Reciprocal scope revisited

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Introduction Williams (1991) expressed the intuition that the ambiguity seen in (1) is not one of scope of the reciprocal but in fact *the same* ambiguity as we see in the two coreferential readings of (2) where there is no reciprocal.

(1) Two girls said that they saw each other.

a. girl_1 said girl_1 saw girl_2 and girl_2 saw girl_1 and girl_2 said the same thing ("narrow scope")

b. girl_1 said girl_1 saw girl_2 and girl_2 said girl_2 saw girl_1 ("wide scope")

(2) Two girls thought they should sit down.

a. Each girl thought that each girl should sit down ($\approx$ (1-a))

b. Each girl thought that she herself should sit down ($\approx$ (1-b))

This intuition was, however, never properly formalized. In this paper we do that by adopting a cumulative analysis of the reciprocal (along the lines of Sternefeld 1998, Dotlačil 2013) in a partial version of compositional DRT (Haug 2013) with plural information states (van den Berg 1996, Brasoveanu 2006). In this setting we can capture anaphoric relationships between *occurrences* of drefs without equating variables. This gives us a richer account of anaphoric dependencies than simple coindexation which, as pointed out by Higginbotham (1985) and Heim, Lasnik and May (1991a), is not (without additional structure) expressive enough to deal with the semantics of reciprocals. In both (1) and (2), then, the two readings in question result from the type of anaphoric relationship that *they* bears to its antecedent *two girls*.

Our analysis thereby avoids the problems facing scopal accounts of *each other* (Heim, Lasnik and May 1991ab, Sternefeld 1998), where as pointed out by Dimitriadis (2000) there are only ad hoc explanations for the principle A effects associated with reciprocals and for why the reciprocal can never scope higher than its highest binder. Furthermore, because the scope effects follow from (chains of) dynamic anaphoric binding relations we also correctly predict that the antecedent need not c-command the anaphor (3) and that the anaphoric relation can cross scope islands (4). Finally, our account straightforwardly generalizes to "chained" reciprocals (5), where a reciprocal antecedes another reciprocal. Dimitriadis (2000) shows that these cannot be derived in the system of Heim, Lasnik and May (1991) and they also cannot be derived in his modification of that system.

(3) The lawyers that represent John and Mary expect them to sue each other.

(4) They were engaged writing in journals that they gave each other on their wedding day.

(5) Two girls gave each other pictures of each other.

The framework Drefs are interpreted by assignments, which are reified as objects of a separate type s. An update (dynamic proposition) is a relation between plural information states, i.e. sets of such assignments. Introduction of new drefs means that for all input assignments there is an output assignment that extends it and for all output assignments there is an input assignment that it extends (6-a), where the extension relation between partial assignments ($s_1[x_1]s_2$) means that the first unused dref in s_1 has an inhabitant in s_2. Each assignment in the output state must satisfy all conditions in the DRS (6-b), which means that each assignment must assign inhabitants to the argument drefs such that the underlying static relation is true (6-c), where we write $j(x_1)$ for the inhabitant of x_1 in j and $\cup j(x_1)$ for the sum of inhabitants of x_1 across all assignments $j \in J$.

Notice how each argument position can be optionally interpreted pointwise or collectively across assignments. Finally, anaphoric drefs are associated with a presupposition that they corefer with their antecedent, $\partial(x_1 = \mathcal{A}(x_1))$, which can be satisfied pointwise or collectively just like other conditions. The antecedent itself, vz. the resolution function $\mathcal{A}$ is pragmatically derived, although it is subject to the syntactic constraints of binding theory. In particular, *each other* must take a superior, local antecedent. For ease of exposition we resolve $\mathcal{A}$ in our DRSs.

(6) a. $[x_1|\,] := \lambda I.J.\forall i \in I.\exists j \in J.i[x_1]j \wedge \forall j \in J.\exists i \in I.i[x_1]j$

b. $[\,|C_1(x_1 \ldots x_i)\ \ldots C_n(y_1 \ldots y_j)] := \lambda I.J.C_1(x_1 \ldots x_i)(J) \wedge \ldots \wedge (C_n(y_1 \ldots y_j)(J))$

c. $C(x_1, \ldots, x_i)(J) := \forall j \in J.C((\cup)j(x_1), \ldots (\cup)j(x_i))$

The analysis Along the lines of Sternefeld (1998) and Dotlačil (2013) we assume the lexical entry in (7) for *each other*.

(7) $\lambda P.[x_1| \cup x_1 = \cup\mathcal{A}(x_1), x_1 \neq \mathcal{A}(x_1)]$

In words, *each other* introduces a dref x_1 and imposes an identity condition between x_1 and its antecedent which is interpreted collectively in both arguments, i.e. across assignments, x_1 and its antecedent must range over the same domain. It also imposes a distinctness condition inside each assignment. (8) shows the DRS for a simple sentence with a reciprocal. The first two conditions make sure that there are two individual girls in $\cup j(x_1)$. The next condition makes sure the same girls are found in $\cup j(x_2)$. The third condition says that in each assignment $j \in J$, $j(x_1) \neq j(x_2)$. Finally, the seeing relation must hold between the inhabitants of x_1 and x_2 in all assignments. This gives us so-called weak reciprocity,[1] as illustrated in the sample output state in (8-b).

In the long-distance case (9), we still have two individual girls in $\cup j(x_1)$. The interesting thing is what happens in the embedded DRS, which is an extension K of J with two new drefs x_2 and x_3. The three last conditions of the embedded DRS require the same plural info state as in (8). If we then also take in the condition that x_2 must corefer with its antecedent (i.e. $x_1 = x_2$) in every state there is only one way to have K extend J, as shown in the first two rows of (9). However, if we instead interpret the antecedency condition collectively, we get a different reading as shown on the bottom in (9). For the sentence to be true, $\cup x_1 = \cup x_2$ must hold in all worlds compatible with what each girl says, and in addition global equality and pointwise distinctness must hold between *each other* and its antecedent. Notice that the collective/non-collective ambiguity in the antecedency condition is independently motivated by (2).

Conclusion On our approach long distance readings result directly from a dependent reading of the reciprocal's antecedent pronoun. A dependent reading, in turn, results from the pointwise interpretation of a standard antecedency condition. We therefore correctly predict long-distance reciprocity with a non c-commanding antecedent (unlike approaches based on distributivity operators) and out of scope islands (unlike approaches based on movement of *each other*), as shown in (3)–(4), cf. (10). Finally, unlike in most approaches we are aware of, no special problems arise in interpreting chained reciprocals (5), cf. (11).

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[1] There are several other readings for the reciprocal which we cannot discuss here, as the focus is on "scope" effects.

(8) a. Two girls[1] saw [each other][2]

b.

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

	x_1	x_2
j_1	girl_1	girl_2
j_2	girl_2	girl_1

(9) a. Two girls[1] said that they[2] saw [each other][3].

b.

x_1
$2.atoms(\cup x_1)$
$girl(x_1)$
$say(x_1,$ [$x_2\ x_3$ | $(\cup)x_2 = (\cup)x_1$, $\cup x_3 = \cup x_2$, $x_3 \neq x_2$, see(x_2, x_3)]

		x_1	x_2	x_3
$x_2 = x_1$:	j_1	girl_1	girl_1	girl_2
	j_2	girl_2	girl_2	girl_1
$\cup x_2 = \cup x_1$:	j_1	girl_1	girl_1	girl_2
	j_2	girl_1	girl_2	girl_1
	j_3	girl_2	girl_1	girl_2
	j_4	girl_2	girl_2	girl_1

(10) a. The[1] lawyers that represent [John and Mary][2] expect them[3] to sue [each other][4].

b.

$x_1\ x_2$
$lawyer(x_1)$
$John\text{-}and\text{-}Mary(\cup x_2)$
$represent(x_1, x_2)$
$expect(x_1,$ [$x_3\ x_4$ | $x_3 = x_2$, $\cup x_4 = \cup x_2$, $x_4 \neq x_3$, sue(x_3, x_4)]

	x_1	x_2	x_3	x_4
j_1	l_1	john	john	mary
j_2	l_2	mary	mary	john

(11) a. Two girls[1] gave [each other][2] pictures[3] of [each other][4].

b.

$x_1\ x_2\ x_3\ x_4$
$2.atoms(\cup x_1)$
$girls(x_1)$
$\cup x_1 = \cup x_2$
$x_1 \neq x_2$
$\cup x_2 = \cup x_4$
$x_2 \neq x_4$
$pictures.of(x_3, x_4)$
$give(x_1, x_2, x_3)$

	x_1	x_2	x_3	x_4
j_1	girl_1	girl_2	pic_1	girl_1
j_2	girl_2	girl_1	pic_1	girl_2