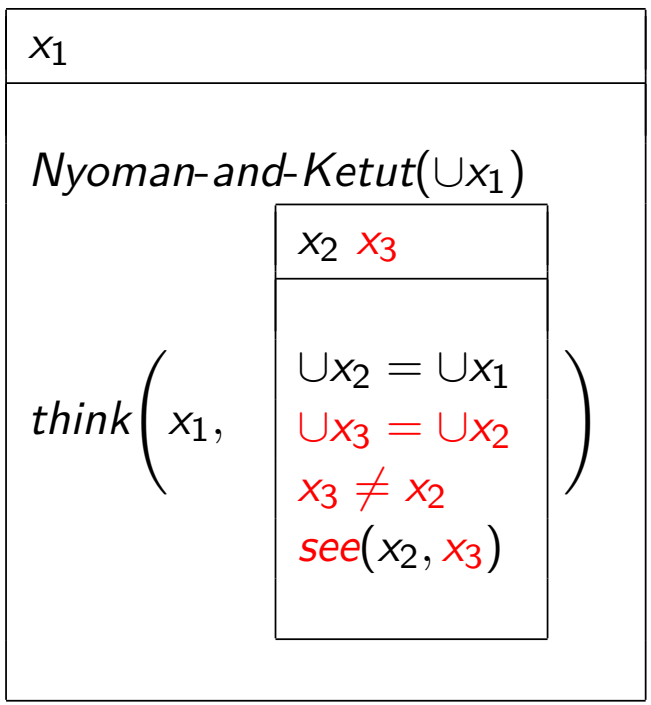

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Nyoman ajak Ketut ngorahang ma-tepuk.
Nyoman and Ketut AV.say MID-see

'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 *-utu* (Bruening, 2004, 2006):

koti-nehpuh-utu-wok.
FUT-kill-RECIP-3PL
'They'll kill each other.'

x_1 x_2
$\cup x_2 = \cup x_1$ $x_2 \neq x_1$ $kill(x_1, x_2)$

- 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.

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

Narrow scope/"we" reading:

$$
\begin{array}{|l}
\hline
x_1 \\
\hline
\textit{Peter-and-Joseph}(\cup x_1) \\
\textit{think}\left(x_1, \begin{array}{|l} \hline x_2\ x_3 \\ \hline \cup x_2 = \cup x_1 \\ \cup x_3 = \cup x_2 \\ x_3 \neq x_2 \\ \textit{defeat}(x_2, x_3) \\ \ \\ \hline \end{array}\right) \\
\ \\
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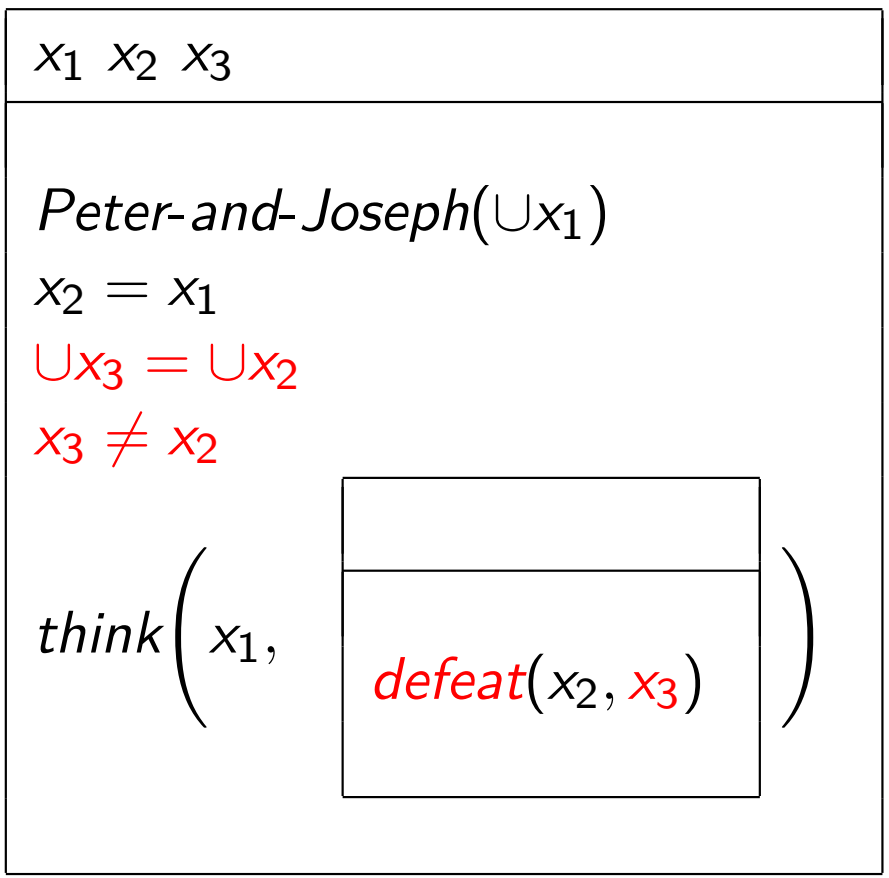
Peter and Joseph both=EMPH think-3PL PFV-defeat-RECIP-3PL

Wide scope/"I" reading:



- Reciprocal predicate is contributed by the predicate marked with *-utu-*.
- Reciprocal scope is not fixed (similar to the English pronominal reciprocal).

Japanese

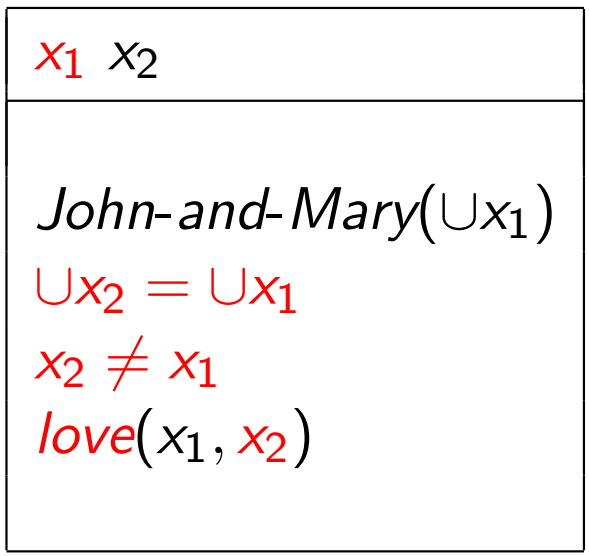
Japanese *-aw-* (Nishigauchi, 1992; Ikawa, 1999):

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-RECIP-PTCP be that



Japanese

John to Mary ga [zibun-tati ga kizutuke-aw-ta to]
and Nom self-PL NOM hurt-RECIP-PST that
sakkaku-si-ta.
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.

Japanese

John to Mary ga [zibun ga kizutuke-ta to] sakkaku-si-aw-ta.
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.
- Nishigauchi (1992): "the 'scope-indicator' flavor of the reciprocal verb *-aw-*"
- Reciprocal scope is fixed by *-aw-*.
- Reciprocal predicate is not fixed by *-aw-*: the reciprocal predicate need not correspond to the *-aw-* marked verb.

Japanese

Narrow scope:

John to Mary ga [zibun-tati ga kizutuke-aw-ta to] sakkaku-si-ta.
John and Mary NOM self-PL NOM hurt-RECIP-PST that illusion-do-PST

$$
\begin{array}{|l}
\hline
x_1 \\
\hline
\textit{John-and-Mary}(\cup x_1) \\
\textit{have.illusion}\left(x_1,\ \begin{array}{|l} \hline x_2\ x_3 \\ \hline \cup x_2 = \cup x_1 \\ \cup x_3 = \cup x_2 \\ x_3 \neq x_2 \\ \textit{hurt}(x_2, x_3) \\ \ \end{array}\right) \\
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\hline
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Wide scope:

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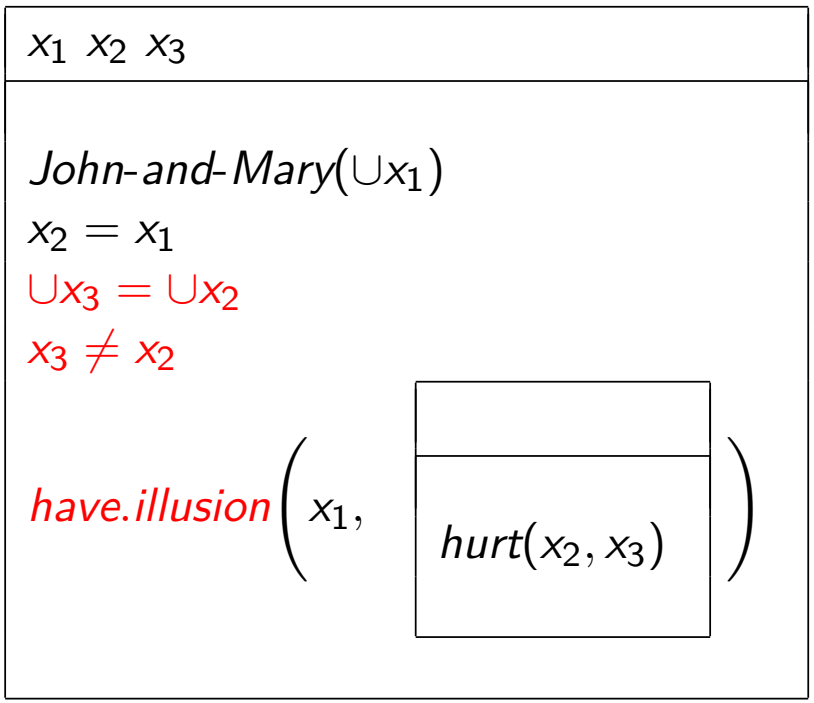

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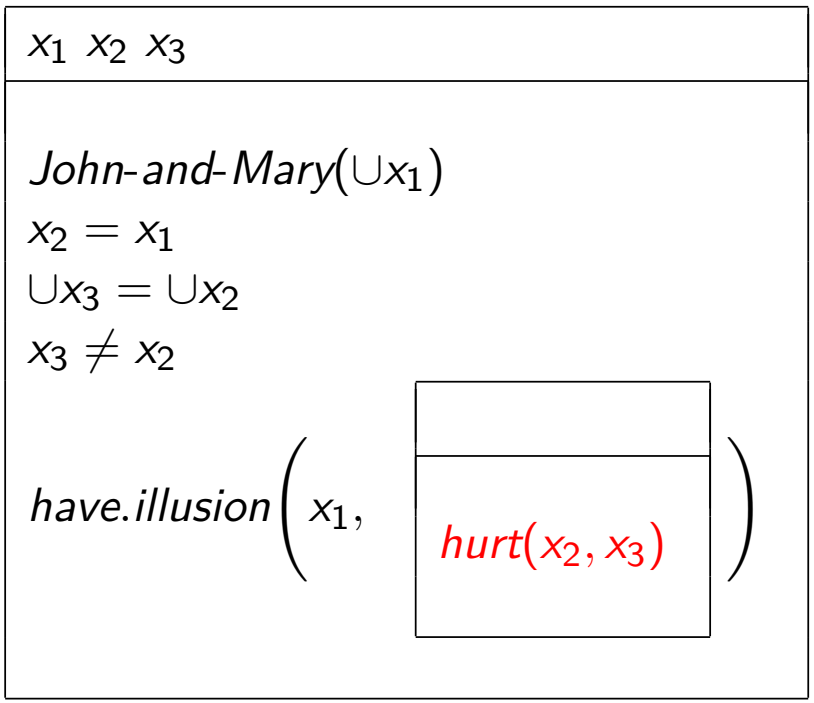

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Summary: Verbal reciprocals and scope marking

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- Scope correlated with verbal marking: Japanese *-aw-*.

Further research questions and future work

Verbal reciprocals, narrow scope only:

- Malagasy *-if-*: Keenan and Ralalaoherivony, 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?

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