On the Syntax-Semantics Interface of Overt and Covert Reciprocals

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Iddo Lev

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Contents

1 Introduction

Reciprocal expressions like "each other" and "one another" take as arguments a set A of individuals and a binary relation R. A reciprocal may have a variety of meanings, depending on the particular lexical items used and the context. For example, in (1)a, the relation R=*must-refer-to-indirectly* holds on each pair of distinct elements from A=*members-of-parliament*. But in (1)b, R=*sit-alongside* forms a chain of elements from A=*five-Boston-pitchers*. There are many other options (see (Dalrymple et al., 1998) for a systematic analysis).

(1) a. Members of Parliament must refer to each other indirectly.
  b. Five Boston pitchers sat alongside each other on a bench.

For the purpose of the syntax-semantics interface, all the cases can be analyzed using the (underspecified) form $\textsc{recip}(A, R)$, where RECIP could mean different things depending on the particular A, R, and the context. This operator is a type-$\langle 1, 2\rangle$ polyadic quantifier[1] because R is a binary relation rather than a monadic set.

The first aim of this paper is to explain how this operator combines with the rest of the semantic material in a sentence to form the meaning of the sentence. The second aim is to investigate cases where the reciprocal is covert, as in the following:

(2) a. John and Mary are similar (to each other).
  b. Oscar and Pedro do not attend the same class (as each other).

2 Basic Syntax-Semantics Interface

I rely here on familiarity with the basics of Glue Semantics. See (Lev, 2006b).

2.1 Basic Case

2.1.1 Statements

Recall the contribution of words in the simple sentence:

(3) [[John]$_2$ saw [Mary]$_3$]$_1$
  $john : \mathbf{2}^e$
  $mary : \mathbf{3}^e$
  $saw : \mathbf{2}^e \rightarrow \mathbf{3}^e \rightarrow \mathbf{1}^t$
  Result: $saw(john, mary) : \mathbf{1}^t$

For a sentence with a reciprocal we have:

(4) [[John and Mary]$_2$ saw [each other]$_3$]$_1$

The contribution of *saw* should remain unchanged. For the contribution of the subject, we have two options. We can take that contribution to be a set (of type $e \rightarrow t$) of individuals, as in (5)a. Or we can say (following e.g. (Link, 1983, 1998)) that

[1]See (Keenan and Westerståhl, 1997; Peters and Westerståhl, 2006).

our domain includes both individuals and pluralities that are made of individuals, and all of them are of type e. Thus, the contribution of the subject is (5)b, where $john \oplus mary$ is the plurality made out of John and Mary. Until we can figure out which option is preferred, I will use (5)c, where γ is a shorthand for either e or et. In this paper, I will not analyze the internals of this NP.

(5) a. $\{john, mary\} : \mathbf{2}^{et}$
b. $john \oplus mary : \mathbf{2}^{e}$
c. $jm : \mathbf{2}^{\gamma}$

The contribution of the reciprocal operator should be $\lambda R\lambda A.\textsc{recip}(A, R)$ of type $(e \to e \to t) \to \gamma \to t$, where RECIP is a type $\langle 1, 2\rangle$ polyadic quantifier. Since this operator needs to take (5) and *saw* as arguments, we have the following statement:[2]

(6) $\lambda R\lambda A.\textsc{recip}(A, R) : (\mathbf{2}^{e} \to \mathbf{3}^{e} \to \mathbf{1}^{t}) \to \mathbf{2}^{\gamma} \to \mathbf{1}^{t}$

By using the APP rule, (6) combines with (5) and then with *saw* to yield the desired result:

(7) $\textsc{recip}(jm, saw) : \mathbf{1}^{t}$

A side note: If we take γ to be e in (5) then *saw* could also apply directly on (5) (as is required in a sentence such as "John and Mary saw the cat"). However, this route would lead to a dead-end derivation because "each other" would then not be able to combine with the result $saw(john \oplus mary) : \mathbf{3}^{e} \to \mathbf{1}^{t}$. This situation is similar to the analysis of equi verbs given in (Asudeh, 2002). There, an equi verb such as *try* in the sentence "[[Gonzo]$_2$ tried [to leave]$_3$]$_1$" contributes the statements in (8). Although *leave* may combine with *Gonzo* to yield $leave(Gonzo) : \mathbf{3}^{t}$, that leads to a dead-end derivation, and it is *try* that needs to take the other two elements as its arguments.

(8) $Gonzo : \mathbf{2}^{e}$
$\lambda P\lambda x.try(x, P) : (\mathbf{2}^{e} \to \mathbf{3}^{t}) \to \mathbf{2}^{e} \to \mathbf{1}^{t}$
$leave : \mathbf{2}^{e} \to \mathbf{3}^{t}$
Result: $try(Gonzo, leave) : \mathbf{1}^{t}$

2.1.2 Lexical Schema

It remains to show the generic lexical entry for "each other" and "one another":[3]

(9) $\lambda R\lambda A.\textsc{recip}(A, R) : (a^{e} \to l^{e} \to k^{t}) \to a^{\gamma} \to k^{t}$
where l is my label, k is the label of the clause that I scope over,
and a is my (ultimate) antecedent's label;
where $k =$ the label of the minimal clause containing a,
and [some more constraints on a]

[2]There is no obstacle in glue semantics to treat $\mathbf{2}^{e}$ and $\mathbf{2}^{et}$ as two distinct categories. So letting $\gamma = et$ does not cause a problem here.
[3]This will be revised in section 4.

Box 1 – Digression: Expressing Constraints on The Anaphor in LFG

The following constraint on the possible antecedents of a reflexive pronoun is given for LFG in (Dalrymple, 2001, p.300):

(10) $(\uparrow_\sigma)_{ant} = ((\underset{\neg(\rightarrow \textsc{subj})}{\textsc{gf}^*}\ \textsc{gf}_{\textsc{pro}}\ \uparrow)\ \textsc{gf}_{\textsc{ante}})_\sigma$

This statement uses a "functional uncertainty" constraints (in the terminology of LFG): if f is an f-structure which is the value of the function $\textsc{gf}_{\textsc{pro}}$ of its mother f-structure, then $(\textsc{gf}^*\ \textsc{gf}_{\textsc{pro}}\ f)$ refers to g which is that mother or some larger f-structure that contains it (f-commands it). GF refers to any grammatical function and * is the Kleene-star (zero or more occurrences). $\uparrow$ stands for the f-structure of the reflexive pronoun. So (10) adds to the feature *ant* of the semantic projection of $\uparrow$ a value which is constrained to be the value if the semantic projection of some grammatical function $\textsc{gf}_{\textsc{ante}}$ of g. The "off-path constraint" $\neg(\rightarrow \textsc{subj})$ requires the functional uncertainty path not to pass through a f-structure that has a SUBJ function, thus preventing "David" from being the antecedent of "himself" in "David thought that Chris had seen himself", while still allowing "Chris" as the antecedent. This is called the Minimal Complete Nucleus binding condition.

The constraint in (10) should actually be augmented with either the off-path constraint $(\rightarrow \textsc{num}) = \textsc{sg}$ or $(\rightarrow \textsc{num}) = \textsc{pl}$ under $\textsc{gf}_{\textsc{ante}}$ to indicate whether the antecedent should be singular (in the case of *he*, *she*, *it*) or plural (in the case of *they*). The constraint for "each other" should be similar to (10) but with $(\rightarrow \textsc{num}) = \textsc{pl}$. There should also be a constraint on the possible pairs of values that $\textsc{gf}_{\textsc{pro}}$ and $\textsc{gf}_{\textsc{ante}}$ could get, e.g. to prevent "each other" from being anaphoric to "Sue and Tom" in "John and Mary introduced each other to Sue and Tom" (cf. example (12) below).

In example (6), l is instantiated to **3** and a is instantiated to **2** since the NP "John and Mary" is the antecedent of "each other". The "some constraints" part above should be filled with conditions on possible antecedents for a reciprocal. I assume that just as for reflexives, these constraints are the responsibility of the syntax. They are more complicated than those for a reflexive, as will be discussed in section 3. In example (6), we can write the fact about the antecedent as $\mathbf{3}_{ant} = \mathbf{2}$. See more in Box 1.

The constraint on k is the same as for pronouns and reflexives (see (21) below and (Lev, 2006a, end of section 1)). Usually, a reciprocal and its antecedent are in the same minimal clause, and k is the label of that clause, but sometimes k may be a larger clause. This will become more clear in section 3.

2.2 "Each Other" Is Not Always Anaphoric to the Subject

"Each other" is not always anaphoric to the subject. We get this result without any further effort:[4]

[4]This is in contrast to the situation in Categorial Grammar where additional "wrapping" operators are needed because combining "each other" with "John and Mary" and $\lambda x \lambda y.introduced(bill, x, y)$ disobeys the linear order (see e.g. (Carpenter, 1998, p.357)). I will elaborate on this in a separate paper.

(11) [[Bill]$_2$ introduced [John and Mary]$_3$ to [each other]$_4$]$_1$
$bill : \mathbf{2}^e$
$introduce : \mathbf{2}^e \to \mathbf{3}^e \to \mathbf{4}^e \to \mathbf{1}^t$
$jm : \mathbf{3}^\gamma$
$\lambda R \lambda A.\textsc{recip}(A, R) : (\mathbf{4}_{ant}{}^e \to \mathbf{4}^e \to \mathbf{1}^t) \to \mathbf{4}_{ant}{}^\gamma \to \mathbf{1}^t$
where $\mathbf{4}_{ant} = \mathbf{3}$
$bill + introduced \Rightarrow \lambda y \lambda z.introduce(bill, y, z) : \mathbf{3}^e \to \mathbf{4}^e \to \mathbf{1}^t$
$+\textsc{recip} \Rightarrow \lambda A.\textsc{recip}(A, \lambda y \lambda z.introduce(bill, y, z)) : \mathbf{3}^\gamma \to \mathbf{1}^t$
$+jm \Rightarrow \textsc{recip}(jm, \lambda y \lambda z.introduce(bill, y, z)) : \mathbf{1}^t$

(I wrote here the results in η-expanded form just to increase readability.) It is also predicted correctly that the following sentence is ambiguous:

(12) John and Mary introduced Sue and Tom to each other.
$\textsc{recip}(st, \lambda u \lambda v.introduce(jm, u, v))$ ("each other" is anaphoric to st)
$\textsc{recip}(jm, \lambda u \lambda v.introduce(u, st, v))$ ("each other" is anaphoric to jm)

2.3 Scope Ambiguity at One Level

"Each other" may have scope interaction with other scope-bearing operators (see (Dalrymple et al., 1998, pp.183–184) for a discussion):

(13) John and Mary gave each other some present.
$\textsc{recip}(jm, \lambda x \lambda y.some(present, \lambda z.gave(x, y, z)))$
$some(present, \lambda z.\textsc{recip}(jm, \lambda x \lambda y.gave(x, y, z)))$

Here is the analysis:

(14) [[John and Mary]$_2$ gave [each other]$_3$ [some present]$_4$]$_1$
$gave : \mathbf{2}^e \to \mathbf{3}^e \to \mathbf{4}^e \to \mathbf{1}^t$
$jm : \mathbf{2}^\gamma$
$\lambda R \lambda A.\textsc{recip}(A, R) : (\mathbf{3}_{ant}{}^e \to \mathbf{3}^e \to k^t) \to \mathbf{3}_{ant}{}^\gamma \to k^t$
where $\mathbf{3}_{ant} = \mathbf{2}$
$some(present) : (\mathbf{4}^e \to k^t) \to k^t$
Instantiate $k^t = \mathbf{1}^t$ in both "each other" and "some present":
$\textsc{recip} : (\mathbf{2}^e \to \mathbf{3}^e \to \mathbf{1}^t) \to \mathbf{2}^\gamma \to \mathbf{1}^t$
$some(present) : (\mathbf{4}^e \to \mathbf{1}^t) \to \mathbf{1}^t$

Now, if we first combine "some present" with "gave" using the rule COMP (function composition), we get:

(15) $\lambda x \lambda y.some(present, \lambda z.gave(x, y, z)) : \mathbf{2}^e \to \mathbf{3}^e \to \mathbf{1}^t$

Then "each other" can apply on "John and Mary" and on (15) to obtain the first reading of (13). If instead we re-arrange the arguments of "gave" using EXCH:

(16) $\lambda z \lambda x \lambda y.gave(x, y, z) : \mathbf{4}^e \to \mathbf{2}^e \to \mathbf{3}^e \to \mathbf{1}^t$

and then combine "each other" with "John and Mary" using APP, and then with (16) using COMP, we get:

$$\dfrac{\dfrac{g : \mathbf{2}\to\mathbf{3}\to\mathbf{4}\to\mathbf{1} \quad s(p):(\mathbf{4}\to\mathbf{1})\to\mathbf{1}}{\lambda x,y.s(p,\lambda z.g(x,y,z)) : \mathbf{2}\to\mathbf{3}\to\mathbf{1}}\text{COMP} \quad \dfrac{jm:\mathbf{2} \quad \text{RECIP}: \mathbf{2}\to(\mathbf{2}\to\mathbf{3}\to\mathbf{1})\to\mathbf{1}}{\text{RECIP}(jm):(\mathbf{2}\to\mathbf{3}\to\mathbf{1})\to\mathbf{1}}\text{APP}}{\text{RECIP}(jm,\lambda x\lambda y.some(present,\lambda z.gave(x,y,z))):\mathbf{1}}\text{APP}$$

$$\dfrac{\dfrac{\dfrac{g : \mathbf{2}\to\mathbf{3}\to\mathbf{4}\to\mathbf{1}}{\lambda z,x,y.g(x,y,z) : \mathbf{4}\to\mathbf{2}\to\mathbf{3}\to\mathbf{1}}\text{EXCH} \quad \dfrac{jm:\mathbf{2} \quad \text{RECIP}: \mathbf{2}\to(\mathbf{2}\to\mathbf{3}\to\mathbf{1})\to\mathbf{1}}{\text{RECIP}(jm):(\mathbf{2}\to\mathbf{3}\to\mathbf{1})\to\mathbf{1}}\text{APP}}{\lambda z.\text{RECIP}(jm,\lambda x,y.g(x,y,z)):\mathbf{4}\to\mathbf{1}}\text{COMP} \quad s(p):(\mathbf{4}\to\mathbf{1})\to\mathbf{1}}{some(present,\lambda z.\ \text{RECIP}(jm,\lambda x\lambda y.gave(x,y,z))):\mathbf{1}}\text{APP}$$

Figure 1: Two derivations in "user friendly" style

(17) $\lambda z.\text{RECIP}(jm,\lambda x\lambda y.gave(x,y,z)) : \mathbf{4}^e \to \mathbf{1}^t$

This can combine with "some present" to get the second reading of (13).

The two derivations are shown in Figure 1 using the "user friendly" style of derivation where no step has free variables (Lev, 2006b, section 4.1). I used here RECIP instead of $\lambda R\lambda z.\text{RECIP}(z,R)$ just for convenience, but it's not a crucial point. If one prefers working with proofs in the "implementation level", they are given in Figure 2.

Scope ambiguities with negation and modals work in the same way. For example:

(18) John and Mary don't like each other.
$\neg\text{RECIP}(jm, like)$
$\text{RECIP}(jm,\lambda x\lambda y.\neg like(x,y))$

(See also (Lev, 2006b, section 3.3).)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\mathbf{2}\to\mathbf{3}\to\mathbf{4}\to\mathbf{1} \quad [\mathbf{2}]_2}{\mathbf{3}\to\mathbf{4}\to\mathbf{1}} \quad [\mathbf{3}]_3}{\mathbf{4}\to\mathbf{1}} \quad (\mathbf{4}\to\mathbf{1})\to\mathbf{1}}{\mathbf{1}}}{\mathbf{3}\to\mathbf{1}}\,{}^3}{\mathbf{2}\to\mathbf{3}\to\mathbf{1}}\,{}^2 \quad (\mathbf{2}\to\mathbf{3}\to\mathbf{1})\to\mathbf{2}\to\mathbf{1}}{\mathbf{2}\to\mathbf{1}} \quad \mathbf{2}}{\mathbf{1}}$$

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\mathbf{2}\to\mathbf{3}\to\mathbf{4}\to\mathbf{1} \quad [\mathbf{2}]_2}{\mathbf{3}\to\mathbf{4}\to\mathbf{1}} \quad [\mathbf{3}]_3}{\mathbf{4}\to\mathbf{1}} \quad [\mathbf{4}]_4}{\mathbf{1}}}{\mathbf{3}\to\mathbf{1}}\,{}^3}{\mathbf{2}\to\mathbf{3}\to\mathbf{1}}\,{}^2 \quad (\mathbf{2}\to\mathbf{3}\to\mathbf{1})\to\mathbf{2}\to\mathbf{1}}{\mathbf{2}\to\mathbf{1}} \quad \mathbf{2}}{\mathbf{1}}}{\mathbf{4}\to\mathbf{1}}\,{}^4 \quad (\mathbf{4}\to\mathbf{1})\to\mathbf{1}}{\mathbf{1}}$$

Figure 2: Two derivations in "implementation level" style (meaning terms omitted)

3 Scope Flexibility

3.1 Overview

Can the k^t in the lexical entry (9) for "each other" be instantiated with the label of a clause that does not immediately contain the reciprocal? The following example has been suggested as evidence that it can:[5]

(19) a. $[[\text{John and Mary}]_2$ think $[[\text{they}]_4$ like $[\text{each other}]_5]_3]_1$

b. 1. $think(jm, \textsc{recip}(jm, \lambda x \lambda y.like(x, y)))$
2. $\textsc{recip}(jm, \lambda x \lambda y.think(x, like(x, y)))$

Reading 1 is obtained when k^t is instantiated to $\mathbf{3}^t$, but reading 2 can only be obtained if k^t is instantiated to $\mathbf{1}^t$, as we shall see below.

A few comments. First, $think(jm, \varphi)$ above means $think(john, \varphi) \wedge think(mary, \varphi)$. This connection is obtained either by a meaning postulate that explains what it means for *think* to apply on a plural entity or by a distribution operator. I will not discuss here which option is better (and perhaps both are needed in different situations), but note that a form such as (19)b.1 is needed if "think" is replaced with a predicate that is collective in its first argument, perhaps: "John and Mary decided that they will support each other" where the decision was reached collectively.

Second, the possibility of a wide-scope RECIP reading comes out more clearly in the sentence "John and Mary think they will defeat each other",[6] where the wide-scope reading in which each thinks s/he will defeat the other makes more sense than the narrow-scope reading in which each thinks an inconsistent thought.

For this to work, "they" should somehow co-vary with a singular entity of type e (even though it seems to refer to the plural "John and Mary") so that it can combine with "think" and "like" to form the $e \to e \to t$ relation $\lambda x \lambda y.think(x, like(x, y))$. We will see this below in more detail. This kind of thing happens in other cases as well. For example, when the speaker cannot use "he" or "she" because of a quantification over a mixed-gender group:

(20) a. Every smart marketer thinks that they know how to improve conversion rate.[7]
b. I also know that nearly every person running thinks that they will win.[8]

Even if "they" can refer to the entire set of smart marketers (in (20)a), the prominent reading has "they" co-varying with the quantification over single marketers. If all marketers or all persons were known to be male (or female) then "he" (respectively, "she") could be used instead of "they". (In contrast, even if the subject of (19)a were "John and Bill", we could not use "he" instead of "they" because of syntactic agreement requirements.)

[5] See (Higginbotham, 1980).
[6] From (Roberts, 1991), repeated in (Carpenter, 1998, p.361).
[7] www.offermatica.com/press-1.1.3.html 10-apr-2006
[8] www.mydd.com/story/2005/8/3/143252/6381 10-apr-2006

3.2 Analysis

For a discussion of the contribution of singular pronouns, see (Lev, 2006a). That discussion ended with the conclusion that it is better to use DRSs as the meaning representation language in order to avoid the problem of multiple glue derivations. For reasons that I will not go into here,[9] I will not pursue this idea but resort to the analysis that uses:

(21) singular pronoun:
$\lambda P \lambda x.P(x,x) : (a^e \to l^e \to k^t) \to a^e \to k^t$
where l is the label of my NP, a is the label of my antecedent,
and k is the label of the minimal clause containing a

(Notice how similar this is to (9)). Syntactic constraints on anaphora tell us that the antecedent of a singular pronoun must be a singular NP, and also that the antecedent of a plural pronoun must not be an NP containing just one singular proper name.[10] The actual schema for a plural pronoun should be the same as (21) except for the type of a. If we assume pluralities in the domain and choose $\gamma = e$ in (5) then nothing more needs to be said. If instead we choose $\gamma = et$ then it is less straightforward what the types on the two a should be. For this reason, from now on I will assume the simpler analysis where $\gamma = e$ and where the schema for a plural pronoun is exactly (21).

Now we go back to example (19):

(22) [[John and Mary]$_2$ think [[they]$_4$ like [each other]$_5$]$_3$]$_1$

jm	$: \mathbf{2}^e$
$think$	$: \mathbf{2}^e \to \mathbf{3}^t \to \mathbf{1}^t$
(they) $\lambda P \lambda x.P(x,x)$	$: (\mathbf{4}_{ant}{}^e \to \mathbf{4}^e \to k^t) \to \mathbf{4}_{ant}{}^e \to k^t$
	($\mathbf{4}_{ant} = \mathbf{2}$ and hance $k = \mathbf{1}$ so:)
	$: (\mathbf{2}^e \to \mathbf{4}^e \to \mathbf{1}^t) \to \mathbf{2}^e \to \mathbf{1}^t$
$like$	$: \mathbf{4}^e \to \mathbf{5}^e \to \mathbf{3}^t$
$\lambda R \lambda z.\text{RECIP}(z,R)$	$: (\mathbf{5}_{ant}{}^e \to \mathbf{5}^e \to l^t) \to \mathbf{5}_{ant}{}^e \to l^t$

The first reading of (19) in which RECIP takes narrow scope can only be obtained if $l = \mathbf{3}$ and $\mathbf{5}_{ant} = \mathbf{4}$. We then get:

(23) $\lambda R \lambda z.\text{RECIP}(z,R) : (\mathbf{4}^e \to \mathbf{5}^e \to \mathbf{3}^t) \to \mathbf{4}^e \to \mathbf{3}^t$
$+like \Rightarrow \lambda z.\text{RECIP}(z, like) : \mathbf{4}^e \to \mathbf{3}^t$
$+think$ (with COMP) $\Rightarrow \lambda u \lambda z.think(u, \text{RECIP}(z, like)) : \mathbf{2}^e \to \mathbf{4}^e \to \mathbf{1}^t$
$+they \Rightarrow \lambda z.think(z, \text{RECIP}(z, like)) : \mathbf{2}^e \to \mathbf{1}^t$
$+jm \Rightarrow (\lambda z.think(z, \text{RECIP}(z, like)))(jm) : \mathbf{1}^t$
$\equiv think(jm, \text{RECIP}(jm, like) : \mathbf{1}^t$

The second reading of (19) in which RECIP takes wide scope can only be obtained if $l = \mathbf{1}$. The reader is invited to verify that in that case we must have $\mathbf{5}_{ant} = \mathbf{2}$

[9] Briefly, the framework in (Lev, 2006a) does not allow us to form a relation like $\lambda x \lambda z.think(x, like(x,z))$. This is because "think they like" gives us $\lambda x \lambda z.[\ |\ think(x, [\widehat{\mathbf{4}}\ |\ \widehat{\mathbf{4}} = \alpha(\widehat{\mathbf{4}}),\ like(y,z)])]$, and $\alpha(\widehat{\mathbf{4}}) = \widehat{\mathbf{2}}$. But we really need $\alpha(\widehat{\mathbf{4}}) = x$.

[10] I am dealing here only with bound anaphora.

or else the premises cannot combine to form a complete derivation. But how can we justify $\mathbf{5}_{ant} = \mathbf{2}$? It seems at first that anaphoric constraints on reciprocals are similar to those for reflexives. For example:

(24) a. John likes himself. But not: Himself likes John.
b. John and Mary like each other. But not: Each other like John and Mary.
c. John thinks that Mary likes him/*himself.
d. John and Mary think that Bill likes them/*each other.

Therefore, it seems at first that "each other" cannot be directly anaphoric to "John and Mary". However, "each other", unlike a reflexive pronoun, is also a quantifier that can take scope. To allow for that while still taking account of (24)d, we can specify the constraints for the lexical schema for reflexives (9) as follows:

(25) The *immediate* antecedent label α_0 of a reciprocal must satisfy the same constraints as the antecedent label of a reflexive (including: α_0 is in the minimal clause containing the reciprocal). This label starts a chain $\alpha_0, \alpha_1, \ldots, \alpha_m$ of labels of anaphoric expressions where for all $0 \leq j < m$, α_j labels an expression which is anaphoric to the expression that α_{j+1} labels.[11] Then the *ultimate* antecedent label of the reciprocal (marked a in (9)) can be any label α_j along the chain.

Thus we have:

(26) $\lambda R \lambda z.\textsc{recip}(z, R) : (\mathbf{2}^e \to \mathbf{5}^e \to \mathbf{1}^t) \to \mathbf{2}^e \to \mathbf{1}^t$
$\mathit{think} + \mathit{like} \Rightarrow \lambda x \lambda y \lambda w.\mathit{think}(x, \mathit{like}(y, w)) : \mathbf{2}^e \to \mathbf{4}^e \to \mathbf{5}^e \to \mathbf{1}^t$
$+\mathit{they} \Rightarrow \lambda x \lambda w.\mathit{think}(x, \mathit{like}(x, w))) : \mathbf{2}^e \to \mathbf{5}^e \to \mathbf{1}^t$
$+\mathit{recip} \Rightarrow \lambda z.\textsc{recip}(z, \lambda x \lambda w.\mathit{think}(x, \mathit{like}(x, w))) : \mathbf{2}^e \to \mathbf{1}^t$
$+\mathit{jm} \Rightarrow \textsc{recip}(\mathit{jm}, \lambda x \lambda w.\mathit{think}(x, \mathit{like}(x, w))) : \mathbf{1}^t$

3.3 Interaction with Equi and Raising Verbs

Does a reciprocal exhibit a similar kind of scope flexibility when it interacts with raising and equi (control) verbs, as in (27)? A-priori it seems like it might since there are two clauses: the main clause and the embedded clause which is the argument of the main verb. So we now turn to investigating this interaction.

(27) a. John and Mary tried to hit each other.
b. John and Mary seemed to like each other.

In the LFG syntactic analysis of both the raising verb "seem" and the equi verb "try", the subject of the main clause's f-structure is structure-shared with the subject of the embedded clause's f-structure (Bresnan, 1982; Dalrymple, 2001, ch.12). The only difference between the two is that "try" selects for a thematic subject whereas "seem" does not. This difference is represented by having the thematic subject inside the angled brackets of the pred, while the non-thematic subject is outside these brackets. Thus the f-structures for (27) are shown in (28).

[11] Cf. (Higginbotham, 1980).

(28) a.
$$\boxed{1}\begin{bmatrix} \textsc{pred} & \text{‘SEEM}\langle(\uparrow \textsc{xcomp})\rangle(\uparrow \textsc{subj})\text{’} \\ \textsc{subj} & \boxed{2}[\text{“John and Mary”}] \\ \textsc{xcomp} & \boxed{3}\begin{bmatrix} \textsc{pred} & \text{‘LIKE}\langle(\textsc{subj}), (\textsc{obj})\rangle\text{’} \\ \textsc{subj} & \boxed{2} \\ \textsc{obj} & \boxed{4}[\text{“each other”}] \end{bmatrix} \end{bmatrix}$$

b.
$$\boxed{1}\begin{bmatrix} \textsc{pred} & \text{‘TRY}\langle(\uparrow \textsc{subj}), (\uparrow \textsc{xcomp})\rangle\text{’} \\ \textsc{subj} & \boxed{2}[\text{“John and Mary”}] \\ \textsc{xcomp} & \boxed{3}\begin{bmatrix} \textsc{pred} & \text{‘LIKE}\langle(\textsc{subj}), (\textsc{obj})\rangle\text{’} \\ \textsc{subj} & \boxed{2} \\ \textsc{obj} & \boxed{4}[\text{“each other”}] \end{bmatrix} \end{bmatrix}$$

Asudeh (2002), following previous accounts in the literature regarding the difference in the semantics of equi and raising verbs, extends this LFG syntactic analysis and provides a glue semantics analysis. This account gives “Gonzo seemed to leave” the semantics $seem(leave(Gonzo))$ whereas the semantics given to “Gonzo tried to leave” is $try(Gonzo, leave)$ and *not* $try(Gonzo, leave(Gonzo))$. The reason for *not* using the latter representation is that it leads to false inference patterns:

(29) Gonzo tried to leave.
and Andrew did too. or: Andrew tried everything that Gonzo tried.
$\Rightarrow$ Andrew tried for Gonzo to leave.

Following this analysis, the glue statements for (28)a should be:

(30) $jm : \mathbf{2}^e$
$seem : \mathbf{3}^t \to \mathbf{1}^t$
$like : \mathbf{2}^e \to \mathbf{4}^e \to \mathbf{3}^t$
$\lambda R\lambda z.recip(z, R) : (\mathbf{4}_{ant}{}^e \to \mathbf{4}^e \to k^t) \to \mathbf{4}_{ant}{}^e \to k^t$

Each index $\boxed{n}$ in the AVM corresponds to the boldface glue category $\mathbf{n}$, i.e. the latter is “the label of” the former.[12] The antecedent of “each other” is “John and Mary” (syntactically, we might need to say that the antecedent of “each other” is the SUBJ of the embedded clause $\boxed{3}$, but $\boxed{3}$ is structure-shared with the SUBJ of the main clause $\boxed{1}$). Hence $\mathbf{4}_{ant} = \mathbf{2}$. According to (9), k should be the label of the minimal clause containing a. But does that mean $\boxed{1}$ only, or is $\boxed{3}$ also possible?

(31) If $k = \mathbf{1}$ then:
$\lambda R\lambda z.recip(z, R) : (\mathbf{2}^e \to \mathbf{4}^e \to \mathbf{1}^t) \to \mathbf{2}^e \to \mathbf{1}^t$
$seem + like \Rightarrow \lambda x\lambda y.seem(like(x, y)) : \mathbf{2}^e \to \mathbf{4}^e \to \mathbf{1}^t$
$+recip \Rightarrow \lambda z.recip(z, \lambda x\lambda y.seem(like(x, y))) : \mathbf{2}^e \to \mathbf{1}^t$
$+jm \Rightarrow recip(jm, \lambda x\lambda y.seem(like(x, y))) : \mathbf{1}^t$
= “John seemed to like Mary and Mary seemed to like John”

(32) If $k = \mathbf{3}$ then:
$\lambda R\lambda z.recip(z, R) : (\mathbf{2}^e \to \mathbf{4}^e \to \mathbf{3}^t) \to \mathbf{2}^e \to \mathbf{3}^t$

[12] In the terminology of the LFG architecture, $\mathbf{n}$ is the *semantic projection* of $\boxed{n}$ (Dalrymple, 2001).

$+like \Rightarrow \lambda z.recip(z, like) : \mathbf{2}^e \rightarrow \mathbf{3}^t$
$+jm \Rightarrow recip(jm, like) : \mathbf{3}^t$
$+seem \Rightarrow seem(recip(jm, like)) : \mathbf{1}^t$
= "It seemed that John and Mary liked each other"

It is not easy to tell whether only one of the options gives the right truth conditions. What about the equi verb?

(33) $jm : \mathbf{2}^e$
$\lambda P \lambda x.try(x, P) : (\mathbf{2}^e \rightarrow \mathbf{3}^t) \rightarrow \mathbf{2}^e \rightarrow \mathbf{1}^t$
$hit : \mathbf{2}^e \rightarrow \mathbf{4}^e \rightarrow \mathbf{3}^t$
$\lambda R \lambda z.recip(z, R) : (\mathbf{2}^e \rightarrow \mathbf{4}^e \rightarrow k^t) \rightarrow \mathbf{2}^e \rightarrow k^t$

(34) If $k = \mathbf{1}$ then:
$\lambda R \lambda z.recip(z, R) : (\mathbf{2}^e \rightarrow \mathbf{4}^e \rightarrow \mathbf{1}^t) \rightarrow \mathbf{2}^e \rightarrow \mathbf{1}^t$
(assumption) $[v : \mathbf{4}]$
$+hit \Rightarrow \lambda y.hit(y, v) : \mathbf{2}^e \rightarrow \mathbf{3}^t$
$+try \Rightarrow \lambda x.try(x, \lambda y.hit(y, v)) : \mathbf{2}^e \rightarrow \mathbf{1}^t$
(discharge assumption + exchange) $\Rightarrow \lambda x \lambda v.try(x, \lambda y.hit(y, v)) : \mathbf{2}^e \rightarrow \mathbf{4}^e \rightarrow \mathbf{1}^t$
$+recip \Rightarrow \lambda z.recip(z, \lambda x \lambda v.try(x, \lambda y.hit(y, v))) : \mathbf{2}^e \rightarrow \mathbf{1}^t$
$+jm \Rightarrow recip(jn, \lambda x \lambda v.try(x, \lambda y.hit(y, v))) : \mathbf{1}^t$
= "John tried to hit Mary and Mary tried to hit John"

(35) If $k = \mathbf{3}$ then:
$\lambda R \lambda z.recip(z, R) : (\mathbf{2}^e \rightarrow \mathbf{4}^e \rightarrow \mathbf{3}^t) \rightarrow \mathbf{2}^e \rightarrow \mathbf{3}^t$
$+hit \Rightarrow \lambda z.recip(z, hit) : \mathbf{2}^e \rightarrow \mathbf{3}^t$
$+try \Rightarrow \lambda x.try(x, \lambda z.recip(z, hit)) : \mathbf{2}^e \rightarrow \mathbf{1}^t$
$+jm \Rightarrow try(jm, \lambda z.recip(z, hit)) : \mathbf{1}^t$
= "John and Mary collectively tried to bring it about that John and Mary would hit each other" (or distributively, "John tried to bring it about that John and Mary would hit each other, and so did Mary")

The second option seems much less likely (and is unavailable according to Higginbotham (1980)). So we can reach the tentative conclusion that although the SUBJ of the main clause is structure-shared with that of the embedded clause, its more prominent place is in the main clause $\boxed{1}$ while its place in the embedded clause is dependent. Therefore, when the lexical schema for the reciprocal refers to "the minimal clause containing my antecedent", it means only the main clause. It is possible to express this constraint on the c-structure in which "John and Mary" have just one location, in the main clause. The conditions here probably need to be expressed more carefully.

4 Type Flexibility

Higginbotham (1980) points out that a reciprocal may also scope around an NP, not just a clause:

(36) a. Bill likes [John and Mary]$_i$'s pictures of [each other]$_i$.
$like(bill, \textsc{recip}(jm, \lambda u \lambda v.poss(u, picture\text{-}of(v))))$
b. [[John and Mary]$_i$'s pictures of [each other]$_i$] collided.
$collide(\textsc{recip}(jm, \lambda u \lambda v.poss(u, picture\text{-}of(v))))$

Here, *picture-of* is of type $e \rightarrow e \rightarrow t$ and *poss* is of type $e \rightarrow (e \rightarrow t) \rightarrow e$, i.e. $poss(a, P)$ returns the element x such that $P(x)$ and x belongs to a (or is related to a in some other way).

The RECIP here is used to form a plurality of type e. If R is of type $e \rightarrow e \rightarrow e$ then $\textsc{recip}(a \oplus b, R)$ means $R(a, b) \oplus R(b, a)$. So (36)a can be expanded to (37)a. Although in this case, this is equivalent to (37)b, it is only thanks to the particular distributive perdicate *like*. The collective predicate *collide* in (36)b shows that in general, the sentence cannot be reduced to a reciprocal that returns a proposition.

(37) a. $like(bill,\ poss(john, picture\text{-}of(mary)) \oplus poss(mary, picture\text{-}of(john)))$
b. $like(bill, poss(john, picture\text{-}of(mary))) \wedge like(bill, poss(mary, picture\text{-}of(john)))$

The conclusion is that RECIP is polymorphic, just like *and* and *or* are. Therefore, (9) should be revised:

(38) $\lambda R \lambda A.\textsc{recip}(A, R) : (a^e \rightarrow l^e \rightarrow k^\tau) \rightarrow a^\gamma \rightarrow k^\tau$
where l is my label, k is the label of the expression α that I scope over,
and a is my (ultimate) antecedent's label;
where if $\tau = t$ then α is a clause, and if $\tau = e$ then α is a NP;
and where $k =$ the label of the minimal expression containing a,
and [some more constraints on a]

Interestingly, when RECIP shows scope flexibility as in section (3), it shows type flexibility at the same time:

(39) John and Mary like their pictures of each other.
a. $like(jm, \textsc{recip}(jm, \lambda u \lambda v.poss(u, picture\text{-}of(v))))$
b. $\textsc{recip}(jm, \lambda u \lambda v.like(u, poss(u, picture\text{-}of(v))))$

I assume that *their* can be analyzed as *they's*, so the discussion about the anaphoric chain *each other* → *they* → *John and Mary* from section (3) carries over. In (39)a, RECIP takes scope over the NP and therefore returns a plurality of type e. But in (39)b, it takes scope over the sentence, so it returns type t. I assume that in:

(40) John and Mary think their pictures of each other collided.
a. $think(jm, collide(\textsc{recip}(jm, \lambda u \lambda v.poss(u, picture\text{-}of(v)))))$
b. $\textsc{recip}(jm, \lambda u \lambda v.think(u, collide(poss(u, picture\text{-}of(v)))))$

the second reading is unavailable not because the syntax-semantics interface blocks it but because of the meaning of *collide*, just as "John collided" is blocked not by the syntax-semantics interface but by the meaning of *collide*.

5 Covert Reciprocation

Sometimes a reciprocal may be expressed covertly. However, not all cases that seem like they have a covert reciprocal are indeed so. In particular, I will discuss the questions for each of the pairs in (41): What is the connection between the two sentences? Do they mean the same? If so, is one of them basic and one derived? Are all these pairs instances of the same kind of alteration?

(41) a1. John and Mary collided.
a2. John and Mary collided with each other.
b1. John and Mary kissed.
b2. John and Mary kissed each other.
c1. John and Mary are similar.
c2. John and Mary are similar to each other.
d1. John and Mary read the same book.
d2. John and Mary read the same book as each other.

Below, I will need the following definition:

(42) The *reciprocal completion* of $R(a, b)$ is $\textsc{recip}(a \oplus b, R)$.

For example, (43)b is the reciprocal completion of (43)a.

(43) a. John saw Mary.
b. John and Mary saw each other.

5.1 Group-Monadic Predicates

According to Ginzburg (1990), there are two unrelated kinds of symmetric alterations: those based on an inherently group-monadic predicate such as *collide*, and those based on an inherently singular-dyadic predicate. We discuss the latter in section 5.2.

Group monadic predicates usually have a comitative construction version. Ginzburg claims this for inherently collective predicates expressing joint activity such as *meet*, *fight*, *correspond*, *compete*, *collaborate*, *copluate*, *coexist*, *play chess*, *agree*, *have an affair*, as in (44)a,b. But the comitative construction is available also for predicates that could apply on either groups or individuals as in (44)c,d.

(44) a. John and Mary collaborated.
b. John collaborated with Mary.
c. John and Mary lifted the table (together).
d. John lifted the table (together) with Mary.

According to Ginzburg, for this kind of predicates, the group-monadic predicate is basic and the comitative construction is derivative. In a comitative construction, the main predicate is collective, but the elements of the group are expressed separately because one element of the group is 'focussed' above the other(s). Ginzburg suggests (in the framework of Situation Semantics) that pairs of sentences such as (44)a,b express different propositions but the two have the same truth conditions, and this is enforced by a postulate on the meaning of the relation *WITH* (which takes two arguments: the NP of the PP, and the VP).

Now, let us look at the reciprocal completion of comitative constructions. They are more or less acceptable depending on the meaning of the predicate and world knowledge:

(45) a. John and Mary met.
b. John met with Mary.
c. ? John and Mary met with each other.

Example (45)c sounds a bit odd. It means "John met with Mary and Mary met with John", so one possible explanation for the oddness is that each of the conjuncts already has the truth conditions of "John and Mary met", and there is a repetition here. Or perhaps the oddness is because of the conflict of who the focussed element is. Observe:

(46) a. John and Mary collided.
b. John collided with Mary.
c. John and Mary collided with each other.

Although these seem to entail each other, perhaps there is a slight difference in meaning, where John is seen to have been moving towards Mary in (46)b, or to be the one responsible for the collision, while Mary could have been standing still. Because of this asymmetry, (46)c sounds less odd than (45)c since it means something like: both were moving towards each other and then collided. An asymmetry might exist in (45)b as well, but this time it seems to imply a difference in who is the more prominent of the two or the more active of the two (who initiated the meeting).[13] If this is correct then (45)c sound a bit odd because it gives contradictory implications about prominency.

There is another kind of variation, which Ginzburg does not discuss:

(48) a. John and Mary kissed.
b. ? John kissed with Mary.
c. ? John and Mary kissed with each other.
d. John kissed Mary.
e. John and Mary kissed each other.

For some reason, group-monadic *kiss* does not like to use the comitative construction. There is a transitive version of *kiss* whose meaning is that the agent kissed the patient, not necessarily on the lips, and the patient did not necessarily kiss back, as in (48)d. This version can undergo reciprocal completion, as in (48)e. The verb *meet* behaves similarly: "John met Mary" seems to mean that John was more active, or was the one who bumped into Mary on the street, perhaps he noticed her first before she noticed him.

[13]Is the following odd?

(47) In a school visit to Buckingham Palace yesterday, my 10-year-old son met with Her Royal Highness, Queen Elizabeth II.

As noted in Dimitriadis (2004) (following Schwarzschild and others), while (48)e could mean various kinds of kissing events, (48)a is "irreducibly symmetric" (this is Dimitriadis' term) and can mean only one event of simultaneous kissing on the lips. This difference also comes up when we examine scope flexibility: (49)a is unambiguous and has only one reading because *kiss* is just group-monadic, while (49)b is ambiguous as we saw in section 3.[14]

(49) a. John and Mary said they kissed.
$say(jm, kiss_{iv}(jm))$
b. John and Mary said they kissed each other.
$say(jm, \text{RECIP}(jm, kiss_{tv}))$
$\text{RECIP}(jm, \lambda x \lambda y.say(x, kiss_{tv}(x, y)))$

To sum up, there is nothing special that needs to be said about the reciprocal beyond what needs to be said about the comitative constructions and lexical alterations between intransitive and transitive versions of verbs like *kiss* and *meet*. In particular, there is no covert reciprocal operator at work here, neither (41)a1 nor (41)a2 is derived from the other, and the same goes for (41)b1 and (41)b2.

5.2 Singular-Dyadic Predicates

In contrast to group-monadic predicates, Ginzburg claims that in symmetric singular-dyadic predicates, it is the singular form that is basic, as in (50)a, and the reciprocalized version which is derivative, as in (50)b.

(50) a. John is similar to Mary.
b. John and Mary are similar.
c. John and Mary are similar to each other.

How does one tell whether a predicate is group-monadic or singular-dyadic? Ginzburg points to the following differences:

1. Predicates whose basic form is group-monadic are odd with a reflexive object whereas predicates whose basic form is singular-dyadic, such as *similar*, *synonymous*, *different*, *parallel*, *perpendicular*, *adjacent*, *equal*, *equivalent*, *identical*, *isomorphic*, *distinct*, *disjoint*, *separate*, *related*, *unrelated*, *opposite*, *near*, are not. Compare:

   (51) a. ? John collaborated with himself.
   b. This line is parallel to itself.

2. Predicates whose basic form is group-monadic do not take null complements as singular-dyadic ones do:

[14] Siloni (2005), who notes this fact, also notes that in some languages, what seems like a reciprocal operator that is separate from the verb in fact merges with the verb to form an irreducible group-monadic predicate.

(52) a. John has strong opinions on a host of issues. Bill and Mary agree on most of the important issues. (Only reciprocal reading, cannot have 'John' as null complement of 'agree').

b. Bill likes ice-cream. John and Mary are similar (in that respect). (Could have both reciprocal and null complement readings).

3. The dyadic form of group-monadic predicates always uses the preposition *with* since this is in fact the comitative construction. In contrast, singular-dyadic predicates use various prepositions:

(53) a. This is similar / equal / isomorphic *to* that.
b. This is different / separate / disjoint *from* that.
c. This is the same *as* that.

Moreover, some tests show that the *with* PP is an adjunct and not a complement of the dyadic form of group-monadic predicates. For example:

(54) a. John can be relied on / dependent upon.
b. ?? John can be met with / competed with / collaborated with.

There seems to be another difference, which Ginzburg did not point out: group-monadic predicates are verbs while singular-dyadic ones are adjectives or adverbs. This seems to be a very robust test, save for the following exceptions.

First, for a few adjectives, it is not clear whether they are singular-dyadic and have a PP argument with preposition *with* or they are group-monadic, and can participate in a comitative construction:

(55) a. Regulations 4 and 9 are compatible (with each other).
b. Regulation 4 is compatible with regulation 9.

Other such adjectives are: *(mutually) incompatible*, *co-extensive*, and *inter-twined*. Second, two adjectives – *inter-dependent* and *pairwise disjoint* – can neither take an additional argument nor participate in a comitative construction. But all these seem to have a part that expresses reciprocation: *co-*, *inter-*, *pairwise*, *mutually*, so that might explain why they are not singular-dyadic.

Now, how do we get the group-monadic form of singular-dyadic predicates, e.g. (50)b from (50)a? First, if the reciprocal is overt as in (50)c then there is no issue. (50)c is simply the reciprocal completion of (50)a, and the usual treatment we saw in previous sections works. As for (50)b, Ginzburg suggests that the group-monadic form of a singular-dyadic predicate is obtained through a *reciprocalization* operator that applies on that predicate. To generalize his proposal (which uses the strongers reading of RECIP , namely Full Reciprocity), this operator, call it *rcp*, is defined:

(56) For a binary relation R, $R^{rcp} := \lambda A.\textsc{recip}(A, R)$

For example, (50)a should be analyzed as $similar^{ccp}(john \oplus mary)$.

There is a point, however, that needs to be addressed and which is missing from Ginzburg's account. If there is a reciprocalization operator, it can sometimes apply on non-atomic predicates. The first case where we might be able to show this is:

(57) a. John and Mary think they are similar to each other.
$think(jm, \textsc{recip}(jm, similar))$
$\textsc{recip}(jm, \lambda x \lambda y.think(x, similar(x, y)))$.
b. John and Mary think they are similar.

That (57)a has the two readings shown follows from what was said in section 3. The two readings are very similar in the present case because it is hard to imagine how a person could think $similar(a, b)$ without also thinking $similar(b, a)$ given that *similar* is a symmetric relation. So it is hard to tell whether the two readings are available for (57)b. But if we use a subject that has three members, such as "John, Bill, and Mary", the two readings become more clearly distinct: if John, Bill and Mary think they are similar to each other, then John can think he is similar to Mary in a different manner to how he is similar to Bill, while also not necessarily thinking at all about the similarity of Mary and Bill. It is not clear whether this reading is also available when the reciprocal is covert. It think that with the right context, it can be available.

A clearer example of the technical problem with the reciprocalization operator has to do with *same* and *different* in the following examples:

(58) a. John and Mary read the same book (as each other).
b. Men and women have a different sense of humour! (than each other)[15]

These examples show that we cannot assume the reciprocalization operator applies only on lexical predicates: here it needs to apply on the complex predicates $\lambda x \lambda y.[x$ read the same book as y (did)] and $\lambda x \lambda y.[x$ have a different sense of humour than y (do)].

These issues lead me to propose that there is no reciprocalization. Instead, I propose the following claim:

(59) Symmetric adjectives and comparative adjectives may drop their complement "p X" (where p is a preposition or *than*) if X is an expression that is anaphoric to an entity salient enough in the context, including when X is a reciprocal.

This theory gives a unified explanation for the possibility to drop all the complements in the following sentences (given the right context):

(60) a. John is 6 feet tall. But Bill is taller (than him/that).
b. Bill likes spicy foods. John is similar (to Bill).
c. Bill read "War and Peace". John read the same book (as that) / a different (than that).
b. These two are similar (to each other) but this one is distinct (from them).

The upshot is that during interpretation, if a symmetric or comparative adjective is encountered which does not have it expected complement, that complement should be reconstructed as "p that/him/her/..." or "p each other".

In the next section, I give more details about what's involved with *same* and *different* and their interaction with overt and covert reciprocals, and show further support for this theory.

[15] http://newmediasphere.blogs.com/nms/2005/02/men_and_women_h.html 1-mar-2005

6 *Same* and *Different* with Covert Reciprocation

The aim of this section is to investigate covert reciprocals in uses of *same* and *different* as in:

(61) a. John and Mary are the same (as each other).
b. John and Mary are different (from each other).
c. John and Mary read the same book (as each other).
d. John and Mary read a different book (than each other).

6.1 Preliminaries

The singular-dyadic predicate *different* can be used just like *similar*, *parallel*, *perpendicular*, *equivalent*, and *equal*:

(62) a. John is different from Mary.
b. John and Mary are different.
c. John and Mary are different from each other.

All of them can also be used to modify a noun, both post nominally and pre-nominally:

(63) a. John drew a line (that was) [perpendicular to / different from] the line Mary drew.
b. John drew a [perpendicular / different] line [to / from] the line Mary drew.

The adjective *same* behaves similarly, except that it requires its NP to have *the* as the main determiner (I will not go into the reason for that here):

(64) a. John is the same as Mary (in that/some respect).
b. John and Mary are the same.
c. John and Mary are the same as each other.
d. John read a book (that was) the same as the book Mary read.
e. John read the same book as the book Mary read.

So far, there is nothing out of the ordinary (other adjectives that take a complement may appear pre-nominally while their complement appears after the noun, e.g.: "an easy man to please"). But in contrast to the other symmetric adjectives above, *same* and *different* also accept clausal complements. For example, compare (65)a to (65)b,c:

(65) a. * John drew a perpendicular line to/than Mary did/drew.
b. John read a different book than Mary did/read.
c. John read the same book (as/that) Mary did/read.

The sentences (65)b,c mean:

(66) a. John read a book that was different from [*the book / some book / all the books*] that Mary read.
b. John read a/the book that was the same as *a/the book* that Mary read.

If *did* is used instead of *read* in (65) then a general ellipsis-reconstruction mechanism takes care to reconstruct it to *read*.[16] I will not go into this mechanism here since this is a big topic in itself.

In addition, the meaning of the noun that *same* and *different* modify somehow needs to be "duplicated" and augmented onto the meaning of the propositional complement, as shown in (66). This also happens with other comparatives:

(67) John read a longer book than Bill did/wrote.
$\Rightarrow$ John read a book that was longer than a/the/all the book(s) that Bill read/wrote.

One option here is to assume some reconstruction mechanism that duplicates the meaning of the noun and combines it with the meaning of the clause. Another option is to assume that the the comparative takes the meaning of the noun and just uses it twice, once normally and once in combination with the meaning of the clause. I will not get here into reasons to prefer the second option – see (Lev, 2005b, section 6.2) for more on that and for an analysis of (67). That analysis can be adapted here by replacing *longer* with *same* or *different* (see also (Lev, 2005a)). The contribution of *same* and *different* is that of an adjective expecting a property Q (of type $e \to t$), and then expecting as usual the meaning of the noun P, and returning a modified meaning for the N':

(68) $\lambda Q \lambda P \lambda x. P(x) \wedge combine(\textsc{op}, x, \lambda z. P(z) \wedge Q(z)) : (e_1 \to t_2) \to (e_3 \to t_4) \to e_3 \to t_4$
$\textsc{op} \in \{\textsc{same}, \textsc{diff}\}$

The argument Q gives a set of objects (in the case above, the set of books that Mary read). If $\textsc{op} = \textsc{same}$ and the set is a singleton $\{c\}$ then the operator *combine* uses it for the meaning $\textsc{same}(x, c)$, i.e. we get $\lambda x. book(x) \wedge same(x, \iota z. book(z) \wedge read(Mary, z))$, the property of being a book that is the same as the book that Mary read. If $\textsc{op} = \textsc{diff}$ then *combine* can say that $\textsc{diff}(x, y)$ for all y in that set (or for a unique y in that set). I do not want to spend more time here on the details since they belong to a general discussion of comparative constructions, and here I want to get to the interaction between the comparatives and the reciprocal.

I am showing here the details of the derivation since I will need them later. First, the analysis of (65)b goes as follows (the analysis of (65)c is similar):

(69) $diff := \lambda Q \lambda P \lambda x. P(x) \wedge combine(\textsc{diff}, x, \lambda z. P(z) \wedge Q(z))$

(70) [[John]$_2$ read [a different [book]$_4$ [than [[Mary]$_6$ wrote]$_5$]]$_3$]$_1$.
$john : \mathbf{2}^e$
$read : \mathbf{2}^e \to \mathbf{3}^e \to \mathbf{1}^t$
$a : (\mathbf{4}_v{}^e \to \mathbf{4}^t) \to (\mathbf{3}^e \to \mathbf{1}^t) \to \mathbf{1}^t$
$book : \mathbf{4}_v{}^e \to \mathbf{4}^t$
$mary : \mathbf{6}^e$
$wrote : \mathbf{6}^e \to \mathbf{7}^e \to \mathbf{5}^t$
$diff : (\mathbf{7}^e \to \mathbf{5}^t) \to (\mathbf{4}_v{}^e \to \mathbf{4}^t) \to \mathbf{4}_v{}^e \to \mathbf{4}^t$
$mary + wrote \Rightarrow \lambda y. wrote(mary, y) : \mathbf{7}^e \to \mathbf{5}^t$

[16] This need not be stated in procedural terms and can be expressed in a constraint-based way.

$+diff \Rightarrow \lambda P.diff(\lambda y.wrote(mary, y), P) : (\mathbf{4}_v{}^e \rightarrow \mathbf{4}^t) \rightarrow \mathbf{4}_v{}^e \rightarrow \mathbf{4}^t$
$+book \Rightarrow diff(\lambda y.wrote(mary, y), book) : \mathbf{4}_v{}^e \rightarrow \mathbf{4}^t$
$+a \Rightarrow a(diff(\lambda y.wrote(mary, y), book)) : (\mathbf{3}^e \rightarrow \mathbf{1}^t) \rightarrow \mathbf{1}^t$
$+(john + read) \Rightarrow a(diff(\lambda y.wrote(mary, y), book),\ \lambda x.read(john, x)) : \mathbf{1}^t$
$\equiv a(\lambda x.book(x) \wedge combine(\text{DIFF}, x, \lambda z.book(z) \wedge wrote(mary, z)),\ \lambda x.read(john, x))$

This means: there is a book which is different from the set of books that Mary wrote and John read that book.

There is also a version of (65)b,c in which the explicit VP-ellipsis marker *did* is elided as well:

(71) a. John read the same book as Mary.
b. John read a different book than Mary.

My current best guess is that "as/than Mary" in (71) are indeed a clausal complement (rather than a PP) from which everything except *Mary* has been elided (see (Lev, 2005b, section 6.5)). This is perhaps related to stripping, a kind of ellipsis where the *do* verb is stripped, as in:

(72) a. John owns a computer, but not David.
Meaning: John owns a computer, but David doesn't.
b. John owns a computer, and David, too.
Meaning: John owns a computer, and David does too.

Two pieces of evidence for this view: Although some people may use *than* when they "should" use *from* in a simple construction as (73)a,b, they do not do so in (73)d (that sentence requires Mary to be a book).

(73) a. This book is different from that book.
b. This book is different than that book.
c. John read a different book than Mary.
d. * John read a different book from Mary.

Also, it might be acceptable if the elided clause still has a temporal adjunct as in (74)a,b (but not in (74)c).

(74) a. John read a different book today than Mary yesterday.
b. Sam introduced Bill to a different woman today than John yesterday.
c. * This book is different today from that book yesterday.

My conclusion is that a general ellipsis-reconstruction mechanism takes care to turn "as/than Mary" to "as/than Mary did" and then to "as/than Mary read". Then, the derivation is exactly as in (70). In other words, we don't have to complicate here the mechanisms of compositional semantics to take care of this case, e.g. by assuming that *diff* itself should take as arguments not only the complement phrase "than Mary [did]" but also the relation *read* which is outside itself, so that *diff* itself could do the reconstruction of the missing verb by feeding *read* into the meaning of the clause. Such a use of an outside relation is unlikely: to make use of it, *same* and *different* would need to know about its category ($\mathbf{2}^e \rightarrow \mathbf{3}^e \rightarrow \mathbf{1}^t$ in (70), which includes the category of "John" $\mathbf{2}^e$). That would make "a different book than Mary" anaphoric to "John" in a way.

6.2 Overt Reciprocal

Now back to reciprocals. (75) are the reciprocal completion of (71):

(75) a. John and Mary read the same book as each other.
b. John and Mary read a different book than each other.[17]

In contrast to these, it sounds quite bad to apply reciprocal completion (76)b directly on (76)a (= (65)b,c), probably because "each other" stands as the subject of a clause.

(76) a. John read [the same / a different] book [as / than] Mary wrote/did.
b. ??? John and Mary read [the same / a different] book [as / than] each other wrote/did.

The tricky issue is that although "as/than Mary" in (71)a,b is a clausal and not a phrasal complement, and although a reciprocal is not supposed to be allowed in subject position according to Condition A of Binding Theory (see (76)b again), it *is* allowed in (75).[18] I think that this is allowed because of a special exception to Condition A of Binding Theory, namely that in an elided VP in which the *do* form is also elided, a reciprocal (and a reflexive) is allowed in subject position and is allowed to be anaphoric to an item outside its minimal domain. This exception might have developed historically because of the similarity of "as/than Mary" in (71)c,d to a phrasal complement.

If this is correct then the way to analyze (75) is to assume that the ellipsis reconstruction mechanism takes care to turn (75) into:

(78) a. John and Mary read the same book as each other read.
b. John and Mary read a different book than each other read.

which, although ungrammatical, are acceptable semantically. The derivation for (78)b is obtained from (70) in the usual manner of reciprocal completion: *read* is used instead of *wrote*, $jm : \mathbf{2}^e$ is used instead of $john : \mathbf{2}^e$, and $\lambda R \lambda z.\textsc{recip}(z, R) : (\mathbf{2}^e \to \mathbf{5}^e \to \mathbf{1}^t) \to \mathbf{2}^e \to \mathbf{1}^t$ is used instead of $mary : \mathbf{5}^e$. The result is:

(79) $\textsc{recip}(jm,\ \lambda u \lambda v.a(\mathit{diff}(\lambda y.read(v, y), book),\ \lambda x.read(u, x))) : \mathbf{1}^t$
$\equiv \textsc{recip}(jm,\ \lambda u \lambda v.a(\lambda x.book(x) \wedge combine(\textsc{diff}, x, \lambda z.book(z) \wedge read(v, z)),\ \lambda x.read(u, x)))$

The meaning is a bit redundant since if John read a book which was different from (some/all of) the book(s) that Mary read, then Mary read a book which was different from (some/all of) the book(s) that John read. However, if we replace the subject with "John, Bill, and Mary", then this becomes non-redundant, since one needs to assert pairwise distinctness.

[17] See (Lev and Garcia, 2005, section 3.2.1) for similar examples, including "the four wheels turn at a different speed than each other".

[18] The same goes for a reflexive:

(77) a. John cannot possibly own a different computer than David does.
b. * John_i cannot possibly own a different computer than himself_i does.
c. John_i cannot possibly own a different computer than himself_i.

6.3 Covert Reciprocal

6.3.1 The Problem

Consider the following:

(80) a. John and Mary read the same book.
b. John and Mary read a different book.

Each of these has two readings. In one reading, "the same book" and "a different book" are anaphoric to some salient book(s) in the discourse, as in:

(81) a. Bill read "I, Robot". John and Mary read a different book than that.
b. Bill read "I, Robot". John and Mary read the same book as that.

Here *that* is anaphoric to (the book) "I, robot", and both *same* and *different* behave very simply.

The other reading of (80) is reciprocal, as in (75). While (80)b, with the reciprocal reading, will probably not win a competition for the most eloquent sentences ever written, people do occasionally use this construction, as (82) shows. The reason people do seems to be their wish to emphasize that each element of the subject is related to just one element of the NP. For example, using "different books" in (80)b and (82)b might confuse the hearer regarding how many books each of the two members of the subject actually read.

(82) a. Men and women have a different sense of humour![19]
b. [After a disagreement about what is written in some book by a certain title:] Clearly, you and I read a different book by that title.[20]

How should this reading of (80) be obtained? Is it somehow related to the anaphoric construction (81)? If so, how? Or if it is related to the overt reciprocal in (75), then how exactly? Or is there a third option?

6.3.2 Some Data

The answer is actually quite complex, no matter how one tries to go about it. First, let us consider the anaphoric option. It seems clear that the *anaphoric* reading of (80) is obtained by dropping the "as/than that" of (81), i.e. this phrase is an optional complement of *same* and *different* when it is clear that some salient object is being referred to. Now consider the following:

(83) a. Every boy / each of the boys read the same book.
b. Every boy / each of the boys read the same book as every other boy / each of the other boys did.
c. * Every boy / each of the boys read the same book as each other.
d. Every boy / each of the boys read a different book.

[19] http://newmediasphere.blogs.com/nms/2005/02/men_and_women_h.html 1-mar-2005
[20] http://www.spinnoff.com/bb/viewtopic.php?p=31228& 1-mar-2005

e. Every boy / each of the boys read a different book than every other boy / each of the other boys did.

f. * Every boy / each of the boys read a different book than each other.

This data indicates that "every boy / each of the boys" really must quantify over individuals and so the set of boys cannot be taken as a whole as an argument for the reciprocal, thus the unacceptability of (83)c,f. The cases (83)a,d seem to be obtained from (83)b,e in a way similar to how "as/than that" is dropped when moving from (81) to the anaphoric reading of (80), except the dropped complement is more complex. This would require extending my theory of (59) with one more option. In any case, it does not seem that a hidden reciprocal is involved in (83)a,d, so I will not discuss this case further here.

But this option is not available in the following constructions:

(84) a. Most boys read the same book.

b. ?? Most boys read the same book as the other boys.

c. Most boys read the same book as each other.

d. ?? [It was assumed that most boys would read the same book as each other, but in fact] most boys read a different book.

e. ?? Most boys read a different book than the other boys.

f. Most boys read a different book than each other.

(85) a. at least / at most five boys read the same book.

b. ?? at least / at most five boys read the same book as the other boys.

c. at least / at most five boys read the same book as each other.

d. ?? [It was assumed that at most three / at least seven of the boys would read a different book than each other, but in fact] at least / at most five boys read a different book.

e. ?? at least / at most five boys read a different book than the other boys.

f. at least / at most five boys read a different book than each other.

In contrast to (83), the data in (84)b,e and (85)b,e indicate that *most* and *at least/most* need to quantify over groups. Notice that (84)d and (85)d don't sound as good as their *same* counterparts (84)a and (85)a. I think this fact is not very significant, the construction is not very clear so people prefer not to use it.

Finally, in:

(86) a. Everyone read the same book.

b. Everyone read the same book as everyone else.

c. Everyone read the same book as each other.

d. Everyone read a different book.

e. Everyone read a different book than everyone else.

f. Everyone read a different book than each other.

since *everyone* allows both forms, we can conclude that it can be understood as either quantifying over individuals or as referring to the whole group (similarly in: (87)).

(87) "Every boy collaborated" $\neq$ "The boys collaborated with each other."

"Everyone collaborated" could mean: "Everyone collaborated with each other."

This means that (86)a,d could really be obtained in two different ways, either from (86)b,e or from (86)c,f.

6.3.3 My Proposal

Now back to the question: how is the reciprocal reading of (80) obtained? I think it is unlikely that an explicit plural NP quantifies over its members, something like:

(88) a. John, Bill, and Mary read the same book as all the others of John, Bill, and Mary.
b. John, Bill, and Mary read a different book than all the others of John, Bill, and Mary.

So the evidence from (83)–(85) suggests (80) is not obtained from the anaphora construction.

An alternative, then, is to suppose that (80) is related to (75). But how are they related? According to my theory in (59), we can say that it is a convention of language use that the complement of *same* and *different* may be omitted (just as it was when moving from (81) to the anaphoric reading of (80)), and in some cases the omitted material is "as/than each other". Once this material is reconstructed, we are back to the analysis of (75).

6.3.4 The Price of a Compositional Analysis, and Barker's *Same*

But some people may not be satisfied. They may want to find a solution within the framework of direct compositionality, where the semantics of the sentence is built strictly from the semantic material contributed by the words and grammar rules without resorting to any reconstructions. The goal is to get (79), repeated here as (89)a, but with having neither the reciprocal nor the second occurrence of *read* overtly. So *different* should be a complex operator that takes much of the other contributions as arguments and creates the desired result from them. We get this operator by taking (89)a and abstracting all the parameters:

(89) a. $\textsc{recip}(jm,\ \lambda u\lambda v.a(\mathit{diff}(\lambda y.read(v,y), book),\ \lambda x.read(u,x))) : \mathbf{1}^t$
b. $\lambda Q\lambda P\lambda R\lambda z.\textsc{recip}(z,\ \lambda u\lambda v.Q(\mathit{diff}(\lambda y.R(v,y), P),\ \lambda x.R(u,x))) :$
$((\mathbf{4}_v{}^e \to \mathbf{4}^t) \to (\mathbf{3}^e \to \mathbf{1}^t) \to \mathbf{1}^t) \to (\mathbf{4}_v{}^e \to \mathbf{4}^t) \to (\mathbf{2}^e \to \mathbf{3}^e \to \mathbf{1}^t) \to \mathbf{2}^e \to \mathbf{1}^t$

This operator needs to include the contributions of *different* and *each other* since we do not have them explicitly. So the last two of the four arguments of this operator look just like the arguments of the RECIP operator, i.e. a binary relation R and an plural entity z. And operator here also takes the meaning P of the noun it modifies, as did *different* before. But it further needs to take as argument Q, the quantifier of the NP where *different* appears.[21] Notice that R is used twice in the body of the operator – the first occurrence is what would be reconstructed by the VP-ellipsis mechanisms under the previous account.

I think this is unbearably complex, and the reconstruction solution is much simpler.

[21]To account for *same*, we need to assume that *the* is also treated like a quantifier, or else we'd need a different operator here.

Barker (2004) also proposes a strictly compositional analysis of *same* in the reciprocal reading of (80)a. His proposal is no less complex than the above one, but in contrast to (89)b, his proposal is completely independent from the overt reciprocal case (75). Furthermore, his proposal accounts for a smaller range of constructions than the present account.

Barker proposes that *same* is an adjective which takes scope outsize its location (in a similar way to *occasional* in "an occasional sailor walked by"). The operator *same* has the following complex definition:

(90) $\mathit{same} = \lambda F_{\mathsf{(et\rightarrow et)\rightarrow et}} \lambda X_{\mathsf{e}}.\exists f_{\mathsf{choice}}.\forall x < X.(Ff)x$

Here F is a variable of type $((e \rightarrow t) \rightarrow (e \rightarrow t)) \rightarrow (e \rightarrow t)$, i.e. a function from adjective meanings (nominal modifiers) to nominal meanings. In addition, f is a variable over choice functions of type $(e \rightarrow t) \rightarrow (e \rightarrow t)$ that, given a set, return a singleton subset of it (i.e. $f(Z) = \lambda x.(x = a)$ for some $a \in Z$). The variable X ranges over non-atomic entities and '$<$' is the proper-part relation over the count domain.

In the sentence:

(91) Two men with the same name left.

the F argument of *same* gets to be $\lambda g.\mathit{the}(g(\mathit{name}))$, and the X argument is *name*. So we get:

(92) $\mathit{two}(\ \lambda X.\exists f.\forall x < X.\ [\mathit{with}(\mathit{the}(f(\mathit{name})))(\mathit{men})](x)\ )(\mathit{left})$

Here, $\mathit{with}(\mathit{the}(f(\mathit{name})))(\mathit{men})$ is the property (of type $e \rightarrow t$, where e can range over pluralities) of being a plurality (possibly of size 1) consisting of men that all have the name picked by f (notice that in Barker's account, *the* is of type $(e \rightarrow t) \rightarrow e$ and it must accept a singleton set and returns its only member). Call this property Q. So the sentence as a whole means: there is an object X with cardinality 2 such that there is a choice function f such that each proper subpart x of X has property Q. The details of how the semantics actually gets computed are not crucial here. Suffice it to say that *same* takes its scope just above *men* and below *two*.[22]

Barker's analysis cannot account for cases that involve an explicit *as* complement for *same*, such as (64)a,c,d, (65)c, (71)a, and (75)a, because his *same* operator does not take such a complement, nor is it possible to revise his analysis to do so. Furthermore, his analysis does not explain the connection between "John and Mary read the same book as each other" (= (75)a) and "John and Mary read the same book" (= (80)a), or similarly between (91) and:

(93) a. Two men with the same name as each other arrived.
b. Two men that have the same name as each other arrived.

His analysis also cannot be easily adapted to account for the similar behavior of "a different".[23] It seems that his analysis is very specific to the few cases he discusses.

[22]Barker also uses a complex mechanism of continuations to explain how *same* can take that scope. I was able to provide a simpler computation of this in glue semantics. I will show it in a separate document as it is not crucial for the discussion here.

[23]Barker gives an operator for *different*, similar in structure to his operator for *same*, but this is for *different* that modifies a plural noun, not a singular noun. Therefore his operator would work

6.3.5 Some Obstacles?

In this and the next sub-sections I look at potential obstacles to my theory, and answer them.

Sentence (94)b is modelled after "John and Mary read the same book" (= (75)a) discussed above. The story in (94)a provides a plausible context, explaining why "as each other" is used in (94)b, to prevent the hearer from assuming that the two buyers were the same.

(94) a. We were surprised to find out that pictures 1 and 2 were bought by the same person, but it became really bizarre when we discovered that ...
b. [pictures 3 and 4]$_i$ were also bought by the same person as [each other]$_i$.

But now consider (95)a, which is the covert reciprocal version of (94)b. If we change it to active voice in (95)b we get a fine sentence. But (95)c it unacceptable.

(95) a. Pictures 3 and 4 were bought by the same person.
b. The same person bought pictures 3 and 4.
c. * The same person as [each other]$_i$ bought [pictures 3 and 4]$_i$.

According to my account, (95)a is obtained from (94)b by omitting "as each other", and so (95)b should also be obtainable from (95)c in the same way. But the latter is ungrammatical – isn't this a problem for my account?

I don't think this is a problem. Sentence (95)c makes sense semantically, just as (95)b does, and it is just a fact about Syntax that doesn't allow such sentences. That *same* can take an *as* argument is still possible in:

(96) The same person as *that one* bought pictures 3 and 4.

where *that one* refers to some salient person. My conclusion is that the reconstruction mechanism here may create structures that are coherent semantically even if not syntactically. We have already seen a similar situation with (75) and (78). Although (78) is ungrammatical due to the reciprocal being in subject position of a clause, (75) can still be derived from it. What makes this possible is the similarity of (75) to the phrasal case. Similarly here: (95)c is ungrammatical, but (95)b is still derived from it and is possible thanks to its similarity to (95)a.

6.3.6 "Pure" Truth Conditions vs. Conventional Use

But what about the following?

(97) a. John, Bill, and Mary have read the same book as each other.
b. John, Bill, and Mary have read the same book.

Applying Barker's *same* in (97)b predicts that there is one book such that each of John, Bill, and Mary read, and it seems a likely reading of the sentence. But according to my account, the meaning of (97)a is: for each pair of people from the

for *a different* only if one assumes that a singular noun can denote non-atomic pluralities. As for *different* modifying a plural noun, see section 6.4 below.

group, the two people read the same book, though there need not be one book that all three people read. Therefore, isn't it wrong to say that (97)b is derived from (97)a by omitting "as each other"?

I don't think so. First, note that if the subject has just two members, or if the situation is such that each person read just one book, then the truth conditions of the two accounts come out the same. If in practice people use sentences such as (97) only under such circumstances, then we could still retain my account. As we are about to see, this is probably the most that can be said.

Note that *all* may be added:

(98) a. John, Bill, and Mary have *all* read the same book as each other.
b. John, Bill, and Mary have *all* read the same book.

These sentences seem to emphasize that there is indeed just one book that all three people read. This suggests that (97) do not force one book, or else there would be no difference in meaning between (98) and (97). If this is true, it does come out that (97)b means the same as (97)a and is derived from it.

How does *all* contribute to (98)? Generally speaking, *all* might be a group-forming operator and the group it forms then combines simply with a collective predicate. But if this were true here, then there would be no difference in meaning between (98) and (97). Another option is that *all* is a type-$\langle 1,1\rangle$ quantifier. This option has two sub-options:

1. *all* combines with the collective predicate "read the same book (as each other)" in the same way that most but not all type-$\langle 1,1\rangle$ quantifiers may combine with a collective predicate (see e.g. the Bounded Composition operator in Dalrymple et al. (1998); Peters and Westerståhl (2006)). In particular, for a monotonically increasing type-$\langle 1,1\rangle$ quantifier Q and a collective predicate P, that combination is: $\exists X.P(X) \wedge Q(A,X)$ where A is the restrictor of Q. But that would give us $\exists X.\textsc{recip}(X, \lambda u\lambda v.read(u, the(same(\lambda z.read(v,z), book))) \wedge all(jbm, X)$, which does not make a stronger claim about the number of books compared to (97).

2. The other option is that (98)b has the same structure as "Every boy read the same book" (= (83)a) which means "Every boy read the same book as every other boy". If this is true then (98)b means: Each of John, Bill, and Mary read the same book that each of the others read.

This last option makes a slightly stronger claim than (97). Still, it does not force just once book. Even worse, if the last option is the right one, how come (98)a is possible? – it should be unavailable just as (99) is unavailable. People should use "as the others" rather than "as each other".

(99) ? Every boy read the same book as each other.

I think that sentences such as (98)a, and similarly (100), are in fact slightly odd, but people might use them anyway because on the one hand they want to say there is just one element that all people are related to, but on the other hand to prevent the interpretation of *same* as anaphoric to some contextual element.

(100) a. They have all grown at about the same rate as each other.[24]

b. . . . which is why Lance, Ullrich, Landis, Vinokourov, Leipheimer, etc., have all stayed within the same range as each other.[25]

A similar thing might be happening in even "less grammatical" constructions that people still do use occasionally. In fact, even sentences like (99) do appear sometime:

(101) *every + same + each other*:

a. I noticed that a lot of the teachers . . . had the same goal, wanting every student to have the same opportunities as each other to learn the subject.[26]

b. Because they chose to put every required class at the same exact time as each other.[27]

c. First of all I always hated it on shows where every single friend was always in the same class as each other.[28]

d. There isn't much to choose from and every student pretty much have the same classes as each other.[29]

(102) *each + different + each other*:

a. If the three referees each gives a score different from each other, the intermediate score is used.[30]

b. ... in such a way that each of the two copies is executed on a different PE from each other.[31]

c. Each of the three or more openings has a different size from each other.[32]

The writers "should" have used "the other(s)" instead of "each other", or use "all the" instead of "every" or "each (of the)" (also notice that the confusion caused the writer of sentence (101)d to use *have* instead of *has*).[33] One might suggest that *each other* here really is not a reciprocal but a form from which a noun was dropped. Thus, for example, "as each other" in (101)a should be reconstructed to be "as each other *student*". But this option is not available to us because *each other* can be replaced by its synonym *one another*:

(103) *every + same + one another*

a. Not every child with Aspergers has exactly the same symptoms as one another but they are very similar.[34]

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[24] www.horseadvice.com/advisor/messages/4/15582.html 1-may-2006

[25] www.latimes.com/sports/weblog/ blog/archives/2005/07/index.html 1-may-2006

[26] http://people.wwc.edu/student/richbra/School%20Sleuth.rtf 27-apr-06

[27] http://www.xanga.com/Fleener?nextdate=4%2F4%2F2006+22%3A10%3A19.217&direction=n 27-apr-06

[28] http://www.jumptheshark.com/b/boymeetsworld.htm 27-arp-06

[29] www.greatschools.net/modperl/parents/ny/6854/?ref=s_bc 27-apr-06

[30] http://www.usakarate.org/dir.pdf/rules_explain.pdf 24-apr-2006

[31] http://doi.ieeecomputersociety.org/10.1109/ICDSN.2000.857536 24-apr-2006

[32] http://www.freepatentsonline.com/6814805.html 24-apr-2006

[33] Moreover, in examples a–c, they "should" have used *than* rather than *from* because this is an elided clause, as discussed above. For example, (102)a does not claim that each of the three referees gives a score where that score is different from the other referees, but rather from the scores those referees gave. In practice, however, because of the similarity of the simple *different from* construction to the elided *different than* construction, people have come to use *from* and *than* almost interchangeably.

[34] http://uk.answers.yahoo.com/question/index?qid=1006040701212 27-apr-06

b. In those games, every race had the same asset as one another and everything was shared.[35]

c. The great thing about them though, is that not every soldier has the exact same accuracy as one another.[36]

(104) *each + same + one another*

a. Each of the other cells had the same fate as one another.[37]

b. Once you have aligned each rod section in its proper orientation to one another ... Once the reel seat is glued in place, each of the rod sections should still be the same length as one another.[38]

c. The grain of each of the wood components runs in the same direction as one another.[39]

(105) *every/each + different + one another*

a. Every track has a different flavor from one another, but also different from what you're likely to hear on the radio.[40]

b. Every single mic has a different proximity from one another in relation to their neighboring noise makers and their respective pickup devices.[41]

c. Every skater had a different bag of tricks than one another which made it much harder to judge than the Intermediate.[42]

d. Each of the puzzle pieces being of a different shape from one another.[43]

My conclusions from all this are the following. The truth conditions of (97) by themselves really do not force just one book. The truth conditions of (98) are slightly more strict, but even they do not force just one book. Nevertheless, in practice people would usually use such constructions when it is clear from context that each member of the set is related to just one element from the noun. This makes the truth conditions logically equivalent to saying there is just one element that all members of the set are related to. The reciprocal statement is an overkill as it states the same thing more than once, but natural language is not a perfect formal language, so occasional cases of overkill are to be expected. Because of this common use, even in contexts where the unique existence is not necessary, the use of the construction came to be associated with this uniqueness assumption and it is therefore invoked. If one *really* wanted to make it crystal clear that there is just one book that all have read, one needs to say it in another way, such as: "There is some book that each of John, Bill, and Mary read".

To account for (100)-(105), I think that both from a scientific point of view as well as an engineering one it is crucial to distinguish the various mechanisms that are at work here:

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[35] http://www.3000ad.com/ubbcgi/ultimatebb.cgi?ubb=get_topic;f=32;t=000091;p=0 27-apr-06

[36] http://coinop.org/kb_dl.aspx/KB/FAQs/FAQ-Time%20Crisis.html 27-apr-06

[37] http://info.med.yale.edu/labmed/faculty/labs/krauselab/pdf/Reg_of_hem_Stem_cell_fate.pdf 27-apr-06

[38] http://www.thomaspenrose.com/ferrule3.htm 27-arp-06

[39] http://www.freshpatents.com/Pallet-with-laminate-blocks-dt20060112ptan20060005746.php 27-apr-06

[40] http://www.amazon.com/gp/product/B00000HZEK/103-4681124-0751800?v=glance&n=5174 27-apr-06

[41] http://www.recordingwebsite.com/forum/index.php?PHPSESSID=dc1817a9f0954624bce3269de983d1ac&topic=628.msg4389 27-apr-06

[42] http://www.revolutionskatepark.co.uk/skatenews.htm 27-apr-06

[43] http://www.freepatentsonline.com/4776802.html 27-apr-06

1. The underlying "pure" compositional semantics of truth conditions based on "correct" use and fully-reconstructed material.
2. Simple ellipsis-reconstruction and stripped ellipsis-reconstruction.
3. Reconstruction mechanism for omitted arguments of "same (as)" and "different (from/than)".
4. Changes made to a form because it is superficially similar to another, e.g. see footnote 33, and perhaps the historical origin of allowing a reciprocal in a stripped clausal complement for *same* and *different* even though it is not allowed as subject in a normally-elided clause.
5. Conventional use of a form to mean something slightly different than what its pure truth conditions say. For example, using (97) as if there is one unique element that all the members of the group are related to.

Making these distinctions allows for clean modules of a theory where each has clear and simple principles, whereas if we conflated them, the resulting theory would be an amalgam of exceptions and complicated formulas (such as (89)b and (90)). The theories of similarity-based changes and of conventional language use that account for the phenomena shown here are, however, beyond the scope of this paper.

6.4 Plural *Different*

I have not investigated above cases where *different* modifies a plural noun, as in:

(106) a. John and Mary read different books from each other.
b. John and Mary read different books than each other. (cf. (75)b)
c. John and Mary read different books. (cf. (80)b)
d. Different people bought pictures 3 and 4. (cf. (95)b)

These cases have an additional complexity in comparison to the cases using *same* and *a different*: here *each other* may be anaphoric to the plural noun *books* or *people*. What does (106)a mean when *each other* is anaphoric to *books*? It means the same as *various*, i.e. each book is different from the other books with respect to some contextually salient feature. This is also possible when "than each other" is not mentioned, as in (106)c,d.

If I started with an analysis of plural *different*, then one might get confused and say: since this internal-reciprocal reading is available, perhaps this is the only reading we have, and the contextually salient feature takes care of the rest. For example, in (106)b,c, if my theory from previous sections predicts that *each other* is anaphoric to "John and Mary", the contextual theory could propose instead that only the internal-reciprocal reading is available, but the relevant contextual feature is "according to who read them". In other words, the contextual theory says that (106)b,c mean: John and Mary read books, and those books were different from each other with respect to who read them.

This is in fact what Beck (2000) proposed to do in her analysis (she considers only cases where *different* modifies a plural noun, and *from/than each other* does not appear overtly after that). However, the internal-reciprocal option is not available when *different* (or *same*) comes before a singular noun, and *each other* must be anaphoric to the subject. This is also true in some sentences even if *different* does modify a plural noun, as shown in (Lev and Garcia, 2005). Therefore, my conclusion is that when *different* modifies a plural noun, whether or not there is an overt reciprocal, then *both* the internal-reciprocal and the external-reciprocal readings are available.

7 Conclusion

In the first part of this paper, I have shown how to calculate the meaning of sentences with the reciprocal expressions *each other* and *one another* in the framework of Glue Semantics. It was very easy to do so thanks to the flexibility of that framework.

I then investigated cases that involve or seem to involve a covert reciprocal, and explained how their meaning can be computed. My main claim, in (59) was that the complement of symmetric and comparative adjectives may be dropped if it is salient enough in context. That simple assumption accounted for a very wide range of cases. I also showed that alternative accounts which use only pure compositional semantics (without dropping and reconstruction operations) are too complex (precisely because too much of the semantic material is really missing from the overt sentence, just as in cases of ellipsis), and cannot account for all the data. This joins nicely with the previous conclusion of Lev and Garcia (2005) to indicate that *same* and *different* cannot be treated as complex operators and their uses must be reduced to the cases where their complement is overt.

Further work includes:

1. As noted in section 3.2, I relied there on an analysis of anaphora in glue semantics that leads to some issues (of duplicate derivations, as explained in (Lev, 2006a).) How can this be fixed without harming the analysis here?

2. One thing that was left unexplained in section 6.1 is the ellipsis-reconstruction mechanism. This is a huge topic in itself, but I want to make sure it interacts correctly with the phenomena I investigated.

3. It will be illuminating to show that the analysis of reciprocals in glue semantics is difficult or almost impossible in other frameworks such as Categorial Grammar (see footnote 4) and underspecified representations (e.g. Hole Semantics and CLLS). A related issue is showing how Barker's analysis (although I rejected it) can be calculated more conveniently in glue semantics compared to his continuations.

4. How can my account be extended to cases of resumptive *same* or *different* such as "Different boys read different books"?

5. An open question remaining is what happens when the NP antecedent of a reciprocal is a quantifier. This question is in fact an instance of a more general question: how does a quantifier combine with a collective predicate? The

Bounded Composition operator proposed in Dalrymple et al. (1998) and generalized in Peters and Westerståhl (2006) was noted there as not accounting correctly for all cases. It is also quite complex. Is there an alternative solution?

6. Another question that pertains not only to reciprocals but also to plurals is how to actually represent them and reason with them in a computational system using first-order reasoners (theorem provers and model builders). In particular, it was shown in (Peters and Westerståhl, 2006) that one of the possible meanings of RECIP , namely *LIN*, is not expressible in first-order logic over an individual domain. What happens if we take the domain to include pluralities, as in Link (1998)? Can we do that and keep the inference efficient?

References

Asudeh, Ash. 2002. A resource-sensitive semantics for equi and raising. In *The construction of meaning*, ed. David Beaver, Stefan Kaufmann, Brady Clark, and Luis Casillas. CSLI Publications.

Barker, Chris. 2004. Parasitic scope. Submitted. Based on a 2004 SALT paper. http://ling.ucsd.edu/%7Ebarker/Research/barker-same.pdf.

Beck, Sigrid. 2000. The semantics of *Different*: Comparison operator and relational adjective. *Linguistics and Philosophy* 23:101–139.

Bresnan, Joan. 1982. Control and complementation. In *The mental representation of grammatical relations*, ed. Joan Bresnan, 282–390. MIT Press.

Carpenter, Bob. 1998. *Type-logical semantics*. MIT Press.

Dalrymple, Mary. 2001. *Lexical Functional Grammar*, volume 34 of *Syntax and Semantics Series*. Academic Press.

Dalrymple, Mary, Makoto Kanazawa, Yookyung Kim, Sam Mchombo, and Stanley Peters. 1998. Reciprocal expressions and the concept of reciprocity. *Linguistics and Philosophy* 21:159–210.

Dimitriadis, Alexis. 2004. Discontinuous reciprocals. Unpublished Ms, Utrecht institute of Linguistics OTS, http://www.let.uu.nl/∼alexis.dimitriadis/personal/papers/discon-long-ms04.pdf.

Ginzburg, Jonathan. 1990. On the non-unity of symmetric predicates: Monadic comitatives and dyadic equivalence relations. In *Proc. of NELS 20, GLSA, UMass, Amherst*, ed. J. Carter et al.

Higginbotham, James. 1980. Reciprocal interpretation. *Journal of Linguistic Research* 1:97–117.

Keenan, Edward L., and Dag Westerståhl. 1997. Generalized quantifiers in linguistics and logic. In *Handbook of logic and language*, ed. Johan van Benthem and Alice ter Meulen, 837–893. Elsevier.

Lev, Iddo. 2005a. Comparative constructions. Addendum to (Lev, 2005b).

Lev, Iddo. 2005b. Gradable comparatives: Syntax and syntax-semantics interface. Paper for Ling221B, Stanford University. http://www.stanford.edu/∼iddolev/pulc/.

Lev, Iddo. 2006a. Anaphora in glue semantics. http://www.stanford.edu/∼iddolev/pulc/.

Lev, Iddo. 2006b. Introduction to the syntax-semantics interface using glue semantics. http://www.stanford.edu/∼iddolev/pulc/.

Lev, Iddo, and Ivan Garcia. 2005. On the syntax-semantics interface of *Different* and *Each Other*. Handout given at the 6th Semantics Fest, CSLI, Stanford University, available here: http://www.stanford.edu/∼iddolev/pulc/.

Link, Gödehard. 1983. The logical analysis of plurals and mass terms: a lattice theoretical approach. In *Meaning, use and interpretation of language*, ed. R. Bauerle, C. Schwarze, and A. von Stechow. De Gruyter, Berlin.

Link, Godehard. 1998. *Algebraic semantics in language and philosophy*. Number 74 in CSLI Lecture Notes. CSLI Publications.

Peters, Stanley, and Dag Westerståhl. 2006. *Quantifiers in language and logic*. Oxford University Press.

Roberts, C. 1991. Distributivity and reciprocal distributivity. In *Proc. of the first SALT conference*.

Siloni, Tal. 2005. The syntax of reciprocal verbs: An overview. (To appear). http://www.tau.ac.il/∼siloni/ReciprocalVerbs2005.pdf.