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RECIPROCALS AND *SAME/DIFFERENT*: TOWARDS A SEMANTIC ANALYSIS

Constructions with *each other* and *same* or *different* (or other relational adjectives) as in (1) and (2) are both subject to constraints on the relation between an antecedent and a dependent element, and they involve a similar semantics.

(1) John and Mary think that they love each other.
(2) John and Mary bought the same book/different books.

Syntactically, *each other* and *same/different* both require a plural antecedent that is 'sufficiently close'. Semantically, both constructions, roughly speaking, involve a comparison between entities that are parts of a group denoted by a plural and are coarguments of some relation expressed by elements in the sentence. (1) has a reading in which John thinks that he loves Mary and Mary that she loves John, whereby neither of them necessarily thinks about the feelings of the other. Then in (1), the compared entities are John and Mary, and the relation is the relation expressed by *think that they love*. In (2), these entities again are John and Mary, and the relation is the relation expressed by *bought*.

I will develop an analysis of reciprocals and *same/different* in which the two constructions are treated in an exactly parallel fashion. This analysis is of a novel type. It is based on a bipartite interpretation of a sentence in which the specific contribution of the element in question (*each other* as a reciprocal or *same/different*) is separated from the semantic evaluation of the rest of the clause. In the case of reciprocals, this means that the semantic status of a reciprocal as an argument and an anaphor is separated from the specific reciprocity effect. This analysis accounts for a number of semantic peculiarities of *each other* which sets it apart from constructions involving quantification of the usual type. In particular, it accounts for the inability of *each other* to interact in scope with other quantifiers in a sentence, the requirement that plurals appear in certain contexts in reciprocal clauses, and the tendency of reciprocal clauses to describe a single event, rather than a set of disconnected events. Further evidence for the bipartite interpretation of reciprocals comes from the expression of reciprocity cross-linguistically. Often reciprocity is expressed independently from argumenthood and anaphoricity by adverbial elements. Furthermore, the semantic analysis presented in this paper accounts for the

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fact that *each other* involves two syntactic relations, a relation of *each other* to what I will call the anaphoric antecedent (*they* in (1a)) and a relation to what I will call the reciprocal antecedent (*John and Mary* in (1a) in the reading mentioned). The first relation is responsible for coreference. The second relation is responsible for the specific reciprocity effect.

This account when carried over to *same/different* explains why *same/different* does not involve the usual syntactic antecedent-anaphor relation. *Same/different* has only one function, which yields the specific *same/different* effect in the bipartite interpretation of a sentence. This function corresponds syntactically to the relation between *each other* and its reciprocal antecedent, not the relation between *each other* and its anaphoric antecedent. Following Carlson (1987), I take the semantic antecedent of *same/different* to be an event, namely the event argument of the relevant verb in the sense of Davidson (1966), and not a group referent of some plural NP. The type of semantic operation for reciprocity and for *same/different* as in (2) and the syntactic relation correlated with it are associated also with other constructions, for instance English reflexives and *same/different* with quantified antecedent.

In the first part of this paper, I briefly introduce the bipartite interpretation of reciprocal clauses. Then I show how the two functions of *each other* as an anaphor and as a reciprocal correlate with two distinct syntactic relations that reciprocals enter. On this basis, I develop the semantic account of reciprocals in detail. I show how this type of analysis receives further support from adverbial expressions of reciprocity cross-linguistically and carries over to English reflexives. In the second part of this paper, I discuss the syntax and semantics of *same/different*. First, I clarify and justify Carlson's suggestion that *same/different* takes an event as its semantic antecedent. Then I discuss the syntactic relation between *same/different* and its antecedent and compare it to the relation with *each other*. Finally, I show how *same/different* can be given a semantic analysis parallel to *each other*.

1. The Bipartite Interpretation of Reciprocal Sentences

Throughout this paper, I adopt Davidson's (1966) proposals about events, namely that verbs have an argument place for events (by convention, I take this to be the first argument place of a verb) and that adverbials such as *quickly* or *in the bathroom* are predicates predicated of these event arguments. In this account, (3a) is represented as in (3b).

(3)a John quickly shaved in the bathroom.
b. $\exists e$(shave(e, [*John*]) & quickly(e) & in(e, [*the bathroom*]) & past(e))

I propose the following semantic analysis of a reciprocal sentence. The semantic interpetation of a sentence such as (4a) has two parts. One is essentially the usual interpetation that (4a) would have if *each other* were disregarded as a reciprocal and instead interpreted as a simple plural anaphor coreferential with *the students*. This part amounts roughly to the event property in (4b), with *each other* refering to the same group as *the students*. The second part consists in the specific reciprocity effect of *each other* as an association of parts of the three arguments that are involved in the first part of the interpretation. Crucially, the analysis is based on a generalized and context dependent notion of part 'P_s' according to which a part of a group may be either a relevant subgroup or an individual, as will be elaborated on later. This part of the interpetation constitutes the second conjunct of the scope of the event quantifier. The intended result is the proposition given in (4c), where 'other$_s$' denotes the relation that holds between x, y and z if x and y are parts of z and x is distinct from y.

(4)a. The students work with each other.
b. λe[work with(e, [*the students*], [*each other*])]
c. $\exists e$[work with(e, [*the students*], [*each other*]) & $\forall x'(x'P_s$[*the students*] $\rightarrow \exists e'e''x''x'''$(other$_s(x'', x'$, [*the students*]) & other$_s(x''', x'$, [*the students*]) & $e'P_se$ & $e''P_se$ & work with(e', x', x'') & work with$(e'', x''', x')))$]

(4c) states that there is an event of working together that involves the students and again the same students such that for every relevent part x' of the students there are parts of the students x'' and x''' distinct from x' such that for subevents e' and e'' of e the relation 'work with' holds among e', x' and x'' and among e'', x''' and x'. The analysis is designed in such a way that in the first part of the proposition of a reciprocal sentence, other elements of the clause such as event quantifiers and other quantificational NPs are represented, whereas the second part is restricted to the reciprocity effect. This will have the effect that reciprocity cannot show scope interactions with other quantifiers.

The two parts of the evaluation of a reciprocal sentence are associated with two functions of the reciprocal *each other*. The first part represents the status of *each other* as an argument of *work with* and as an anaphor with respect to *the students*. The second part is based on the relation of

each other as a reciprocal with respect to *the students*. The two relations of *each other* to *the students* as an anaphor and a reciprocal have to be represented separately as in (5), where '*i*' indicates the relation of anaphoricity and '*r*' the relation of reciprocity.

(5) [The students]$_{i,r}$ worked with [each other]$_{i,r}$.

In a given sentence, *each other* may be related to distinct NPs in the two relations. Furthermore, the two relations are subject to different syntactic constraints as we shall see in the next section.

1.1. *The Syntactic and Semantic Antecedent-Anaphor Relation with* Each Other

Each other is commonly regarded as a prototypical anaphor, which has to satisfy condition A of Binding Theory (cf. Chomsky, 1981). That is, it must be coindexed with a c-commanding antecedent in its local domain, as is illustrated in (7).

(7)a. *[John and Mary]$_i$ think [that Sue loves each other$_i$].
b. John and Mary think [that they$_i$ love each other$_i$].
c. *[John and Mary]$_i$ believe [that he loves each other$_i$].

Let me call this antecedent of *each other* the 'anaphoric antecedent'. The anaphoric antecedent of *each other* need not coincide with the antecedent that enters the reciprocal interpretation (as discussed in Higginbotham 1981, 1985, and Williams 1986, 1991). The relations between this antecedent and *each other* need not satisfy, for instance, the Specified Subject Condition or the Tensed S Condition. Let me call this antecedent the 'reciprocal antecedent' of *each other*. (7b) is ambiguous with respect to the reciprocal antecedent of *each other*. It can have either of the following interpretations. John and Mary both have thoughts about mutual love (the *narrow reading* of *each other*), or they each think that they like the other (the *broad reading* of *each other*). In the first case, the reciprocal antecedent is the embedded *they*, in the second case, it is the matrix subject *John and Mary*. The second case is the interesting one: The anaphoric antecedent must be the lower subject, but the reciprocal antecedent is the matrix subject. Thus, *each other* enters two different syntactic relations, one that involves the reciprocal antecedent and one that involves the anaphoric antecedent. These two relations can be associated with two distinct semantic operations that are involved in the interpretation of reciprocals, an operation that yields coreference and an operation that yields the reciprocal relation.

As the relation between *each other* and its anaphoric antecedent is restricted by condition A of Binding Theory, there are syntactic restrictions on the relation between *each other* and its reciprocal antecedent. These restrictions are peculiar to *each other* (and, as we shall see, to *same/different*) and are not shared by other syntactic relations that have been more thoroughly investigated. Let me mention here only two of those. First, it appears that the reciprocal antecedent has to c-command *each other*. In the examples (8a)–(8b), a broad reading of *each other* is impossible. Though the acceptability of (8c), an example from Williams (1986), indicates that the relation must be somewhat looser than c-command, since *their* in (8c) can be the reciprocal antecedent of *each other* (see Heim, Lasnik and May, 1991 for discussion).

(8)a. Two people who know Sue and Mary$_j$ claim that they$_j$ exceed each other$_j$.
b. John and Mary said about Sue and Bill$_j$ that they$_j$ exceed each other$_j$.
c. Their$_i$ friends say they$_i$ like each other$_i$.

Second, *each other* cannot have a reciprocal antecedent outside a clausal complement of a nonbridge verb (such as a verb of manner of speaking) or an adjunct, as noted by Heim, Lasnik and May (1991):

(9)a. #John and Mary whispered that they hated each other (because they didn't want the other to hear it).
b. #John and Mary screamed that they hated each other (and were surprised that they had the same opinion about the other).
(10) John and Mary criticized Max after they defeated each other.

(9a) and (9b) can only report John and Mary's pronouncement of mutual hatred. In (10) the criticism of Max can take place only after John defeated Mary and Mary defeated John.

The last constraint on the antecedent of *each other* also holds for overt *wh* movement at S-structure. Heim, Lasnik and May (1991) therefore take it as evidence that *each other* involves movement of the *each* part at LF. In this account, (7b) would have the LF representation in (11):

(11) [[John and Mary] each$_i$] think [that they love [t_i other].

The problem with this argument, however, is that LF movement is allowed from complements of nonbridge verbs and adjuncts, as was noted by Huang (1982).

(12)a. Who whispered that Mary loves whom?

b. Who left the room because Mary said what?

Moreover, the reciprocal antecedent is not subject to various other island constraints that restrict overt *wh* movement, in particular the *Wh* Island Constraint or the Complex NP Constraint, as we shall see in Section 2.2.3. Finally, this kind of representation is not well-motivated semantically, since *each other* does not exhibit the usual properties of quantifier scope. This is shown in the next section.

To summarize, the syntactic basis for the interpretation of *each other* involves two relations, the relation between the anaphoric antecedent and *each other* and the relation between the reciprocal antecedent and *each other*. These two relations are syntactically distinct, namely with respect to the specific locality conditions they have to meet, and the relation between *each other* and its reciprocal antecedent has characteristics of its own, different from the characteristics of better-investigated syntactic relations.

1.2. *The Semantics of Reciprocals*

1.2.1. *Reciprocals and the* Each-the Other *Construction*

The characteristic semantic properties of reciprocal constructions can best be illuminated if constructions with the reciprocal *each other*, as in (13a), are contrasted with constructions with *each-the other*, as in (13b):

(13)a. The boys hit each other.
b. The boys each hit the other.

In fact, there are attempts to analyse the *each other* construction in terms of the *each-the other* construction, namely Dougherty (1970, 1971, 1974), Lebeaux (1983) and, recently Heim, Lasnik and May (1991) (though the latter analysis is explicitly intended only for the simple case in which reciprocals involve an antecedent group with two members). Some of the differences between the *each other* construction and the *each-the other* construction have been observed by Lasnik and Fiengo (1973), Langendoen (1978), and Williams (1991). Since it is most explicit semantically, let us consider the semantic analysis of the *each other* and *each-the other* constructions by Heim, Lasnik and May (1991). *Other* is treated as a three-place relation that holds between x, y and a group z iff x and y are members of z and x is different from y. Thus, both (13a) and (13b) are analyzed as in (14), where 'Π' is the relation 'is a group member of'.

(14) $\forall x(x\Pi\,[\textit{the boys}] \rightarrow \forall y(\text{other}(x, y, [\textit{the boys}]) \rightarrow \text{hit}(x, y)))$

This analysis relies crucially on the following two general assumptions. First, *each other* involves quantification over individual members of the antecedent group. Second, this quantification is to be represented in sentence meaning by a quantifier that has the same status as any other quantifier and thus should, for instance, be able to show scope interactions with other quantifiers. There is, however, strong evidence against both assumptions. The arguments against the first assumption are weaker than the arguments against the second assumption, since in the first case the analysis can easily be modified in the required way. However, for reasons of exposition, let me start with discussing the first assumption.

Lasnik and Fiengo (1973) have noted that *each other* does not imply that every single member of the antecedent group is involved in the described activity with every other member of the antecedent group. (13a) can be true if not every boy hit every other boy or was hit by every other boy. In contrast, (13b) must involve every single boy in the event of hitting. Lasnik and Fiengo propose therefore that *each other* involves a reciprocal relation not between any two members of the antecedent group, but rather only between the members of a subgroup which belongs to a partition of the antecedent group. Thus, (13a) may be true just in case the boys can be partitioned into subgroups such that every boy in a subgroup x hit every other boy in a different subgroup y. But, as Dougherty (1974) and Langendoen (1978) have pointed out, this does not work for groups smaller than four. For instance, if in (13a) the group of boys consists of x, y and z and x hit y, y hit z and z hit x, then it is correct to say that the boys hit each other; but there is no partition of the group for which Lasnik and Fiengo's condition would be satisfied. Langendoen (1978) develops a weaker condition. First, he suggests Weak Reciprocity, as defined in (15).

(15) *Weakly Reciprocity*
$\forall x(x \in A \rightarrow \exists yz(y \in A \ \& \ z \in A \ \& \ x \neq y \ \& \ x \neq z \ \& \ xRy \ \& \ zRx))$

Weak Reciprocity accounts for reciprocal sentences with disconnected and asymmetric relations as in (16a–b).[1] These relations are not possible with the *each-the other* constructions given in (16a′–c′).

[1] The analysis does not explicitly account for reciprocals with founded relations such as in (1).

(1) The numbers follow each other.

However, these cases do not seem to be a challenge to the analysis, since, as Langendoen (1978) observes, they depend very much on the lexical items used and on the nature of the

(16) a. They displaced each other.
b. They scratched each other's back.
c. The soldiers shot each other.
a′. They each displaced the other.
b′. They each scratched the other's back.
c′. The soldiers each shot the other.

Langendoen, however, shows that even Weak Reciprocity should be substituted by a more general condition. Weak Reciprocity does not account for cases in which the reciprocal relation cannot be reduced to relations between individuals, but which have a collective interpretation, as is possible in Langendoen's example in (17). Again, collective reciprocity is possible only with the *each other* construction, not with the *each-the other* construction. (17a) may describe a situation in which there is a set of groups of people (this set being the referent of *they*) such that each group endorsed some other group and was endorsed by yet another group in that set. (17b), in contrast, can only describe a situation in which the relation of endorsing holds between individuals.[2]

(17) a. They endorsed each other.
b. They each endorsed the other.

Further examples that show collective reciprocity are given in (18a) and (19a) with the appropriate reading.

(18) a. The (brown and white) cows mingled with each other.
b. #The cows each mingled with the others.
(19) a. The (old and young) people support/ruin each other
b. The people each support/ruin the other.

(18a) contains a collective predicate that does not take individual arguments neither for the subject nor for the *with* phrase. (19a) may describe a relation of mutual support or mutual ruin among groups of people which cannot be reduced to relations of support or ruin holding between individuals. But (19b) can only describe a situation in which individuals ruin or support each other.[3]

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relation involved (for instance, Langendoen notes that they seem to arise only with temporal and spatial relations).

[2] In some varieties of English, the reciprocal *one another* must be used rather than *each other* for cases of collective reciprocity. Here apparently, a sortal restriction of *each* to individuals is at work.

[3] There are other cases in which reciprocals occur with collective predicates, but which have to be distinguished from the collective reciprocity in (17)–(19). First, *each other* may have a plural antecedent that has a strict collective reading. Consider the following example (due

In order to account for collective reciprocity as in the examples (17)–(19), Langendoen replaces Weak Reciprocity by the following condition for a sentence of the form AR *each other*, which is based on subsets rather than individuals:

(20) *Weak Reciprocity with Subsets*
$\forall x(x \in A \rightarrow \exists X_1X_2YZ(X_1 \subseteq A \ \& \ X_2 \subseteq A \ \& \ Y \subseteq A \ \& \ Z \subseteq A \ \& \ Y \neq \emptyset \ \& \ Z \neq \emptyset \ \& \ x \in X_1 \ \& \ x \in X_2 \ \& \ x \notin Y \ \& \ x \notin Z \ \& \ X_1RY \ \& \ ZRX_2))$

As Langendoen notes, the condition on the interpretation of reciprocal sentences can be obtained compositionally from the correct condition on the interpretation of relational sentences with plurals. The possible distributive readings of sentences with plurals seem to be exactly parallel to the ones that (20) provides. The corresponding condition for binary relational plural sentences is given in (21) for a sentence of the form ARB, where A and B are sets that plurals stand for.

(21) *Relational Distributive Interpretation with Subsets*
$\forall x_1x_2(x_1 \in A \ \& \ x_2 \in B \rightarrow \exists X_1X_2YZ(X_1 \subseteq A \ \& \ X_2 \subseteq B \ \& \ Y \neq \emptyset \ \& \ Y \subseteq B \ \& \ Z \neq \emptyset \ \& \ Z \subseteq A \ \& \ x_1 \in X_1 \ \& \ x_2 \in X_2 \ \& \ X_1RY \ \& \ ZRX_2))$

First, relational plural sentences may involve disconnected relations as in (22a), where not each of the men married each of the women. Second, they may involve irreducible relations between subgroups as in (22b,c) in situations in which individual circles were formed and individual cakes were eaten only by groups of children.

(22)a. These men married these women.

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to Jim Higginbotham), which are generally, though not without reluctance, accepted.

(1) John and Mary divided each other's belongings (among themselves).

The predicate *divide* in (1) has a subject position that is obligatorily collective. This means that with groups of two as in (1) such a reciprocal sentence cannot be interpreted anymore in the usual way, not even with reference to subgroups. The only interpretation that (1) can have is this. John and Mary (together) did the following. They divided Mary's belongings and they divide John's belongings. Thus, in this case, the reciprocal does not involve a distribution of the antecedent referent. There are two possible ways of accounting for these cases. The first alternative is to take the event as the proper semantic antecedent. Then the rule for reciprocal interpretation can be applied in the usual way except that now the part quantifier ranges over the parts of the event (as with *same/different* in the internal reading). The second alternative is to assume another semantic operation for reciprocals which does not relate parts of the antecedent group to other parts of the antecedent group, but rather relates the entire antecedent group to its parts in the relevant relation.

b. The children formed circles.
c. The children ate the cakes.

I will formulate a rule for the distributive interpretation of plural sentences that, unlike (21), does not mention individuals at all, but only parts of groups in a generalized and context dependent sense. This requires a few further comments. The notion of part that I am employing differs from set-theoretical or mereological notions of part (as employed, for instance, in Link, 1983 and Landman, 1989). My notion, denoted by 'P', has the following characteristics (cf. Moltmann, 1990a,b,c). First, it is a very general relation comprising the relations 'is a group member of', 'is a subgroup of' and the intuitive notion of part according to which a leg is a part of a chair and a subquantity of ink is part of the quantity of ink. Second, it is to be understood in the sense of 'is a relevant part of', depending on the kind of object and the perspective. Not any mereological part of an entity need to be a relevant part. For instance, not every subgroup of every group member is necessarily a relevant part of a group. Furthermore, one and the same entity may have different sets of parts in different situations. For instance, in a given situation s, the set of parts of a group composed of the members a, b, c, and d may be the set $\{G_s(\{a. b\}), G_s(\{b, c\})\}$, where $G_s(\{a, b\})$ is the group composed of a and b (in the situation s). But in a different situation s', it may be the set $\{a, b, c, d\}$. I will notate this dependence of P on a situation by a subscript s as in 'P_s'. P is a very weak relation from a formal point of view and inherently lacks properties such as transitivity and closure under sum formation. However, closure under sum formation and transitivity are influenced by the information given in the relevant situation. In particular, given certain conditions (which I will not specify here) entities that fall under a sortal predicate or are maximal entities that satisfy a nonsortal predicate count as the only parts of an entity by the following principles (cf. Moltmann, 1990a,b,c):

(23) *Principles for the Individuation of Relevant Parts in a Situation*
Given a situation s and a set of mereological parts A of an entity x covering x, then
a. if for each $y \in A$ there is a sortal predicate Q such that $Q(y)$ in s, the elements in A may be the only parts of x in s.
b. if for each $y \in A$ there is a nonsortal predicate Q such that y is a maximal entity in s such that $Q(y)$ in s, then the elements in A may count as the only parts of y.

By (23a), for instance, the only parts of an event described as a 'playing in the garden and playing in the livingroom' (both conjuncts being nonsortal predicates) may be the maximal subevent of playing in the garden and the maximal subevent of playing in the livingroom (see the example (81a) discussed Section 2.1 and 2.3).

G is an operation that maps a set of entities relative to a situation into an entity that is constituted of the elements of the set with the part structure relevant in s. This relation of constitution is vague in the following sense. If $\{a, b, c, d\}$ constitutes the group x, then, depending on the situation s, the parts of x may be identical to a, b, c, and d or they may be the elements $G_s(\{a, b\})$ and $G_s(\{c, d\})$ or they may consist of proper parts of a, b, c or d. There are only few general conditions on what the part structure of x may consist of, for instance the parts of x must 'cover' x.

We can now state the condition of the distributive interpretation of relational plural sentences as in (24) (disregarding the event component).

(24)a. *Relational Distributive Interpretation with Generalized Parts*
If for all $i \in I$, $j \in J$ (I, J index sets) $x_i R y_i$ in s, then $G_s(\{x_i \mid i \in I\})RG_s(\{y_j \mid j \in J\})$.

b. *Explication of Relational Distributive Interpretation*
xRy is interpreted distributively in s iff $\forall x_i y_i (x_i P_s x \;\&\; y_j P_s y \rightarrow \exists x_j' y_j' \; (y_j' P_s y \;\&\; x_i' P_s x \;\&\; x_i R y_j' \;\&\; x_i' R y_j))$ (for $i \in I$, $j \in J$).

The effect of (24b) is the same as that of (21), since if the part structure of a group consists only of subgroups, every individual member of the group must be included in some subgroup.

Now Weak Reciprocity can be reformulated as follows for a sentence of the form xR[*each other*] (where x is the group that the antecedent stands for):[4]

[4] At first sight, this condition may not seem equivalent to Langendoen's Weak Reciprocity for Subsets. But with two reasonable assumptions on part structures, we get the desired equivalence. First, Langendoen's condition mentions explicitly each individual member of the group (which must be included in two subsets each of which stands either in the relation R or its inverse to some other subsets). Reciprocity for generalized parts accounts for this under the very general condition that the set of parts of an entity x must cover x. Therefore, generally, any member of a group must be included in some part (subgroup) of the group. (Notice, however, that there may be admissible exceptions, depending on the size of the group. For *the MIT students and the BU students hate each other* to be true not every student must, however remotely, be involved. Thus, the condition should have the status of a preference law on part structures only.) Second, Langendoen requires that for a group member x and subsets X_1 and X_2 containing x, only those subsets Y and Z should be related to X_1 and X_2 respectively that do not contain x. Within the generalized parts approach, this is accounted for by a general condition that the parts of an entity x should form a partitioning,

(25) *Weak Reciprocity with Generalized Parts:*
$\forall x_1(x_1 P_s x \rightarrow \exists y_1 y_2(y_1 P_s x \ \& \ y_2 P_s x \ \& \ x_1 \neq y_1 \ \& \ x_1 \neq y_2 \ \& \ x_1 R y_1 \ \& \ y_2 R x_1)$

Assuming that this condition is essentially correct, the analysis of reciprocal sentences given in Heim, Lasnik and May (1991) can be modified for (13a) as in (26), where 'other$_s$' now denotes a relation between either groups or individuals x, y and z such that x and y are parts of z (in s) and x is distinct from y:

(26) $\forall x_1(x_1 P_s[\textit{the boys}] \rightarrow \exists y_1 y_2(\text{other}_s(y_1, x_1\ [\textit{the boys}]) \ \& \ \text{other}_s(y_2, x_1, [\textit{the boys}]) \ \& \ \text{hit}(x_1, y_1) \ \& \ \text{hit}(y_2, x_1)))$

With this modification, (13a) has the following interpretation. Every relevant subgroup of the boys stands to some other (relevant) subgroup of the boys in the relation 'hit' and also stands to some other subgroup in the converse relation. The relation of hitting then holds between two groups just in case a sufficient number of members of the two groups are actively or passively involved in hitting. This analysis assumes a great amount of vagueness in the interpretation of *each other*, first with respect to what counts as a part of a group in a context and second with respect to when two subgroups stand in the relation denoted by the predicate. In contrast to *each other*, *each* must involve every single group member. That is, *each* quantifies over individual group members, whereas the quantifier involved in *each other* ranges over parts of the group in the vague sense, i.e., over members or subgroups.

Further evidence that reciprocals involve the general notion of part comes from the fact that the antecedent of *each other* need not be a plural NP. It may, under certain cicumstances, also be a mass NP. For instance, conjoined mass NPs or mass NPs with conjoined modifiers can act as antecedents of reciprocals as in (27).[5]

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rather than a covering of x, i.e., no two parts should overlap. Again, this should be a preference law on part structures, and there might be counterexamples to it.

[5] The range of mass noun constructions which can serve as antecedents of reciprocals are discussed in Moltmann (1990a,c). The relevant generalization is the following. A mass NP can be the antecedent of a reciprocal iff it provides the descriptive means to designate the parts of the mass NP referent. Parts of a quantity can be so designated, for instance, by mass or other predicates that hold of maximal subquantities, for example the conjuncts of a definite conjoined mass NP or the conjuncts of a conjoined modifier of a definite mass NP, as in (27a) and (27b).

Dougherty (1974) considers reciprocal constructions in a more general sense. They include the following types of constructions:

(1)a. Either/Neither of the men would die for the other.
b. Each of the workers respect his coworkers/fellow workers.

(27)a. John compared the juice and the wine with each other.
b. (?) The juice in the glass and in the bottle resemble each other.

By (23b), the quantity described as *the juice and the wine* may have only two parts, the maximal subquantity of juice and the maximal subquantity of wine.

Now let us turn to the second assumption of the analysis of *each other* in terms of *each-the other* as in Heim, Lasnik and May (1991), namely the assumption that *each* acts as a quantifier over parts in a sentence meaning like any other quantifier.

There are three sorts of arguments that show that the quantification involved with *each other* differs crucially from that involved with other quantifiers such as independent *each*. The first argument is that the *each other*-construction, in contrast to the *each-the other* construction, does not exhibit scopal interactions with event quantifiers such as *at most ten times* (Jim Higginbotham class lectures MIT, spring 1989) and other temporal quantifiers such as *on two cold days* or *for one hour*. Consider the following examples:

(28)a. John and Mary at most ten times saw each other.
b. John and Mary each at most ten times saw the other.
(29)a. John and Mary wrote to each other on two cold days.
b. John and Mary each wrote to the other on two cold days.
(30)a. The children disturbed each other for an hour.
b. The children each disturbed the other for an hour.

(28a) excludes a reading in which the ten times at which John saw Mary are distinct from the ten times at which Mary saw John (such that the total of the occasions in which either John saw Mary or Mary saw John makes twenty occasions). The total number of seeing events in which John saw Mary and/or Mary saw John must amount to at most ten. (28b), in

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c. Each of the players respected his teammates.

In this generalized sense, reciprocal contructions may also occur with mass NPs as antecedent which do not induce a discrete part structure of their referent. Dougherty's example is given in (2).

(2) The assumption that any of the beer is representative of the rest of the beer is the basis of beer sampling.

However, the constructions in (1) differ from the *each other* construction in that it involves an NP like *the rest* as the reciprocator. What seems crucial is that *rest* itself is a sortal predicate and therefore can properly individuate a part of a quantity. Thus, it appears that the relevant condition on reciprocals with mass antecedents is met in (2) by what is expressed by the reciprocator, rather than by the antecedent.

contrast, does not have this implication. (28b) is compatible with a case in which John saw Mary at ten occasions and Mary John at a different ten occasions.

Similarly, (29a) is not true if John and Mary did not write each other on the same two days. (29b) may be true even if John and Mary never wrote on the same day. In (30a), the children must have disturbed each other during the same interval of one hour. In (30b), each of the children may have disturbed the other during a different interval which was one hour long.

The fact that *each other* does not express a quantifier that can interact in scope with a quantifier over situations, events or times suggests the following. *Each other* must, at some point in the interpretation, stand for the referent of the plural antecedent, and this group referent must stand in the relation denoted by the verb (or whatever the relevant relation is) to just one event argument. A reciprocal should not simply be represented by a quantifier over parts or members of the plural antecedent because such a representation would allow for scope interactions with event quantifiers or temporal quantifiers. Instead, before the semantic rule interpreting *each other* applies, (29a) has to be represented as in (31a). In contrast, the quantifier associated with *each* should be represented in sentence meaning in the usual way, thus allowing the existential quantifier associated with *two cold days* to have narrow scope with respect to *each* as in (31b).

(31)a. λet [two cold days(t) & on(e, t) & write(e, [*John and Mary*], [*John and Mary*])]

b. $\forall x[x \text{II}[\textit{John and Mary}] \rightarrow \forall y(\text{other}(y, x, [\textit{John and Mary}])) \rightarrow \exists et(\text{write}(e, [\textit{John and Mary}], y)$ & two cold days(t) & on $(e, t)))]$

(28a) requires a more complicated analysis, since downward entailing frequency adverbials like *at most ten times* do not act as event predicates. Roughly, the analysis of (28a) should be as in (32), where *at most ten times* is intended to hold of a group event e in case e has at most ten (relevant) parts:

(32) at most ten times($G_s(\{e \mid \text{see}(e, [\textit{John and Mary}], [\textit{John and Mary}])\})$)

(32) is to be read as follows. The maximal event e such that e is an event involving John and Mary as seers and persons seen has at most ten (relevant) subevents. Application of the rule for distributive interpretation in (24a) to the proposition represented in (32) may give the following

situation. The maximal event *e* such that *e* consists of seeing events involving John and Mary as seers and as persons seen has at most ten such subevents. However, we may also get the following situation. The maximal event *e* such that *e* consists of seeing events in which either John sees Mary or Mary sees John has at most ten such subevents. In this reading, there does not have to be a subevent in which John sees Mary and Mary sees John simultaneously. Such a reading is the most plausible one for (33).

(33) John and Mary called each other at most ten times.

Both of the readings are accounted for by the way the operation G and distributivity are conceived. The first reading arises if the parts of the group event in (32) are the elements of the set {*e* | see(*e*, [*John and Mary*], [*John and Mary*])}. This is the simplest case: The parts of the group event are the elements of the set generating the group. The second case crucially involves the situation-dependent notion of part. Here, the relevant parts of the event are actually proper subevents of the elements of the set {*e* | see(*e*, [*John and Mary*], [*John and Mary*])}, namely subevents which involve only either John or Mary as the seer and either John or Mary as the seen. Since G was conceived in such a way that parts of elements constituting an event *e* may be the relevant parts of *e* in the relevant situation, these subevents may precisely count as the parts of the complex event represented in (32).

The second argument regarding the difference between *each other* and *each-the other* is due to Williams' (1991) observation that for certain predicates, *each other* requires a plural argument, whereas the *each-the other* construction requires a singular NP. Williams gives the examples in (36). Not all speakers agree with the indicated judgments; but this does not necessarily weaken the overall argument.[6] A perhaps less problematic, since less idiomatic, example of this type is given in (37). A related observation was made by Chomsky (1981, Chap. 3, fn. 57), namely that reciprocals that are arguments of nouns require the noun to be plural, as in (38).

[6] Many speakers accept *they gave each other a new nose*, which Williams evaluates as unacceptable. This might be because the indefinite NP can act in defining semantically a complex predicate *gave a new nose*, rather than acting as a real quantifier in sentence meaning (see also Note 7). This should also explain why some speakers accept *the doctors gave the patients a new nose*. Whatever the status of these data may be, what is important is that the bare plural is fine with reciprocals where it is excluded in the *each-the other* construction (cf. *they gave each other new noses* vs. # *they each gave the other new noses*). This is explained by the present analysis.

(36)a. They gave each other new noses/??a new nose.
b. They each gave the other a new nose/#new noses.
(37)a. The children gave each other ?? a Christmas present/Christmas presents. (each child receiving a different present)
b. The two children each gave the other a Christmas present/ #Christmas presents. (each child receiving only one present)
(38)a. They read each other's books/#book.
b. They saw pictures/#a picture of each other.

(37b) with the plural object *presents* implies that every child gave another child more than one present. This is not implied by (37a) with the plural *presents*. (37a) can describe a situation in which each child received exactly one present. As Williams observes, this constraint on *each other* shows up also with nonreciprocal plural NPs as in the following examples (though, again not all speakers agree with the judgments):

(39)a. The doctors gave the patients new noses/??a new nose.
b. The doctors gave themselves new noses/??a new nose. (Williams 1989)
(40) The men gave the women/themselves presents/??a present (each woman/man receiving a different present)

This constraint follows simply from the semantics of plurals and definite NPs under some elementary semantic assumptions: First, plural nouns always refer to groups of entities; second, definite NPs are always referential NPs, not quantifying NPs. Notice that this also means that plural NPs cannot be associated with 'silent' distributive operators, a view about distributivity that is assumed, for instance in Link (1987), Roberts (1987) and Heim, Lasnik and May (1991).[7] Within my approach to plural semantics, distributive interpretations are always the result of the application of the rule in (24a). Then, sentences with definite plural NPs such as (41) receive a very simple sentence meaning.[8]

[7] There are counterexamples to the view that the distributivity of definite plurals cannot scopally interact with other quantifiers, in particular with numeral quantifiers, as in (1).

(1)a. The second year students wrote two papers this semester.
b. The people in the mountains get sick very rarely.

In Moltmann (1990a) I argue that such scope interactions can only arise with predicates (VPs) describing well-established properties, i.e., with predicates that are lexicalized. This means that there is a 'silent' distributive operator which may apply in the lexicon, though not in sentence meaning.

[8] The requirement of plurals could in principle also be explained as an instance of the phenomenon of dependent plurals, as discussed in Chomsky (1975) and DeMey (1981). According to this explanation, the plural in object position would syntactically be required

(41) The doctors saw the patients.

Under the assumptions above, (41) describes the following situation. For the group of doctors and the group of patients there is a past event *e* that stands in the relation 'see' to the group of doctors and the group of patients. This is illustrated in a schematic fashion in (42).

(42) $\exists e(\text{see}(e, [\textit{patients}], [\textit{the patients}]))$

The various collective and distributive readings of (41) (whether the doctors individually, as a group or in subgroups, saw patients individually, as a group or as subgroups) can be traced to the lexical vagueness of *see*. The event argument of *see* may be a group event (each member of which may involve an individual doctor and an individual patient), or it may be a single event involving the doctors and the patients as groups, or it may be anything in between.

From this analysis the degraded acceptability of (39a) with the indefinite singular object *a nose* immediately follows. The schematic analysis of (39a) is given in (43).

(43) $\exists ex(\text{give}(e, [\textit{the doctors}], [\textit{the patients}], x) \ \& \ \text{new nose}(x))$

In the natural course of events, it is just impossible for the arguments in (43) to stand in the relation 'give'. The relation 'give' can hold only between the first three arguments of *give* in (43) and a group of noses.

This explanation can be carried over to (36a) with *each other* if we make the following assumption. The argument position that *each other* stands for in the first step of the semantic interpretation must be satisfied by a group, namely the plural referent of the antecedent of *each other*, not by individuals, e.g., individual members of the group referent of the antecedent. Thus, we get the predicate in (44a) as the first part of the interpretation of the first sentence in (36a), where *they* stands for the group referred to by the antecedent *they*, and not the logical structure in (44b) with quantification over parts. In contrast, the *each-the other* construction should be analysed with quantification over individual group members, as in (44b) with 'Π'' instead of 'P'.

(44)a. $\lambda ex(\text{give}(e, [\textit{they}], [\textit{they}], x) \ \& \ \text{new} \ (\text{noses}(x))$

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because of the plural in subject position. However, it is clear that here the plural has a purely semantic, not a syntactic source. If the referent on the object NP is a single individual, the plural is disallowed, as in (1), an example suggested to me by Irene Heim.

(1) The brothers John and Bill admire their father/# their fathers.

b. $\forall y(yP_s[they] \rightarrow \forall y'(\text{other}_s(y', y, [they]) \rightarrow \exists ex(\text{give}(e, y, y', x) \& \text{a new nose}(x))))$

There is another piece of evidence that reciprocal sentences do not involve quantifier scope relations. It also involves events. Lasnik and Fiengo (1973) have observed that reciprocal sentences, in contrast to sentences with *each-the other*, usually are understood as describing only one event. Thus (45a), but not (45b) and (45c), most likely describes a single collision, and (46a), but not (46b) and (46c), mutual staring at one time.

(45) a. The cars bumped into each other.
b. Each of the cars bumped into the other.
c. The cars each bumped into the other.

(46) a. The men stared at each other.
b. Each of the men stared at the other.
c. The men each stared at the other.

Furthermore, Lasnik and Fiengo observe that the same tendency holds for nonreciprocal plural sentences, as in (47).

(47) a. The men climbed Mt. Everest.
b. The musicians played Beethoven's 5th.

This, of course, follows directly from the analysis I have given for reciprocals so far. Reciprocal sentences, like simple sentences with definite or indefinite plurals, require one and only one event argument. Even though this event argument may in principle be a group event whose members are distant in time and are otherwise independent from each other, it is preferably taken to be an event that has a certain degree of integrity, for instance with respect to time or with respect to the interaction of participants. This can be considered an instance of a very general condition on the individuation of entities. Entities that are semantic reference objects are 'better' the more they are integrated wholes, where the integrity of events can be constituted on the basis of connectedness in time or in space or on the basis of causal relations or the participation of other entities in the event.

The condition on the event described by reciprocal or plural sentences also seems to be responsible for certain apparent counterexamples to the analysis of reciprocal sentences in terms of Weak Reciprocity. Loenning (1989) notes that (48), given Weak Reciprocity, may describe a situation in which the black children play separately from the white children.

(48) The (black and white) children are playing with each other.

(48), however, is normally understood as describing an event of playing in which white and black children interact. This, in the present view, is simply a consequence of a general condition on the individuation of the event argument involved in reciprocal sentences, namely the condition of integrity for values for the event variable. This individuation condition on events is not strict, since (48) may in principle also describe a situation in which the black children play separately from the white children, and also the sentences (45a) and (46a) can in principle be true with completely independent events. The condition that events (and other entities) be integrated wholes constitutes only a preference law, not a strict condition on what may count as an event (or other entity).

1.2.2. *A Bipartite Compositional Analysis of Reciprocal Sentences*

Let us now turn to the specific reciprocal effect of *each other*. As it is clear from the discussion so far, *each other* operates on a relation between certain arguments of predicates and does not in the usual way act as an independent quantifier in the sentence meaning. When a sentence with *each other* is interpreted, a relation R must be established that holds between an event and a group x and the group x again. The reciprocity effect of *each other* then is the result of some operation on such a relation. This operation must relate parts x' of x appropriately to parts e' of an event e and complement parts x'' to x' in x such that these three subarguments stand in the relation R. To see how exactly this idea works, let us slightly reformulate the semantic interpretation of (4a) repeated here as (49a). Before the semantic effect of *each other* becomes operative, (49a) is first to be represented as (49b). The referent of *each other*, [*each other*], is simply the group of students referred to by *the students*. Coreference between *each other* and *the students* is independent of the specific reciprocity effect of *each other*. It is simply the result of *each other* being an anaphor and thus coindexed with *the students*. With an appropriate semantic operation to be defined below for the reciprocity effect of *each other* applied to (49b), we get the formula in (49c).

(49) a. The students work with each other.

b. λexy[work with(e, x, y)]

c. $\exists e$[work with$(e$, [*the students*], [*each other*]) &
$\forall x'(x' \mathrm{P}_s x \rightarrow \exists e' e'' x'' x'''(\mathrm{other}_s(x'', x'$, [*the students*]) &
$\mathrm{other}_s(x'''$, x', [*the students*]) & work with(e', x', x''') & work with$(e'', x''', x')))$]

(49c) states that there is an event e of working together that involves the

students in both argument positions such that for every relevant part x' of the students there are complement parts x'' and x''' of x' of the students such that for subevents e' and e'' of e the relation 'work with' holds among e', x' and x'' and among e'', x''' and x'.

In order to yield the second conjunct in (49c) in a compositional way, an operation applies to the relation λexy[work with (e, x, y)] and gives the second conjunct of (49c) as its output. This essentially constitutes the reciprocity effect of *each other*.

This analysis gets more complicated when R is not just a relation expressed by a lexical verb, for instance, when *each other* is a noun modifier as in (50a) or when it has a broad reading, as is possible in (7b) repeated here as (50b).

(50)a. John and Mary dislike pictures of each other.
b. John and Mary think that they love each other.

Let me now outline a formal compositional semantic analysis of reciprocal sentences. In this analysis, I assume that the semantic composition of a sentence is based on systematic correlations between syntactic relations and semantic operations or conditions (the semantic content of the syntactic relation). The view on compositionality I will adopt is based on ideas in Lieb (1983) (see also Moltmann, 1992). Compositionality in this approach consists in systematic correlations between syntactic relations and semantic operations. To formulate the relevant principles, a few further remarks are in order.

I assume that constituents (including sentences themselves) are sequences of lexemes, that is, sets of ordered pairs consisting of lexemes and natural numbers. That way, the 'concatenation' of several constituents $c_1, c_2, \ldots, c_n$ can be formulated as the set-theoretical union of the constituents, i.e., $c_1 \cup c_2 \ldots \cup c_n$.

In every language, certain syntactic relations or functions are correlated with semantic operations or what I will call 'semantic conditions'. Semantic conditions impose certain requirements on meanings and specify, for example, the identity of the referents of NPs. Such a correlation for a language L can be taken as a set of pairs consisting of a syntactic relation or syntactic function R and a semantic operation or condition O. If we call this correlation for English 'corr', semantic composition consists essentially in the following. Let R be an n-place syntactic relation that is correlated with an n-place semantic operation O, i.e., $\langle \mathrm{R}, \mathrm{O} \rangle \in$ corr. Then, if constituents $c_1, c_2, \ldots, c_n$ stand in the relation R, i.e., $\mathrm{R}(c_1, c_2, \ldots, c_n)$, the application of O to the meanings of $c_1, c_2, \ldots, c_n$ gives the meaning of $c_1 \cup c_2 \cup \cdots \cup c_n$, i.e., the meaning of the union of

$c_1, c_2, \ldots, c_n$. More formally, this can be stated as $O([c_1], [c_2], \ldots, [c_n]) = [c_1 \cup c_2 \cup \cdots \cup c_n]$, where '[ ]' denotes the interpretation function.

R need not be a relation between constituents, but rather, more generally, is a relation between syntactic units, i.e., parts of sentences which need not be constituents. These syntactic units, however, have to be syntactically identifiable.

Reciprocal sentences involve two such syntactic relations with specific semantic contents. First, they involve the relation between *each other* and its antecedent (more precisely, its local and possibly its distant anaphoric antecedents). Second, they involve the relation between the antecedent of the reciprocal, the reciprocal itself, and the material between antecedent and reciprocal which provides the relation R above.

Let us first look at how the syntax-semantics relationship works in the first case. Here, the syntactic relation is correlated with a semantic condition, rather than a semantic operation. Let 'ANAPH' (for English) be the syntactic relation between a (reflexive or reciprocal) pronoun and its antecedent and let 'coref' be the correlated semantic condition (a predicate of n-tuples of meanings). If $\langle c_1, c_2 \rangle \in$ ANAPH, then coref$([c_1], [c_2])$, where coref$([c_1], [c_2])$ iff $[c_1] = [c_2]$. Thus, for (50a) we have $\langle$[*each other*], [*John and Mary*]$\rangle \in$ ANAPH and [*each other*] = [*John and Mary*] = G({John, Mary}) (disregarding the relativization of G to situations).

Now let us look at the syntactic relation for the reciprocal effect. This relation actually has to be conceived as a family of reciprocity relations, which differ in which argument places of a predicate correspond to which arguments. I first consider cases such as (49a) and (50a), which involve only two arguments and no adjuncts. A reciprocal relation in this family has to be defined on the basis of simpler syntactic relations, namely the relation of being an argument (ARG) and the relation between a reciprocal and its reciprocal antecedent (REC). One of the conditions on the latter relation when it applies to two syntactic elements is that the first element has to meet the specific locality conditions associated with reciprocals with respect to the second element. The two relations are formally given in (51).

(51)a. *The Relation of Argumenthood*
For constituents c_1 and c_2, $\text{ARG}^{i,k}(c_1, c_2)$ iff c_2 is k-place and c_1 is the ith argument of c_2.

b. *The Relation Between a Reciprocal and a Reciprocal Antecedent*
For constituents c_1 and c_2, REC(c_1, c_2) iff c_2 is a reciprocal and c_1 is a reciprocal antecedent of c_2.

Now the family of reciprocal relations can be defined as follows:

(52) *The Family of Reciprocal Relations*
For constituents c_1 and c_2 and a syntactic unit c_3,
$\text{RECIPR}^{m,n;k}(c_1, c_2, c_3)$ only if $\text{ARG}^{m,k}(c_1, c_3)$,
$\text{ARG}^{n,k}(c_2, c_3)$ and $\text{REC}(c_1, c_2)$ $(m, n < k)$.

For (50a), we have $\langle$*John and Mary*, *each other*, *dislike pictures of*$\rangle \in$ $\text{RECIPR}^{2,3;3}$, since *dislike pictures of* expresses a three-place relation with the event argument occupying the first argument place and *John and Mary* and *each other* corresponding to the second and third argument places. Notice that a reciprocal relation need not hold between constituents; only the first and the second, but not the third element need be constituents. If a syntactic relation relevant for semantic interpretation should be based strictly on constituenthood, then this syntactic relation may arise via reanalysis or via movement of *each* at LF. However, these are just specific ways of syntactically identifying the middle element. The question of the identification of syntactic relations is independent of the question of how the compositional semantics of the elements that stand in a semantically relevant syntactic relation works.

The syntactic reciprocal relations are associated with semantic operations ('reciprocity operations') which are relativized to the same argument places. I will denote the reciprocal operation that is associated with $\text{RECIPR}^{m,n;k}$ by '$\text{recipr}^{m,n;k}$'. The next task consists in defining these operations. I assume that the last element in a triple of elements standing in the reciprocal relation is interpreted as a relation in essentially the usual compositional way. The only special feature in the interpretation of this syntactic unit when it stands in a reciprocal relation is that the argument places corresponding to *each other* and its antecedent are satisfied by variables bound by a lambda operator, rather than by the referential values of *each other* and its antecedent. In the interpretation of the last argument of a reciprocal relation, at least three argument places (corresponding to the event, the reciprocal, and the antecedent) are represented by variables that are bound by a lambda operator. Thus, for (50a) (in a nongeneric reading) we have (53).

(53) $[\textit{dislike pictures of}] = [\lambda exy[\exists z(\text{pictures}(z) \,\&\, \text{of}(z, y) \,\&\, \text{dislike}(e, x, z))]$

In order to define recipr, another family of semantic operations has to be defined. I will call these operations 'reciprocal functions'. In the case of (50a), such an operation, $\text{F}^{2,3;3}$, applies to the relation in (53). It modifies

this relation with respect to specific argument places, namely the second and third argument places, i.e. the two argument places that have to be satisfied by the referential value of *John and Mary* (and *each other*). This operation is defined in (54), an operation among a family of 'reciprocity operations' which differ in the arity of the relation R and the argument place they apply to. $F^{2,3;3}$ 'means': the reciprocity function that applies to three-place relations and 'affects' the second and the third argument place 'in a special way'.

(54) *Definition of a Reciprocity Function*
For a three-place relation R,
$F^{2,3;3}(R) = \lambda exy[\forall x'(x'P_s x \rightarrow \exists e'e''y'x''(e'P_s e \ \& \ e''P_s e \ \& \ y'P_s y \ \& \ x''P_s x \ \& \ y' \neq x' \ \& \ x'' \neq x' \ \& \ R(e', x', y') \ \& \ R(e'', x'', x')))]$.

We still have to define other semantic operations in order to define recipr, namely operations of argument satisfaction $arg^{n,k}$. $arg^{n,k}$ is an operation that maps a pair consisting of a k-place relation and an individual x into a $(k-1)$-place relation in which the nth argument place has been satisfied by x:

(55) *The Operations of Argument Satisfaction*
For a k-place relation R and an individual x $(n < k)$,
$arg^{n,k}(R, x) = \lambda y_1 y_2 \ldots y_{n-1} y_{n+1} \ldots y_k$
$[R(y_1, y_2, \ldots, y_{n-1}, x, y_{n+1}, \ldots, y_k)]$.

Now we can define the reciprocity operation for (50a), namely $recipr^{2,3;3}$. This is an operation which applies in the following way to yield a one-place predicate:

(56) *Definition of a Reciprocity Operation:*
For a k-place relation and individuals x and y,
$recipr^{2,3;3}(x, y, R) = arg^{2,2}(arg^{3,3}(F^{2,3;3}(R), x), y)$.

The application of the reciprocal operation to the present case is given in (57):

(57) $recipr^{2,3;3}([John\ and\ Mary], [each\ other], [dislike\ pictures\ of]) = arg^{2,2}(arg^{3,3}(F^{2,3;3}([dislike\ pictures\ of]), [each\ other]), [John\ and\ Mary]))$

The event argument place, the only remaining argument place of the relation in (57), is generally 'discharged' by existential quantification. However, this is only so if the clause does not contain adverbials like *at most ten times*, which, as discussed in the previous section, involve predication of the group of events satisfying the event predicate and not existential

quantification. For this reason, existential quantification over the event should not be incorporated into the analysis of *each other*.

Now let us turn to more complex cases. The reciprocity function $F^{2,3;3}$ does not affect the event argument place 'in a special way', but only the second and third argument places. However, the event variable e plays a role in (54) in the following respects: in quantification over two parts of the values of e and in relating these parts in the relation R to other participants. If we look at relations with more than three arguments in a reciprocal construction, it turns out that all other argument places behave like the event argument position. Consider (58).

(58) John and Mary introduced the guests to each other.

(58) can be true if John and Mary do not act collectively, but instead, for instance, John introduces half of guests to each other and Mary the other half. In this case, the second half of the bipartite reciprocal interpretation is to be paraphrased as follows. For any part x of the guests there are subevents e and e' of the total event of introduction, parts y and x' of the guests, and parts z and z' of John and Mary such that y and x' are distinct from x and the relation 'introduce' holds among e, z, x, and y and among e', z', x', and x. Notice that this formulation also allows for the case in which Mary introduced guest A to guest B, but not vice versa, and John introduced B to A. The syntactic relation induced by the reciprocal in (58) is given in (59a) and the formal analysis of the relevant reading of (58) in (59b).

(59)a. $\langle$*the guests*, *each other*, *introduced to*$\rangle \in \mathrm{RECIPR}^{3,4;4}$

b. $\exists e$[introduce to(e, [*John and Mary*], [*each other*]) & $\forall x'(x'\mathrm{P_s}[$*the guests*$] \rightarrow \exists e'e''z'z''y'x''(e'\mathrm{P_s}e$ & $e''\mathrm{P_s}e$ & $z'\mathrm{P_s}[$*John and Mary*] & $z''\mathrm{P_s}[$*John and Mary*] & $y'\mathrm{P_s}[$*each other*] & $x''\mathrm{P_s}[$*the guests*$_j$] & $y' \neq x'$ & $x'' \neq x'$ & introduce to(e', z', x', y') & introduce to(e'', z'', x'', x')))]

This motivates the following definition of the family of reciprocal functions and reciprocal operations. (For the sake of perspicuity *each other* and its antecedent are taken to satisfy adjacent argument positions m and $m + 1$ of the relation R.)

(60) *The Family of Reciprocity Functions*
For a k-place relation R ($m + 1 < k$),
$\mathrm{F}^{m,m+1;k}(\mathrm{R}) = \mathrm{L}x_1 \ldots x_k[\forall x'_m(x'_m\mathrm{P_s}x_m \rightarrow \exists x'_1x''_1 \ldots x'_{m-1}x''_{m-1}$
$x'_{m+1}x''_mx'_{m+2}x''_{m+2} \ldots x'_kx''_k(x'_1\mathrm{P_s}x_1$ & $x''_1\mathrm{P_s}x_1$ & $\ldots$ & $x'_k\mathrm{P_s}x_k$ &
$x''_k\mathrm{P}x_k$ & $x'_{m+1} \neq x'_m$ & $x''_m \neq x'_m$ & $\mathrm{R}(x'_1, \ldots, x'_{m-1}, x'_m, x'_{m+1},$

$x'_{m-2}, \ldots, x'_k)$ & $R(x''_1, \ldots, x''_{m-1}, x''_m, x'_m, x''_{m+2}, \ldots, x''_k)))]$.

(61) *The Family of Reciprocity Operations*
For a k-place relation R ($m + 1 < k$),
$\text{recipr}^{m,m+1;k}(x, y, R) = \text{arg}^{m+1,k-1}(\text{arg}^{m,k}(F^{m,m+1;k}(R), y), x)$.

What is still missing in the analysis is the conjunction of the relation that is the value of a reciprocal operation with the 'rest of the proposition' in the bipartite interpretation. This can be implemented in the following way. In (50a), a semantic operation of conjunction as given in (62) conjoins the relation expressed by *dislike pictures of* and the relation that is the value of the reciprocal operation applied to this relation. This gives rise to the definition of a 'Complete Reciprocity Operation' as in (63).

(62) *The Conjunction of Relations*
For k-place relations R and R',
$\text{conj}^k(R, R') = \lambda x_1 \ldots x_k[R(x_1, \ldots, x_k)$ & $R'(x_1, \ldots x_k)]$

(63) *The Complete Reciprocity Operation*
For a k-place relation R($m + 1 < k$),
$\text{compl-recipr}^{m,m+1;k}(x, y, R) =$
$\text{conj}^k(\text{arg}^{m+1,k}(\text{arg}^{m,k}(R, x), y), \text{recipr}^{m,m+1;k}(x, y, R))$.

As a correlary of the general conception of compositional interpretation based on correlations between syntactic relations and semantic operations, we finally can state the following condition.

(64) *The Semantic Composition of Reciprocal Sentences*
For constituents c_m, c_{m+1}, c_k ($m + 1 < k$), if
$\text{RECIPR}^{m,m+1;k}(c_m, c_{m+1}, c_k)$, then
$\text{compl-recipr}^{m,m+1;k}([c_m], [c_{m+1}], [c_k]) = [c_m \cup c_{m+1} \cup c_k]$.

A question that is still left open by this analysis concerns the last argument of a reciprocal relation, the element that expresses the relation. In more complex cases such as (58), it is not obvious what this element should be. (58) also allows for a collective action on the part of John and Mary. In this case, no argument place has to be 'affected' by quantification over parts when the reciprocity function applies. If an argument behaves collectively with respect to the reciprocal, it should satisfy the relevent argument position prior to the construction of the relation R. In this way, the application of a reciprocity function will not involve that argument position.

Another case that is of interest in this respect is Williams' unacceptable example *they gave each other a new nose*. Here, the last argument of the syntactic reciprocal relation need not be *gave*, but might also be construed

as *gave a new nose*. Then, the second part of the bipartite interpretation would say that everyone of 'them' gave some other one of 'them' a new nose, and thus, several noses might be involved. Even then, the sentence is ruled out semantically because of the first part of the bipartite interpretation. The first part says that 'they' gave 'them' (i.e. the same group) a new nose, and this can only be true if only one nose is involved in the acts of giving among 'them'.

1.2.3. *Further Evidence for the Bipartite Analysis of Reciprocals*

The crucial feature of the present analysis of reciprocals is that the semantic construal of reciprocal sentences proceeds in two steps. In the first step, the reciprocal is regarded as a plural element coreferential with its antecedent. In the second step, the reciprocal makes a complex contribution to an incomplete sentence meaning. Notice, however, that in the first part the reciprocal is not to be taken as equivalent to the English plural reflexive *themselves*. English *themselves* never allows a reciprocal reading, i.e. a reading in which parts of the group referent are related to different parts of the group referent in the relevant relation. For instance, as Langendoen (1978, fn. 17) observes, (65a) cannot be understood as a reciprocal action of any sort. A sentence with accidental coreference such as (65b), in contrast, can describe the same situation as (65c). The possible reciprocity of (65b), of course, is allowed by the rule for distributive interpretation (24a).

(65)a. The women released themselves.
b. The women released the inmates of this prison.
c. The women released each other.

However, from a crosslinguistic point of view, as we shall see immediately, this appears to be a semantic peculiarity of plural reflexives in English.

Notice that the absence of a reciprocal reading is not a matter of plural reflexives not to allow collective readings. In (66a), *themselves* is fine with an obligatorily collective interpretation, and as (66b) shows, this interpretation is independent of whether the antecedent is understood collectively or distributively.[9]

[9] The fact that plural reflexive pronouns can be understood collectively constitutes an argument against the analysis of reciprocals with a distributive operator (*each*) that is adjoined to the antecedent as proposed in Heim, Lasnik and May (1991) and others. Consider (1) as describing individual acts of painting or writing by John and Mary.

(1)a. John and Mary (individually) painted double portraits of themselves without talking to each other.

(66)a. They divided up/separated themselves.
b. John and Mary (individually) painted double portraits of themselves.

There is evidence for the adequacy of the bipartite analysis of reciprocals from the range of reciprocal constructions attested across languages. In many languages, for instance in Romance languages (including French, Italian, Portuguese, and Spanish) and in German, reciprocity can be expressed by a simple reflexive together with a reciprocal adverbial. For instance, in French, this adverbial is the nominal construction *l'un l'autre*. As in other Romance languages, this construction is related to the nonadverbial reciprocal which occurs in other contexts, for instance as a prepositional object (see Kayne, 1975 for French and Belletti, 1982 for Italian). This reciprocal requires that material intervene between *l'un* and *l'autre*, for instance a preposition as in (67). Adverbial reciprocals are illustrated in the French examples in (68) (cf. Langendoen, 1978) and in the German examples in (69).

(67) Les femmes ont écrit l'une à l'autre.
The women have written to each other.

(68)a. Les femmes se sont liberées l'une l'autre.
The women have released them (refl.) each other.

b. Les femmes se sont liberées elles-mêmes.
The women have released them (refl.) themselves.

c. Les femmes se sont liberées.

(69)a. Die Frauen haben sich gegenseitig befreit.
The women have released them (refl.) mutually.

b. Die Frauen haben sich befreit.

These data show that plural reflexives in those languages have a meaning

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b. John and Mary wrote books about themselves without each other.

(1b) can describe a situation in which John wrote a book about John and Mary without Mary and Mary did the same without John. Heim, Lasnik and May (1991) would analyse (1b) as (2):

(2) [[John and Mary] each]$_i$ wrote books about themselves$_i$ without [e_i other].

Themselves can only be coindexed with the distributor phrase containing *each* not with *John and Mary* directly, since it is not c-commanded by it. This phenomenon shows that distributivity is in fact a local phenomenon, which plural arguments exhibit independently from each other.

that is vague with respect to whether the relation to the antecedent group is reciprocal or reflexive, comparable to the vagueness of plurals with respect to collective and distributive readings. Plural reflexives in these languages simply refer to the antecedent group allowing for the application of the usual rules for distributive interpretation, which may yield 'reciprocal' as well as 'reflexive' relations. The crucial point is that these plural reflexives have exactly the same semantic function as reciprocals in the first step of their interpretation in the bipartite analysis.

Notice that plural reflexives in the languages mentioned do not allow for a broad reciprocal reading. In the examples in (70) and (71) only the (nonadverbial) reciprocals may take the matrix subject as their reciprocal antecedent.[10]

(70)a. Hans und Maria glauben, daß sie sich gesehen haben.
John and Mary believe that they have seen them (refl.).

b. Hans und Maria glauben, daß sie einander gesehen haben.
John and Mary believe that they have seen each other.

(71)a. Jean et Marie croient qu'ils se sont vus.
John and Mary believe that they have seen them (refl.).

b. Jean et Marie croient qu'ils ont ecrit l'un sur l'autre.
John and Mary believe that they have written about each other.

The propositions of the embedded clauses in (70a) and (71a) can only be about mutual seeings, whereas (70b) can describe a situation in which John believes only that he has seen Mary and conversely for Mary, and (71b) can describe a situation in which Mary believes only that she has written about John and conversely for John. The fact that reciprocity with plural reflexives can take only narrow scope follows immediately from already established principles. If plural reflexives are nothing more than group-referring expressions, then reciprocity effects may coccur only as a result of the rules for distributive interpretation whose scope is restricted to coarguments or arguments of coarguments etc.

Also the reflexive construction with adverbial reciprocals does not allow for a broad reading. This is expected, since adverbials generally take scope only within their clause. The examples in (72) are not ambiguous:

[10] The narrow scope of reflexives with reciprocal reading is also discussed by Heim, Lasnik and May (1991) and Williams (1991) with respect to the Italian clitic *si*. They relate the scope possibilities to the status of the reflexive/reciprocal as a clitic. However, the phenomenon is more general, since German reflexive *sich*, for instance, is not a clitic and takes only narrow scope.

gegenseitig and *l'un l'autre* may take only the embedded subject as their antecedent.

(72)a. Hans und Maria wollen, daß sie sich gegenseitig unterstützen.
John and Mary want that they support them (refl.) mutually.

b. Jean et Marie croient qu'ils se sont vus l'un l'autre.
John and Mary believe that they have seen each other.

Another example showing the difference between English and German plural reflexives is given in (73). Only (73a) allows for a plausible reading. The contrast between (73a) and (73b) should be compared with the examples in (74), which both allow for plausible readings.

(73)a. John and Mary gave themselves books about each other.

b. Hans und Maria schenkten sich Bücher übereinander.
John and Mary gave them (refl.) books about each other.

(74)a. John and Mary introduced themselves to each other.

b. Hans und Maria stellten sich einander vor.
John and Mary introduced themselves to each other.

(73a) can only mean either of the following. John gave himself a book about Mary, and Mary gave herself a book about John, or John and Mary gave John and Mary as a group a book about Mary, and John and Mary gave John and Mary as a group a book about John. In the second reading, the only plausible one, *themselves* has a collective reading. In contrast (73b) can, in addition to the other two readings, describe the following situation. John gave Mary a book about Mary, and Mary gave John a book about John. Thus, the German plural reflexive *sich* allows for a reciprocal relation. This suggests that the English plural reflexive is subject to an additional rule prohibiting reciprocity. This 'antireciprocity effect' can be captured by a semantic operation of the same type as the operation responsible for the reciprocity effect of *each other*. This again requires a bipartite interpretation for English plural reflexives. (65a) in this account is to be analysed as in (75).

(75) $\exists e(\text{release}(e, [\textit{the women}], [\textit{themselves}]) \;\&\; \forall xx'e'(x\text{P}_s[\textit{the women}] \;\&\; x'\text{P}_s[\textit{themselves}] \;\&\; e'\text{P}_s e \;\&\; \text{release}(e', x, x') \rightarrow x = x'))$

Now we can also analyse (74a), which contains both a plural reflexive and a reciprocal. The rule of plural reflexive interpretation and reciprocal interpretation can apply completely independently from each other. We

can assume that the antecedent of both *themselves* and *each other* in (74a) is *John and Mary* (although in this case, syntactically the antecedent could also be *themselves*). Application of the rules in the usual way gives (76).

(76)a. $\exists e[\mathrm{R}(e, [\textit{John and Mary}], [\textit{themselves}], [\textit{each other}]) \;\&\; \forall x(x\mathrm{P_s}\,[\textit{John and Mary}] \rightarrow \exists yy'e'e''(y\mathrm{P_s}[\textit{John and Mary}] \;\&\; y'\mathrm{P_s}[\textit{John and Mary}] \;\&\; y \neq x \;\&\; y' \neq x \;\&\; e'\mathrm{P_s}e \;\&\; e''\mathrm{P_s}e \;\&\; \mathrm{R}(e', x, y) \;\&\; \mathrm{R}(e'', y', x))) \;\&\; \forall xx'e'(x\mathrm{P_s}[\textit{John and Mary}] \;\&\; x'\mathrm{P_s}[\textit{John and Mary}] \;\&\; e'\mathrm{P_s}e \;\&\; \mathrm{R}(e', x, x') \rightarrow x = x'))]$

b. $\mathrm{R} = \lambda exy[\text{introduce to}(e, x, y)]$

Now let us turn back to the implications for the semantics of reciprocals. We can conclude that the constructions in (68a) and (69a) express the semantic structure of reciprocals in the bipartite analysis overtly. The plural reflexive component and the reciprocal component are expressed by distinct syntactic elements, and it is a typical semantic function of adverbials to make a complex contribution to the proposition as a whole like the reciprocity effect of reciprocals.

The proposed analysis of reciprocal expressions also accounts for adjectival reciprocals such as *mutual* in (77).

(77)a. mutual support

b. John and Mary's mutual hatred

The semantic effect of *mutual* can be treated exactly like the reciprocity effect of *each other* as an operation on a relation between arguments of the relevant predicate, for instance in (77b) on the relation λexy[hatred (e, x, y)]. Thus, the same semantic operation can be applied to both pronominal and adjectival reciprocals, and, of course, to adverbial reciprocals.

2. The Syntax and Semantics of *Same/Different*

2.1. *The Semantic Antecedent of* Same/Different *in the Internal Reading*

Same and *different* occur in a variety of constructions in English. First, *same* and *different* may have a deictic or anaphoric reading (as in *John saw the same movie*). Apart from this reading, essentially three constructions can be distinguished in which *same* and *different* are referentially dependent upon some other element in the sentence. *Same/different* occur in comparatives and relative identity statements as in (78a) and (78b) respectively; furthermore, they can have a quantified antecedent as in (79); and finally, they may have an internal reading in the sense of Carlson

(1987). The last construction is illustrated in (80). In this reading, *same/different* may relate to a plural NP, for instance *John and Mary* in (80); more precisely, it takes a complex event as its antecedent (see below).[11]

(78)a. John found the same solution as Mary.
b. This is the same man that we saw yesterday.
(79)a. Everyone saw the same horse/a different horse/different horses.
b. The entire house is the same color.
(80) John and Mary found the same solution/different solutions/#a different solution.

Crucially, in the internal reading, an NP with *different* must be in the plural, rather than in the singular, as seen in (80). However, the singular is possible with a quantified antecedent as in (79a). I shall mainly discuss the construction with *same/different* in (80), although *same/different* with quantified antecedents will also play a role. I assume that *same/different* in the deictic or anaphoric reading and in the three constructions in (78)–(80) may have different, though possibly related, structural meanings. The analysis I develop for *same/different* in the internal reading is not intended to be generalizable to *same/different* in other constructions.

At first sight, *same/different* in the internal reading seems to require a

[11] In the literature, there are attempts of unified analyses of some of the constructions with *same/different*. Dowty (1985), tries to analyse *same/different* in deictic use, in comparatives, and in the internal reading in the same fashion. Also Heim (1985) tries to analyse *same/different* in comparatives together with the internal reading (in the context of a more general analysis of comparatives and superlatives). However, only Carlson (1987) observes the full generality of the internal reading of *same/different*, namely the phenomena that show that it is related to an event, rather than an antecedent group.

The various constructions with *same/different* are crosslinguistically not always expressed by the same words. For instance, German distinguishes for *different* between *anderer* and *verschieden*. *Anderer* is used for comparatives, relative identity statements and for the deictic use, as in (1). *Verschieden* is used for the internal reading and for the reading as a group predicate, as in (2).

(1)a. Hans hat einen anderen Film gesehen als Maria.
John has seen a different film than Mary.

b. Maria ist eine andere Studentin als Anna.
Mary is a different student than Ann.

c. Hans hat einen anderen Film gesehen.
John has seen a different movie.

(2)a. Verschiedene Kinder spielten im Garten und im Wohnzimmer.
Different children played in the garden and in the livingroom.

b. Hans und Maria sind sehr verschieden.
John and Mary are very different.

plural antecedent as in (80). However, Carlson (1987) has shown that the internal reading of *same/different* can be licensed in various ways; not only by plural NPs as in (80), but also by conjoined PPs as in (81), conjoined adverbials as in (82), and conjoined verbs or VPs as in (83).

(81)a. Different children played in the garden and in the living room.
b. The same politician voted for and against the proposal.
(82) The same musicians played the quartet sloppily and carefully.
(83) Different men came and left.

As suggested by Carlson (1987), these data indicate that the proper semantic antecedent for *same/different* in the internal reading is actually never a group referred to by a plural NP, but rather a group of events described in the sentence – even in cases such as (80). Intuitively, this means the following. (80) describes a group of events, which consists of individual events of finding a solution by either John or Mary. Similarly. (81a) describes a group of events some of which are playings in the gardens, others playings in the living room. (81b) describes a group of two events, one being a voting for the proposal, the other one a voting against the proposal. The event group described by (82) consists of an event of playing the quartet sloppily and an event of playing the quartet carefully. Finally, (83) describes an event consisting of a subevent of coming and a subevent of leaving.

The semantic effect of *same/different* then consists of a comparison of certain participants in the subevents of such a complex event. Thus, *different* in (81a) means that the children that participated in the subevent of playing in the garden are different from the children that participated in the subevent of playing in the livingroom. *Same* in (82) means that the musicians that participated in the subevent of playing the quartet carefully are the same as the musicians that participated in the subevent of playing the quartet sloppily. *Different* in (83) means that the men that were the agents of the subevent of coming are distinct from the men that were the agents of the subevent of leaving.

These data show that an event group (as opposed to an individual event) can be determined in various ways. These different ways of determining group events can be formulated within a Davidsonian theory of events. In (81), the event argument is determined as a group event by a group participant referred to by a plural complement NP. The event groups in (81)–(83) are determined by predicates of group events given that adverbial PPs, adverbs, and verbs are event predicates. In fact, the PP *in the garden and in the living room*, the adverbial phrase *sloppily and carefully*,

the conjoined verb *came and left* and the VP *helped John and ruined Bill* are predicates of groups of events in the same way that *boys and girls* is a predicate of a group of persons.

The ways of determining group events can be described more formally on the basis of simple event semantic representations of the examples as follows. Disregarding the contribution of *same/different*, (84a) represents the first and second sentence in (80), (84b) represents (81a), (84c) represents (82), and (84d) represents (83).

(84)a. ($\exists ex$(solutions(x) & find(e, [*John and Mary*], x))
b. $\exists ex$(children(x) & play(e, x) & in the garden and in the living room(e))
c. $\exists ex$(musicians)(x) & play(e, x, [*the quartet*]) & carefully and sloppily(e)))
d. $\exists ex$(men(x) & come and leave(e, x))

The group character of the described event, that is, the value for the variable e satisfying one of the representations above, can now be predicted from the representations in (84). Consider (84a). If an event e stands in the relation 'find' to a group of students, then e may be a group of events consisting of individual events each of which stands in the relation 'find' to one of the students. The possibility of an event being determined as a group by a group participant follows from the rule of distributive interpretation (24a). (84b) requires that the value for the event variable be a group event because of the complex event predicate *in the garden and in the living room* that characterizes this event. An event which has the property of being in the garden and being in the living room has two natural parts (one in the first location and the other one in the other). Similarly, the event that is the value for the variable in (84c) must fall into two natural parts, one being an event that is executed carefully, the other one an event that is executed sloppily. Finally, in (84d), an event that satisfies the predicate *come and leave* is an event composed of a subevent of a coming and a subevent of a leaving. More formally, the following rule for the interpetration of conjunction accounts for group events determined by conjoined event predicates. For simplicity, this rule is formulated only for one-place predicates.[12]

[12] As was pointed out to me by an anonymous referee, there seem to be counterexamples to this account of conjunction. The examples in (1) do not seem acceptable.

(1)a. #John and Mary are male and female.
b. #Quine and Russell are dead and alive.

(85) *The Interpretation of Conjoined Predicates*
If $X_1, \ldots, X_n$ are of the category PP, N′, adverb or V or VP, then $[X_1, \ldots, X_{n-1}, \textit{and}\ X_n](x)$ iff $Ex_1, \ldots, x_n$ such that $x = G_s(\{x_1, \ldots, x_n\})$ and $X_1(x_1), \ldots, X_{n-1}(x_{n-1})$ and $X_n(x_n)$.

Same/different in the internal reading are not only licensed by group arguments of eventive predicates, but also by group arguments of stative predicates. Similarly, conjoined stative predicates may allow for the internal reading of *same/different*:

(86)a. The boys own different cars.
b. Different people are tall and short.

To carry (24) and (85) over to these cases, I assume that stative predicates also have an event argument place for states or quantities and that the rules given in (24a) and (85) apply not only to events in the narrow sense, but also to states and qualities. Thus, even states or qualities should be able to have a group structure with distinguishable members.

We have seen that the semantic antecedent of *same/different* in the internal reading can always be taken as an event group, which may be determined as a group event in a variety of ways, by plural or conjoined NPs or by conjoined PPs, adverbs, verbs or VPs.[13] A semantic operation

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However, such counterexamples seem to be restricted to conjoined predicates whose subject is a conjunction of two singular count NPs, since the following examples are unproblematic.

(2)a. The chairs in the garden are red and white.
b. The students in this school are French and Italian.

Thus, the predication of a conjoined group predicate seems to be prohibited for some reason if the subject is itself a group-referring expression whose group reference is due to a conjunction of singular count NPs.

The group predicate defined by conjunction are also degraded when they are based on contradictory properties as in (3).

(3)a. ??The chairs in the garden are heavy and light.
b. ??The students of this school are diligent and lazy.

Such examples do not undermine the empirical adequacy of the definition of conjunction given in this paper, but simply show that there are further conceptual conditions on when such group predicates are felicitous.

Note also that (85) is not the only rule for the interpretation of conjoined predicates. Conjoined predicates may also be interpreted by Boolean conjunction as in (4).

(4)a. John is tall and slim.
b. John took out the silver quickly and carefully.

[13] Sentences with *same/different* in the internal reading exhibit systematic ambiguities if there is more than one licenser for the group event. In (1), the event is determined both by the group participant John and Mary and by the conjoint event predicate *praise and criticize*.

associated with *same* and *different* then applies to the members of this event group involving the general context dependent notion of part P.[14]

2.2. *Syntactic Constraints on the Antecedent-Anaphor Relation with Same/Different*

2.2.1. Same/Different *with Quantified Antecedent*

The construction with *same/different* in the internal reading is related to, but different from, the construction with *same/different* in (87).

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(1) John and Mary praised and criticized the same person.

This ambiguity can be traced to the ability of events of having more than one part structure. An event quantifier such as the one associated with the internal reading of *same/different* must select one of the part structures of the event to which it applies. This multidimensionality of the part structures of events is with further applications discussed in Moltmann (1990b).

[14] If *same/different* in fact involves a more general notion of part than the notion of 'group member', the internal reading of *same/different* should also be available if the event just has a 'sufficiently articulated' part structure, not a group structure as determined by (24a) or (85). In fact, the examples in (1) seem at least marginally to be capable of an internal reading of *same/different*, even though corresponding examples with a quantified antecedent for *same/different* as in (2), are clearly preferred.

(1)a. John accomplished the project with the same collaborator.
b. John used to sing the same song during work.
(2)a. John accomplished all of the project/the entire project with the same collaborator.
b. John always sang the same song during work.

Note that *different* does not always have an event-related meaning, but may just function as a group predicate specifying that the group members differ from each other in one way or another or to a certain degree. In particular, this is the case when *different* occurs with degree words or with numeral determiners as in (3).

(3)a. John has very different children.
b. Mary made ten different mistakes.
c. These children are too different to be friends.

Interestingly, with numerals the order with *same/different* in the internal reading and with quantified antecedent is reversed:

(4)a. (?) John and Mary made a different two mistakes.
b. Every student made a different two mistakes.
c. They always select a different ten children.
d. John and Mary made the same two different mistakes.
(5)a. John and Mary made two different mistakes.
b. Every student made two different mistakes.
c. They always select ten different children.

Unlike the examples in (4), the sentences in (5) do not allow for an internal or a bound reading of *different*. This shows that *different* as a simple group predicate and *different* in a

(87) Every student read the same book/a different book.

The antecedent of *same/different* in this construction is a quantified NP, not an event. The difference between the two constructions becomes clear with the possibility of a bound interpretation of the NP *a different* N′. *A different* N′ can take only a quantified antecedent. (88) shows that the bound interpretation of *a different* cannot be licensed by a definite plural NP or a conjoined event predicate.

(88) a. #John and Mary/The students found a different solution.
b. #John wrote a different letter carefully and sloppily.
c. #John met a different friend in the house and in the garden.

Like the relation between a reciprocal and its reciprocal antecedent, the syntactic relation involved with *same/different* does not behave like any of the more familiar syntactic relations, but has properties peculiar to it. However, *a different* does exhibit some properties of bound elements. (89) suggests that *a different* cannot receive a bound interpretation when it is not c-commanded by the licencing NP. Though this condition has to

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referentially dependent function are correlated with different syntactic functions or at least different syntactic scope relations. This justifies a treatment in terms of an ambiguity.

The meaning of *different* as a group predicate requires some consideration. Naively, the meaning could be given as the property $\lambda x[\mathrm{A}yy'(y\mathrm{P}x \,\&\, y'\mathrm{P}x \,\&\, y \neq y' \rightarrow y \neq y')]$. But this is, of course, a tautology, and since the group predicate *different* has significant informational weight, it cannot be correct. Rather *different* always implies that the group members are distinct with respect to some qualitative dimension. Thus, it should express the property $\lambda x[\mathrm{A}yy'(y\mathrm{P}x \,\&\, y'\mathrm{P}x \,\&\, y \neq_1 y' \rightarrow y \neq_2 y')]$, where $=_1$ is to be taken as the relation of ontological distinctness, but $=_2$ as the relation of distinctness with respect to some qualitative dimensions. Alternatively, $=_1$ might be taken as distinctness between actual referents and $=_2$ as distinctness between discourse referents or partial objects at the relevant semantic level. The second relation of distinctness is discussed in Nunberg (1984). On the basis of this relation, Nunberg proposes a uniform treatment of *same/different* with respect to the (apparent) type/individual-ambiguity, as found in (6).

(6) John drives the same car as Mary/a different car than Mary.

Notice that the meaning of *different* as a group predicate also seems to involve the general part relation P, since the relation 'is a subgroup of' is involved in a plausible reading of (7).

(7) This school has attracted very different students.

be appropriately weakened in view of the examples in (90).[15] (91) shows that *different* both with quantified antecedent and in the internal reading is subject to the Name Constraint (May, 1977; Higginbotham and Fiengo, 1981), which prohibits 'variables' to be free in specific NPs. Notice that *opening nights* in (91) is the head of a nonspecific definite NP, therefore allowing for a complement NP with *different*.

(89)a. #A different witness believed every defendant to be guilty.
b. #A different professor wrote a book about every artist.
(90)a. A different waiter served every table. (Dowty, 1985)
b. The same dog turned up at every home on our block last night. (Carlson, 1985)
(91)a. #John and Mary/Everybody saw these pictures/Sue's pictures of different women.
b. John and Mary/Everybody attended the opening nights of different operas.

However, in crucial respects *a different* behaves neither as an anaphor nor as a bound variable. One can easily see that *a different* is not an anaphor. (92b)–(92f) show that it need not be bound in its governing category, though, speakers vary or are unsecure with respect to the acceptability of these examples, which are generally considered increasingly degraded.

(92)a. Everybody believes a different person to have come.
b. Everybody believes Mary to have seen a different man.
c. Everybody saw a man who was riding a different horse.
d. Everybody heard a rumor that a different horse was killed.
e. Everybody believes that Mary saw a different man/the same man.

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[15] The fact that an event is the semantic antecedent of *same/different* in the internal reading has presumably syntactic relevance. One of the apparent differences in the antecedent-anaphor relationship between *same/different* and *each other* is that the apparently licensing plural for *same/different* need not c-command *same/different*:

(1)a. *Each other saw the children.
b. Different women/The same woman loved the two men.
c. Children from different families were adopted by Mary and Sue.
d. Students of the same university applied for the first and the second job.

But given our analysis, this data does not indicate a difference in the syntactic antecedent-anaphor relation between *same/different* and reciprocals. In fact, the difference is expected, if the proper semantic antecedent *same/different* in (1b)–(1d) is the event argument of the verb, not a group denoted by a plural complement. Syntactically, either the verb or INFL should have to c-command *same/different* in the internal reading, and this is the case with INFL in the examples above.

f. Everybody believes that Mary received flowers that were sent by a different man.

There are differences between *same/different* with quantified antecedent and bound variables. Unlike variables, *same/different* for most speakers cannot take a quantified antecedent outside of factive clauses, indirect questions, or clausal complements of nonbridge verbs. This is seen in (93)–(95).

(93) a. #Everybody knows that a different person has come.
b. Everybody$_i$ knows that his$_i$ mother has come.
(94) a. #Everybody asked whether a different student/the same$_i$ student had stolen the book.
b. Everybody$_i$ asked whether his$_i$ book had been stolen.
(95) a. #Everybody whispered that a different student/the same$_i$ student was guilty.
b. Everybody$_i$ whispered that his$_i$ book had been stolen.

Also the relation between *same/different* and a quantified antecedent differs from the relation involved with *wh* movement. Like the relation between *each other* and its reciprocal antecedent, it is not subject to the Complex NP Constraint. This is seen in the acceptability of (96).

(96) Everybody believes a claim that a different city was attacked.

Thus, *same/different* with a quantified antecedent enters a syntactic relation that is different from the syntactic relation involving anaphors, bound variables and *wh* movement, but that is parallel to the syntactic relation between *each other* and its reciprocal antecedent in that it does not have to obey conditions on anaphor binding and *wh* movement.

2.2.2. *The Syntactic Relation between* Same/Different *in the Internal Reading and its Antecedent*

The syntactic conditions that an antecedent must satisfy in order to license an internal reading of *same/different* are parallel to those on *same/different* with a quantified antecedent and again in certain respects to the relation between *each other* and its reciprocal antecedent. The antecedent of *same/different* in the internal reading (the verb or maybe INFL whose event argument is the semantic antecedent of *same/different*) must c-command *same/different*. An internal reading of *same/different* is possible in (97), but excluded in (98).

(97)a. John and Mary want Sue to learn the same instrument/different instruments.
b. John and Mary said that the same student was guilty.
(98)a. The same person/different people said that John and Mary were guilty.
b. The same person believes Mary to have seen John and Bill.

Now let us look at the locality conditions that *same/different* in the internal reading must satisfy. First, *same/different* does not observe most of the locality conditions on the relation between a reflexive or reciprocal and its (anaphoric) antecedent. Generally, the syntactic relation with *same/different* does not observe the Specified Subject Constraint (cf. Carlson, 1987), as in (99a), and for many speakers, it does not observe the Tensed S Condition, as in (99b). Furthermore, it may violate conditions on extraction such as subjacency in (99c). Marginally, even multiple violations of such conditions are acceptable such as (99d–e).

(99)a. John and Mary want Sue to take different courses.
b. John and Mary thought that Sue took different courses.
c. John and Mary organized parties that took place on different days.
d. John and Mary thought that Sue took courses that were taught by different teachers.
e. John and Mary thought that Sue solved the problem by using different methods.

Second, *same/different* does not allow for an internal reading in clausal complements of nonbridge verbs, as in (100a), or in clausal complements of factive verbs, as in (100b). Furthermore, *same/different* in the internal reading for most speakers allows for an antecedent outside a complex NP, as in (100c).

(100)a. John and Mary whispered that different students were guilty.
b. John and Mary know that different students were guilty.
c. John and Mary heard claims that different stores were robbed.

In summary, event-related *same/different* seems to behave exactly like *same/different* with quantified antecedent and in some respects like *each other* with respect to its reciprocal antecedent. The data suggest that all three constructions involve the same type of syntactic relation and motivate an account in which they all are interpreted by the same type of semantic operation. However, there are also differences between *same/different* and *each other* (with respect to its reciprocal antecedent), as we

will see in the next section. These differences can be attributed to the fact that *each other* functions as an anaphor in addition to having the function common to *each other* and *same/different*.

2.2.3. *Comparison of the Syntax of* a Different *and* Same/Different *with* Each Other

Among the differences between *same/different* in both constructions on the one hand and *each other* with respect to its reciprocal antecedent on the other hand, the first one to note is that *each other* may have a reciprocal antecedent only via a chain of local antecedents. *Same/different* is not subject to such a requirement, since the relation between *same/different* to its antecedent may without significant degradation violate the Specified Subject Condition in exceptional Case marking constructions. The contrast is shown in (101a) and (101b).

(101)a. #John and Mary$_i$ expect Sue to believe them$_i$ to exceed each other$_i$.

b. John and Mary expect Sue to believe different men to be guilty.

This follows straightforwardly from the following requirement. Not only does *each other* have the status of an anaphor with respect to some local antecedent, but also the reciprocal antecedent has the status of an anaphoric antecedent with respect to an element connected with *each other* by a chain of anaphors (see also Moltmann, 1990c).

The second difference is that the reciprocal antecedent of *each other* may be outside a factive clause, as in (102), but, as we have seen, the antecedent of *same/different* for most speakers may not.

(102) John and Mary knew that they hated each other.

A related observation is that unlike the antecedent of *same/different*, the reciprocal antecedent of *each other* may be outside an indirect question, as in (103).

(103) The enemies thought about how they could damage each other.

Finally, *same/different* and *each other* behave differently in contexts involving reconstruction or connectivity (cf. van Riemsdijk and Williams, 1980; Barss, 1986). *Each other* behaves as if it undergoes reconstruction, but not *same/different*. This is seen in the contrasts among the pseudocleft

constructions in (104), the topicalization constructions in (105), and the cases of *tough*-movement in (106).[16]

(104)a. #What John and Mary/every professor saw was the same student.
b. What John and Mary did was damage each other.
(105)a. #The same man, John and Mary/all children certainly hate.
b. Each other, John and Mary certainly hate.
(106)a. #The same woman will be difficult for John and Bill/everyone to marry.
b. #Different universities will be difficult for John and Bill/every student to attend.
c. Each other's friends are easy for John and Bill to recognize.

These differences may be traced to the following principle. If a syntactic relation can be established by reconstruction (such as the anaphor-antecedent relation), then the items standing in this relation may also enter a syntactic relation that generally cannot be established by reconstruction (such as the reciprocal–reciprocal antecedent relation).

Notice a difference between *same/different* in the internal reading on the one hand and *same/different* with a quantified antecedent on the other hand. The former construction, but not the later one, allows for a bound interpretation in pseudocleft as in (107).

(107)a. #What every patient did was see a different doctor.
b. What the doctors did was make different decisions.

Actually, this difference between *same/different* with a quantified antecedent and *same/different* in the internal reading is to be expected, given what we have identified as the semantic antecedent of *same/different* in the internal reading. The semantic antecedent of *different* in (107b) is the event argument of the verb *make*. Since the verb in the clefted VP can bind *different* in (107b), the internal reading should be possible.

2.3. *The Semantics of* Same/Different

One might propose for *same/different* a semantic analysis similar to the one Heim, Lasnik and May (1991) have proposed for *each other*. Then, (108) would be analysed as in (109):

[16] Reconstruction cannot be tested with *wh* movement because *same/different* may never receive a bound interpretation in *wh* phrases, whether moved or not, as seen in (1).

(1)a. #How fond of the same movie was everyone?

(108) John and Mary saw different movies.

(109) $\forall x$(x is individual member of [*John and Mary*] $\rightarrow$ x saw a different movie that any other one in [*John and Mary*])

This analysis fails for a number of reasons, some of which are the same as in the case of *each other*. First, *same/different* may compare subgroups, rather than group members. The internal reading of *same/different* is compatible with collective predicates as in the following sentence describing a situation in which the students are divided into different discussion groups.

(110) The students are discussing the same subject.

Same in (110) with a collective predicate most naturally compares subgroups of students, not individual students.

Second, like *each other*, *same/different* in the internal reading require plural indefinite objects in certain contexts, disfavoring singular indefinite objects in those contexts, although, as with *each other*, speakers vary in their judgments.[17]

(111)a. The doctors gave different patients new noses/??a new nose.

b. John and Mary saw the husbands/#the husband of different women.

The requirement of plurals again follows if a sentence with *same/different* involves a bipartite interpretation in which the semantic operation associated with *same/different* applies to an argument relation which relates events to participants. Before this operation applies, a sentence with *same/different* such as (111a) should be represented as the relation between events and arguments given in (112a), which requires the plural *noses* in order for the distributivity rule (24) to apply and associate different patients with different noses. The full sentence meaning of (111a) it as indicated in (112b). Here, R is the relation representing the semantic effect of *different*, to be spelled out below.

(112)a. λex(give(e, [*patients*], x) & new noses(x))

b. $\exists ex$(give(e, [*the patients*], x) & new noses(x) & R(e, [*the patients*], x))

An apparent difference between *same/different* and *each other* is that

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(Answer: Everybody was very fond of the same movie.)

b. #Whom did everyone give which picture of the same celebrity.

[17] The requirement of plurals in sentences with *same/different* in certain contexts could be seen as an instance of dependent plurals. But see Note 8.

same/different exhibits certain scopal interactions with event quantifiers. A sentence such as (113) is ambiguous.

(113) John and Mary often saw the same film.

(113) can mean that for many situations *s*, the film that John saw in *s* was the same as the one that Mary saw in *s*, whereby different situations may involve different films. Here, *often* has wide scope with respect to *the same film*. But (113) can also mean that the film John saw was the same as the one Mary saw and they saw this film often. In this case, *the same film* has wide scope with respect to *often*. This ambiguity is a true ambiguity and not a matter of vagueness. In some languages, for instance German, the two readings correspond to different syntactic positions of the event quantifier. Consider (114).

(114)a. Hans und Maria haben oft denselben Film gesehen.
John and Mary have often the same film seen

b. Hans und Maria haben denselben Film oft gesehen.
John and Mary have the same film often seen

The strongly preferred reading of (114a) is the one in which different situations may involve different films, and the strongly preferred reading of (114b) is the one in which one and the same film was seen often in different situations.

How should this ambiguity be semantically represented? It is clear that it is not a counterexample to a bipartite analysis of *same/different*, since it is not a scope ambiguity involving a universal quantifier ranging over the parts of an antecedent. Rather, it is a scope ambiguity that involves the quantifier representing the NP with *same/different* and the event quantifier. If NPs with *same/different* are treated as existential quantifiers, this ambiguity is in fact the same ambiguity that shows up in (115a) and in the contrast between (115b) and (115c), where *einen Film* preferably has narrow scope with respect to *oft* in (115b) and wide scope in (115c).

(115)a. John often saw a film.

b. Hans und Maria haben oft einen Film gesehen.
John and Mary have often a film seen

c. Hans und Maria haben einem Film oft gesehen.
John and Mary have a film often seen

This ambiguity can be represented in a bipartite proposition simply by different scope orders of an existential quantifier representing *the same*

film and *often* in (116). (116a) represents (114b) and (116b), (114c). 'R' is the relation between events and arguments that represents the specific contribution of *same/different*.

(116)a. often(G_s({e | $\exists x$(see(e, [*John and Mary*], x) & films(x)) & R(e, x)}))

b. $\exists x$(films(x) & often(G_s({e | see(e, [*John and Mary*], x) & R(e, x)}))

What is required in the semantic analysis of *same/different* now is a sufficiently general rule for *same/different* that can apply to the relation (112a). This rule should involve universal quantification over the parts of the event argument and compare certain participants of these subevents. Consider again (81a), repeated here as (117).

(117) Different children played in the garden and in the living room.

Given the notion of part P_s and principle (23b) of Section 1.2.1, (117) may describe an event of playing of the children that has exactly two parts in the relevant situation, one that is the maximal event of playing in the garden, the other one the maximal event of playing in the living room. The semantic effect of *different* in (117) can now be described in the following way. There is an event of playing in the garden and the living room such that any agent of the subevent which is in the garden is different from any agent of the subevent which is in the living room. More generally, for every part e' of the playing event e and any part e'' distinct from e, any agent of e' is distinct from any agent of e''. This is formally given in (118), where 'different' holds of a pair $\langle x, x' \rangle$ if x is distinct from x'.

(118) $\exists ex$(children(x) & play(e, x) & in the garden and in the living room(e) & $\forall e'e''x'x''(e'P_se$ & $e''P_se$ & $x'P_sx$ & $x''P_sx$ & $e' \neq e''$ & play(e', x') & play(e'', x'') $\rightarrow$ different(x', x'')))

The corresponding sentence with *same*, *the same children played in the livingroom and in the garden*, has the same analysis, except that the predicate 'different' in (118) is replaced by a predicate 'same', where 'same' holds of a pair $\langle x, x' \rangle$ if x is identical with x'.

Same and *different* with an apparent plural antecedent such as in (80) are accounted for in exactly the same way. The difference can simply be traced to the fact that the part structure of the event is determined in a different way, namely by a group participant, rather than by a predicate that holds of group events. Thus, the first sentence of (80) repeated here as (119) has the analysis in (120).

(119) John and Mary found the same solution.

(120) $\exists ex(\text{find}(e, [\textit{John and Mary}], x)$ & solutions(x) & $\forall e'e''x'x''y'y''(e'\text{P}_s e$ & $e''\text{P}_s e$ & $x'\text{P}_s x$ & $x''\text{P}_s x$ & $y'\text{P}_s[\textit{John and Mary}]$ & $y''\text{P}_s[\textit{John and Mary}]$ & $e' \neq e''$ & $\text{find}(e', y', x')$ & $\text{find}(e'', y'', x'') \rightarrow \text{same}(x', x'')))$

In the first part of this analysis, the NPs modified by *same* or *different* are treated as like indefinite NPs.

The analysis predicts that singular NPs with *different* cannot have an internal reading, as in (121).

(121) #A different child played in the living room and in the garden.

The plural is required since the NP must provide a plural referent whose parts can be correlated with parts of the event (and maybe parts of another group participant).

The analysis also can account for the fact that *same* always cooccurs with a definite determiner, while *different* cooccurs with an indefinite determiner – even though it treats definite NPs as indefinite NPs and does not mention directly any condition associated with definiteness. Definiteness is required compositionally by the content of the first and the second part of the interpretation. Together, they constitute the Russellian account of definite descriptions: The first part provides existential quantification, the second part universal quantification and identification.

The analysis can easily be carried over to more complex cases of constructions with *same/different*, for instance to *same/different* with 'long distance antecedent' as in (122).

(122) John and Mary found the solutions to different problems.

Here, the comparison relation is not a simple relation denoted by a verb as in the cases above, but instead involves the complex relation R given in (123).

(123) $\text{R} = \lambda exy[\text{find}(e, x, [\textit{the solutions to}(y)])]$

With this relation, (123) can be analysed as the other cases.

A compositional analysis of the internal reading of *same/different* can be given in a fashion parallel to the one of reciprocals. It is based on the same type of syntactic relations, relations between the verb or adjective as syntactic antecedent, the occurence of *same* or *different* and the material between the antecedent (including the antecedent). Again we have to assume a family of syntactic relations and correlated semantic operations, which differ in the arity of the relation involved and the argument place occupied by the NP with *same/different*. The syntactic relations for *different* are partially characterized in (124). For (122), we have (125)

(124) *Partial Characterization of a Syntactic* Different *Relations*
For constituents c_1 and c_2 and syntactic units c_3. $\text{DIFF}^{n;k}(c_1, c_2, c_3)$ only if c_1 is a verb, c_2 an NP modified by *different*. c_3 denotes a three-place relation, $\text{ARG}^{n,k}(c_2, c_3)$, and c_1 c-commands c_2.

(125) $\langle$*found*, *different problems*, *found the solutions to*$\rangle \in \text{DIFF}^{3;3}$

The semantic operation that applies in the case of (125) is 'compl-diff$^{1,3;3}$', where 'compl-diff$^{1,3;3}$' is to be understood as 'the complete *different*-operation that applies to three-place relations and 'affects' the first and third argument place'. Thus, we have $\langle \text{DIFF}^{3;3}, \text{compl-diff}^{1,3;3} \rangle \in$ corr. compl-diff$^{1,3;3}$ is defined on the basis of two other semantic operations analogous to the definition of the Reciprocity Operation in (63) in the following way. (Note that all complete *different*-operations must affect the first argument place, since this is, by convention, the event argument place.)

(126) *Definition of a* Different-*Function*
For a three-place relation R
$\text{H}^{1,3;3}(\text{R}) = \lambda exy[\forall e'e''(e'\text{P}_s e \,\&\, e''\text{P}_s e \,\&\, e' \neq e'' \rightarrow \exists x'x''y'y''(x'\text{P}_s x \,\&\, x''\text{P}_s x \,\&\, y'\text{P}_s y \,\&\, y''\text{P}_s y \,\&\, \text{R}(e', x', y') \,\&\, \text{R}(e'', x'', y'') \rightarrow \text{different}(y', y'')))]$

(127) *Definition of a* Different-*Operation*
For a three-place relation R and an individual x,
$\text{diff}^{1,3;3}(x, \text{R}) = \text{arg}^{3;3}(\text{H}^{1,3;3}(\text{R}), x)$

(128) *Definition of a Complete* Different-*Operation*
For a three-place relation R and an individual x,
$\text{compl-diff}^{1,3;3}(x, \text{R}) = \text{conj}^3(\text{arg}^{3;3}(\text{R}, x), \text{diff}^{1,3;3}(x, \text{R}))$

All argument places that are not specifically 'affected' by a *different*-operation are treated in exactly the same way as in the case of reciprocity operations.

Another family of such operations, construed in an exactly parallel fashion, yields the interpretation of *same*. It is clear how the general definition of complete *same*- and *different*-operations would look like formally.

The analysis of the semantic effect of *same/different* in the internal reading immediately accounts for sentences with multiple occurrences of *same/different* as in (127).[18]

[18] Multiple instances of *same/different* are also found in generic sentences as in the construction in (1).

(1) Different subjects attract different students.

However, the first occurrence of *different* in (1) does not seem to have an internal event-related meaning. (1) can be paraphrased roughly as follows. Whenever there is a group of

(127)a. The same men loved different women.
b. The same man gave different women the same ring.

Here, the event argument functions as the semantic antecedent of several instances of *same/different*. The usual application of the semantic rule for *same/different* yields (128) as the interpretation of (127b).

(128) $\exists exyz(\text{give}(e, x, y, z) \;\&\; \text{men}(x) \;\&\; \text{women}(y) \;\&\; \text{rings}(z) \;\&\; \forall e'e''x'x''y'y''z'z''(e'\text{P}_s e \;\&\; e''\text{P}_s e \;\&\; x'\text{P}_s x \;\&\; x''\text{P}_s x \;\&\; y'\text{P}_s y \;\&\; y''\text{P}_s y \;\&\; z'\text{P}_s z \;\&\; z''\text{P}_s z \;\&\; e' \neq e'' \;\&\; \text{give}(e', x', y', z') \;\&\; \text{give}(e'', x'', y'', z'') \rightarrow \text{same}(x', x'') \;\&\; \text{different}(y', y'') \;\&\; \text{same}(z', z'')))$

The analysis of *same/different* in the internal reading is parallel to the analysis of *each other*. In both cases, the interpretation consists of two parts, and in both cases, it involves the same type of semantic operation on relations between arguments, an operation that quantifies over parts of a group or an otherwise complex entity x and compares entities that stand in a specific relation to x. The difference between the semantic operation for *each other* and the semantic operation for *same/different* lies only in what kind of entity the quantifier over parts applies to: In the case of *each other*, it is the group denoted by the syntactic antecedent; in the case of the internal reading of *same/different*, it is the event argument of the verb which acts as the antecedent.[19]

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different subjects x, then there is an event of attraction e which involves x and a group of students y such that the parts of e, which are each correlated with a different subject, are such that the themes (the students attracted) are different from each other. Thus, the first occurrence of *different* is a simple group predicate specifying the content of a condition on a regularity, whereas the second occurrence has an internal reading.

[19] The analysis still poses a potential problem, namely with respect to how the NP containing *same/different* should be interpreted in the first step of the interpretation. In the analyses given above, this NP is always interpreted as an indefinite plural NP. However, this raises a problem for the broad reading of *different* in clauses embedded under an attitude verb such as in (1).

(1) John and Mary believe that different men married Sue.

In the first step of the interpretation, (1) would be evaluated as (2).

(2) λe[believe(e, [*John and Mary*], [*that men married Sue*])]

However, this does not make sense if the plural *men* is interpreted literally as referring to a group of men. There are several possibilities to account for the problem. First, one might say that a plural noun may also refer to individuals as a marginal case of a group. Then, (1) is first interpreted as *John and Mary believe that Sue is married to a man*. Second, one might assume that the plural of NPs correspond to a pluralization of the containing proposition. Then, the proposition in (2) would be a group of two propositions each involving a different man. However, propositions are generally not 'pluralized' in this way (see Moltmann, 1990c). Third, one might assume that the NP is actually interpreted as singular and that the plural

The analysis of the internal reading of *same/different* can essentially be carried over to *same/different* with a quantified antecedent. I only briefly sketch the analysis. (129) can be represented as in (130b), where R is the relation given in (130a).

(129) Everybody saw a different movie.

(130)a. $R = \lambda xy[Ee(\text{see}(e, x, y) \ \& \ \text{movie}(y))]$

b. $\forall x(\text{person}(x) \rightarrow \exists ey(\text{movie}(y) \ \& \ \text{see}(e, x, y) \ \& \ \forall x'x''y'y''$ $(\text{person}(x') \ \& \ \text{person}(x'') \ \& \ x' \neq x'' \ \& \ \text{movie}(y') \ \& \ \text{movie}(y'')$ $\& \ R(x', y') \ \& \ R(x'', y'') \rightarrow \text{different}(y', y'))))$

The compositional analysis of *same/different* with quantified antecedent is parallel to the one of *each other* and *same/different*. First, we have a family of syntactic relations. One of these relations is $\text{DIFFQ}^{1,2;2}$. It relates an NP that has the (syntactic and semantic) status of a quantifier and an NP with *different* as the first and second argument to a predicate. In the case of (129) if applies as in (131).

(131) $\langle$*everybody*, *a different movie*, *saw*$\rangle \in \text{DIFFQ}^{1,2;2}$

As can be seen from (130b), the semantic operation for *same/different* with quantified antecedent must specifically take the semantic restriction of the antecedent into account, namely in the case of (129) the concept 'person'. The semantic value of the quantifier *everybody* can be taken as the concept 'person' (i.e. [*everybody*] = 'person'), and similarly the semantic value of *a different movie* can be taken as the concept 'movie'. All other components of *everybody* and *a different movie* then have only the status of syncategorematic elements. The second conjunct of (130b) is the output of a function $\text{diffq}^{1,2;2}$ which takes triples consisting of a (one-place) concept, again a (one-place) concept and a relation as its arguments. '$\text{diffq}^{1,2;2}$' is to be understood as 'the *different* function for *different* with a quantified antecedent which 'affects' the first and second argument place'. How this operation works is indicated in (132). R is the relation given in (130a).

(132) $\text{diffq}^{1,2;2}([\textit{everybody}], [\textit{different movie}], R) = \forall x'x''y'y''(\text{person}(x') \ \& \ \text{person}(x'') \ \& \ x' \neq x'' \ \& \ \text{movie}(y') \ \& \ \text{movie}(y'') \ \& \ R(x', y') \ \& \ R(x'', y'') \rightarrow \text{different}(y', y''))$

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is the result of some other condition, for instance of the fact that the second step in the interpretation of a sentence containing *different* involves at least two distinct individuals. I leave it open whether the first or the third explanation should be adopted.

A more complicated case, which involves a three-place relation, is (133a). The analysis is sketched in (133b–d), whereby $\text{diffq}^{2,3;3}$ is defined in (134).

(133)a. John gave every child a book about a different topic.

b. $\langle$*every child, a different topic, gave a book about*$\rangle \in \text{DIFFQ}^{2,3;3}$

c. $R = \lambda xyz[\exists ev(\text{book}(v) \ \& \ \text{about}(v, z) \ \& \ \text{give}(e, x, y, v)]$

d. $\text{diffq}^{2,3;3}([\textit{every child}], [\textit{a different topic}], [\textit{gave a book about}]) = \lambda x[\forall yy'zz'(\text{child}(y) \ \& \ \text{child}(y') \ \& \ y \neq y' \ \& \ \text{topic}(z) \ \& \ \text{topic}(z') \ \& \ R(x, y, z) \ \& \ R(x, y', z') \rightarrow \text{different}(z, z''))]$

(134) *Definition of a* Different-*Operation for Quantified Antecedents*
For one-place concepts Q and Q′ and a three-place relation R, $\text{diffq}^{2,3;3}(Q, Q', R) = \lambda x[\forall yy'zz'(Q(y) \ \& \ Q(y') \ \& \ y \neq y' \ \& \ Q'(z) \ \& \ Q'(z') \ \& \ R(x, y, z) \ \& \ R(x, y', z') \rightarrow \text{different}(z, z'))]$

Appendix: Comparison with the Polyadic Quantification Approach

In this appendix, I will briefly discuss an alternative approach to the semantics of reciprocals and of *same/different* namely the account in terms of polyadic quantification given in Keenan (1987) (see also Clark and Keenan, 1985–6, 1986 and van Benthem (1989). For *different* with quantified antecedent as in (1a), Keenan proposes the logical form in (1b). (EVERY, DIFF) is a dyadic quantifier, a relation taking two sets and a two-place relation as arguments. Its semantic interpretation as suggested in Keenan (1987) is given in (2).

(1)a. Every student read a different book.

b. (EVERY, DIFF)(STUDENT, BOOK, READ)

(2) (EVERY, DIFF)(P, Q, R) = 1 iff (i) and (ii) both hold:

(i) $Q \cap R_a = Q \cap R_b$, $a \neq b$ in P.

(ii) for all $a \in P$, $|Q \cap R_a| = 1$.

Similarly, reciprocals in this approach would be accounted for roughly as follows, with a very simplified definition of EACH OTHER.

(3)a. John and Mary like each other.

b. EACH OTHER ({John, Mary}, LIKE)

(4) EACH OTHER(Q, R) iff $\forall xy(x \in Q \ \& \ y \in Q \ \& \ y \neq x \rightarrow xRy)$.

The questions to be answered when comparing this approach to the present one are the following. First, can the full range of *same/different*- and reciprocal constructions be captured? Second, does the lack of scope

interactions of reciprcoals and *same/different* with other quantifiers follow in this approach? Third, can the approach appropriately incorporate the event-relatedness of reciprocals and especially *same/different* in the internal reading?

The first question can certainly be answered positively. The polyadic quantification approch can easily be carried over to sentences with *same/different* in the internal reading based on parts of events. (5a) in this approach would roughly be analysed as in (5b), where 'DIFFERENT' is defined in (6) similarly to (2) as a dyadic quantifier taking a set and a two-place relation as arguments.

(5)a. John and Mary sang different songs.

b. $\exists ex(\text{sing}(e, \text{John and Mary}, x)$ & DIFFERENT(SONG, $\{\langle x', e'\rangle \mid x'\text{P}_\text{s}$ & $e'\text{P}_\text{s}e$ & $y\text{P}_\text{s}$John and Mary & $\text{sing}(e', y, x')\})$

(6) DIFFERENT(Q, R) iff for $\text{R}_a \cap \text{Q} = \text{R}_b \cap \text{Q}$ for $a \neq b$ and $|\text{R}_a \cap \text{Q}| = 1$.

A nice result of this account of the internal reading of *same/different* based on parts of events is that sentences with several occurrences of *same/different* as in (7) (see also note 19) can be represented on the basis of the same binary quantifier as in (6) and do not require the introduction of quantifiers of a more complex type as in Clark and Keenan (1985, 1986) and Keenan (1987). The analysis of (7a) is accordingly (7b). Such a representation is possible also for sentences such as (7c) with more than two occurrences of *same/different*.

(7)a. Different students read different books.

b. $\exists exy$ [read(e, x, y) & DIFFERENT(STUDENT, $\{\langle x', e'\rangle |$ DIFFERENT(BOOK, $\{\langle y', e'\rangle | x'\text{P}_\text{s}x$ & $y'\text{P}_\text{s}y$ & $e'\text{P}_\text{s}e$ & $\text{read}(e', x', y')\})\})$]

c. Different professors gave the same grade to different students.

To answer the second question, quantifier scope interactions of sentences with *same/different* and with reciprocals are in fact straightforwardly representable in the polyadic quantification approach. In this respect, therefore, the bipartite analysis presented in this paper is superior, since it excludes such quantifier scope interactions. In the polyadic quantification approach, (8a), for example, could have the representation in (8c), where *ten times* takes narrow scope with respect to *each other* (whatever interpretation for *ten times* one may adopt), and (9a) could have the representation in (9c), where *some present* takes narrow scope with respect to *each other*

(8)a. John and Mary called each other ten times.

b. $R = \{\langle x, y\rangle \mid \text{TEN TIMES}(\text{call}(x, y))\}$
c. EACH OTHER({John, Mary}, R)

(9)a. John and Mary gave each other some present.
b. $R = \{\langle x, y\rangle \mid (\text{SOME})(\text{PRESENT}, \text{GIVE}_{xy})\}$
c. EACH OTHER({John, Mary}, R)

The third question was already answered with the analysis given in (5). Event-based semantics can easily be incorporated into the theory of generalized quantifiers, and furthermore it gives rise to more uniform and simpler analyses of sentences with *same/different* than are available in a theory that is not based on events and their parts.

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