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COMPREHENDING *EACH OTHER*:
WEAK RECIPROCITY AND PROCESSING

A dissertation presented

by

HELEN CHRISTA MAJEWSKI

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Linguistics

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ABSTRACT

COMPREHENDING *EACH OTHER*:
WEAK RECIPROCITY AND PROCESSING

SEPTEMBER 2014

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This dissertation looks at the question of how comprehenders get from an underspecified semantic representation to a particular construal. Its focus is on reciprocal sentences. Reciprocal sentences, like other plural sentences, are open to a range of interpretations. Work on the semantics of plural predication commonly assumes that this range of interpretations is due to cumulativity (Krifka 1992): if predicates are inherently cumulative (Kratzer 2001), the logical representations of plural sentences underspecify the interpretation (rather than being ambiguous between various interpretations). The dissertation argues that the processor makes use of a number of general preferences and principles in getting from such underspecified semantic representations to particular construals: principles of economy in mental representation, including a preference for uniformity, and principles of natural grouping. It sees no need for the processor to make use of a principle like the Strongest Meaning Hypothesis (Dalrymple et al. 1998) in comprehending reciprocal sentences. Instead, they are associated with cumulative semantic representations with truth conditions

equivalent to Weak Reciprocity (Langendoen 1978), as in Dotlačil (2010). Interpretations weaker than Weak Reciprocity ('chain interpretations') arise via a process of pragmatic weakening. Interpretations stronger than Weak Reciprocity may arise in different ways. Statives are seen as having special requirements regarding the naturalness or 'substantivity' of pluralities (Kratzer 2001), and this leads to stronger readings. In other cases, strong interpretations are favoured by a preference for uniformity, which is taken to be a type of economy preference. It is assumed that the processor need not commit to a fully spelled out construal, but may build mental models of discourse that themselves underspecify the relations that hold among individuals. While the dissertation's focus is on reciprocal sentences, the same principles and preferences are argued to be involved in comprehending other plural sentences.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Reciprocal sentences can be used to describe a range of different scenarios. Surprisingly, not all of these scenarios actually involve relations that hold mutually. Consider the contrast between *Brigid and Mackie adore each other* and *The chairs are stacked on top of each other*. The first sentence requires mutual adoration, but the second does not – cannot – require mutual being-stacked-on-top-of. Some reciprocal sentences require that each individual described take part in the relation with every other (*Those five kids hate each other*), but others are satisfied if each of the individuals takes part with some other(s) (*Those five kids are sitting next to each other on the bench*).

This raises the question: does *each other* contribute the same meaning in each of these sentences? Semanticists have been puzzling over the range of reciprocal interpretations for some time. Some contend that the different interpretations are due to distinct grammatical representations: for instance, that *each other* is ambiguous, or that non-overt operators in the grammatical representation distinguish the various readings. An alternative view is that the different interpretations arise from a single grammatical representation; on this kind of view, the grammar leaves the details of the interpretation vague.

Work on the semantics of reciprocals has motivated the introduction of a new semantic principle. In their 1998 paper, Dalrymple, Kanazawa, Kim, Mchombo & Peters observe that despite the wide range of possible interpretations, a particular reciprocal sentence uttered in a particular context

does not seem to be ambiguous. Rather, it receives a single interpretation: the strongest one available to it in that context. The strongest interpretation possible for *Those five kids hate each other* is that each kid hates every other one of the kids. But, given what we know about the world, such a strong interpretation is not available for *Those five kids are sitting next to each other on a bench*. Humans only have two sides, so each kid can at most sit next to two others. Dalrymple et al. propose a new semantic principle: the Strongest Meaning Hypothesis (SMH). They hold that the various reciprocal interpretations are distinct, due to involving distinct versions of the reciprocal quantifier, and that the SMH is a principle that selects from among the possible reciprocal meanings the appropriate truth conditions for a given sentence and context. This has proved to be an influential idea: most contemporary accounts of the semantics of reciprocals make use of some version of the SMH.

This dissertation approaches the puzzle of reciprocal interpretations from a psycholinguistic perspective. How does the language processor arrive at an interpretation of a reciprocal sentence, given the range of possible interpretations? In this respect, it is approaching the problem from a different direction than much work on the semantics of reciprocals in the SMH tradition. For instance, Kerem, Friedmann & Winter (2009) and Sabato & Winter (2012) both propose SMH-type analyses that explicitly define their SMH-like principles as part of a verification procedure: they approach the problem in terms of how the system decides whether a particular scenario satisfies the principle[1]. But a more natural take on the problem from the perspective of the sentence processor

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[1] Dalrymple et al. (1998) are not as explicit about this, but their account could certainly be viewed this way.

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is to ask how the processor accomplishes the task of arriving at a construal of a given sentence. The task is not one of verification, but potentially of the instantiation of certain relations between individuals in the mental model of the discourse. When I read the sentence *Those five kids hate each other*, and intuit that what it means is that each of the five kids hates all of the others, how is this accomplished? Is there any role for an SMH-like principle in accomplishing this task?

Dalrymple et al. (1998) describe the SMH as a semantic principle, and distinguish it from pragmatic principles like Grice's. But on its own, this is not enough information to tell us whether or how a principle like the SMH might be involved in the task of the sentence processor in fixing on an interpretation.

It seems worth considering what predictions we would make if an SMH-like principle is involved in instructing or guiding the language processor in the task of fixing on an interpretation. If a principle like the SMH selects the single appropriate interpretation of a reciprocal sentence in a given context, then the task for the language processor is a relatively simple one. The processor is not faced with the task of choosing among the range of reciprocal meanings; this version of the SMH instructs the processor as to the appropriate meaning given linguistic and extralinguistic information.

But the task for the language processor looks very different if the grammatical representation leaves the details of the interpretation underspecified, and if a principle like the SMH does not play a part in guiding the processor to an interpretation. One of the aims of this dissertation is to explore the possibility that reciprocal sentences are associated with grammatical representations that are underspecified, and further, that the processor does not

need a principle like the SMH to guide it. The challenge for such an approach is to explain SMH effects without an SMH.

1.1   Grammatical representations and comprehension

This dissertation takes as its starting point certain assumptions about how grammatical representations are related to sentence comprehension, and about how the language processor constructs grammatical representations.

I assume a representational approach, where the language processor makes use of linguistic representations in constructing an interpretation. And I assume that interpretations are built up incrementally out of their parts (i.e. that interpretations are compositional, cf. work by Ferreira and colleagues that disputes compositionality (Ferreira, Ferraro & Bailey 2002; Ferreira 2003)).

I assume a serial model, in which the processor – guided by structural principles – constructs a single parse of a sentence (Frazier & Fodor 1978; Ferreira & Clifton 1986; Frazier 1990; Frazier & Clifton 1996). The processor prefers the structurally simplest parse. This contrasts with parallel, constraint-based models, where multiple sources of information (e.g. plausibility, frequency) activate multiple potential parses simultaneously (e.g. MacDonald 1994; Tanenhaus, Spivey-Knowlton & Hanna 2000).

On the view that I am assuming, Logical Form (LF) parsing is guided by the same principles as surface syntactic structure parsing (Frazier 1999; Tunstall 1998). LF is the level of representation between the surface syntax and truth-conditional semantics. The parser builds a single LF, with a surface-structure default (Tunstall 1998; Anderson 2004).

A single LF may not fully specify a particular construal. I assume that the processor makes use of various extragrammatical principles and preferences in arriving at a particular construal. I assume that grammatical principles determine the possible interpretations of a given sentence, while the processor is responsible for preferences in interpretation.

I assume that, simultaneous with surface structure and LF parses, the processor builds a conceptual representation: a mental model. Early work on mental models and language (Johnson-Laird 1983) saw linguistic comprehension as yielding a mental model of the entities and relations described by the discourse. The mental model aided later non-linguistic reasoning about information provided by that discourse. I assume that a mental model is built simultaneously with the linguistic parse, that it is concerned with representing possible discourse referents (individuals and events), and that the mental model can have an immediate effect on syntactic processing (Crain & Steedman 1985; Patson & Ferreira 2009; Patson & Warren 2011; Huffman 2011).

1.2   Semantic analyses of the reciprocal

In Dalrymple et al.'s (1998) analysis, the three different reciprocal meanings on display in (1) involve different versions of the reciprocal quantifier. In their analysis *each other* has a single context sensitive meaning, and that meaning is a cluster of 6 quantifiers. A semantic principle, the Strongest Meaning Hypothesis (SMH), determines that a reciprocal sentence receives the logically strongest meaning consistent with available linguistic and non-linguistic information.

(1)   a. The five kids hate each other.
        b. The five kids are sitting next to each other on a bench.
        c. The chairs are stacked on top of each other.

Dalrymple et al. are careful to clarify that on their view, the reciprocal has a single meaning; it is not ambiguous, but rather context-sensitive. Nevertheless, their approach can be seen to involve a certain degree of ambiguity[2]: they propose that there are six possible reciprocal quantifiers, and that the SMH plays a role in determining which of them applies in a given utterance and context.

Beck (2001) takes a very different approach. In her analysis, *each other* is completely unambiguous: it always contributes a meaning we can paraphrase as 'the other ones among them'. The variety of reciprocal interpretations comes about through the ordinary mechanisms of plural predication (distributive and cumulative operators) and LF operations (Quantifier Raising). Sentence (1a) has a double-distributive semantic representation, while sentence (1b) has a cumulative one. Beck follows Dalrymple et al. in making use of a version of the SMH, but Beck's SMH operates on the set of interpretations associated with the different possible LFs, selecting the logically strongest one available in a particular context. As for sentences like (1c), which receive an interpretation that is weaker than ordinary plural predication allows, Beck proposes that this is a distinct, lexical phenomenon.

While they are quite different, Beck's and Dalrymple et al.'s approaches share the characteristic that the SMH is involved in choosing among a finite set of reciprocal interpretations. Other researchers (Schwarzschild 1996; Sauerland

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[2] Later proponents of SMH-like approaches, like Sabato & Winter (2012) also classify Dalrymple et al.'s account as involving ambiguity.

1998; Dotlačil 2010; Sabato & Winter 2012) have proposed analyses that involve greater degrees of underspecification. For instance, Sabato & Winter (2012) see the reciprocal as an unambiguous quantifier that takes the semantic properties of the predicate as a parameter. Some researchers argue that getting from the unambiguous grammatical representation to a particular interpretation is a task for pragmatics (Schwarzschild 1996; Sauerland 1998) and may involve more general preferences to do with natural groupings (Dotlačil 2010).

If we assume, following Beck (2001), that the various reciprocal interpretations are associated with distinct grammatical representations, then on a representational approach to psycholinguistics, the question of how the processor arrives at a particular interpretation of a reciprocal sentence may in part be a question about how those grammatical representations are built. On Beck's view, where the distinct interpretations result from the application of different operators/operations at LF, comprehending a reciprocal sentence may be seen to be in effect the same kind of task as, for example, comprehending a sentence with a quantifier scope ambiguity. In the case of quantifier scope ambiguity, there is strong evidence that the processor builds a single LF, and that by default that LF is one that mirrors the surface structure and respects principles of economy (Tunstall 1998, Anderson 2004). If as Beck argues, the different reciprocal interpretations arise from different LFs, we would expect that the most economical LF would be constructed by the processor by default. While the serial model of processing that I assume predicts an advantage for the most economical LF, it has difficulty making predictions about the processing implications of Beck's account. For Beck, the SMH chooses among the interpretations associated with various possible LFs. This makes it a particularly

bad fit for a serial model of processing. It is possible that a parallel model, where multiple parses are constructed simultaneously, would do better at making predictions based on Beck's analysis.

If we assume, following Dalrymple et al. (1998), that the reciprocal is a context-sensitive quantifier with 6 different possible meanings, then the question is: by what process does the language processor arrive at an interpretation involving a particular version of the quantifier? On this view, the LF that the processor constructs underspecifies the eventual interpretation. Based on Dalrymple et al.'s observations that reciprocal sentences do not feel ambiguous, and tend to receive the strongest possible interpretation given the context and other information, it seems that we might need the processor to have input from an SMH-like principle in choosing the appropriate version of the reciprocal quantifier.

Dotlačil (2010) presents an account that involves a greater degree of underspecification than that of Dalrymple et al. (1998). In his analysis, different reciprocal interpretations involve neither different versions of the reciprocal quantifier (as in Dalrymple et al. 1998), nor different LF structures (as in Beck 2001). Dotlačil argues that there are only two distinct reciprocal interpretations. They are not structurally/grammatically distinct. The single grammatical structure is compatible with both interpretations: one where each individual is understood to be related to every other, and one where all that is required is that each individual is related to at least one other. Since the former meaning is stronger than the latter, Dotlačil suggests that an SMH-like principle chooses it whenever possible, given contextual and other information. But this version of the SMH is quite diminished: notice that in this system it chooses between only

two interpretations. This SMH is not choosing between a number of different versions of a quantifier, or different LFs. It merely favours, where possible, an interpretation where each individual is in the relation with all of the others. Once our conception of the SMH has shrunk to it only needing to account for this one preference, it seems possible that the processor does not need to rely on an SMH-like mechanism to choose among a wide array of reciprocal meanings. It might be that all that is required is some preference that favours the interpretation where each individual is in the relation with all of the others, known as Strong Reciprocity (SR).

1.3   Strongest Meaning Hypotheses

Despite their different assumptions about the semantics of reciprocals, most of the researchers so far discussed argue for some version of the SMH. While it was first proposed by Dalrymple et al. (1994, 1998) in order to deal with reciprocals, the SMH is envisioned as a more general principle: potentially involved in the interpretation of presuppositions (Dalrymple et al. 1998), quantifier domain restriction (Blutner et al. 2003), prepositions (Zwarts 2003), and plural sentences (Winter 1996, 2001; Beck 2001).

As we have seen, there is no consensus as to what kind of mechanism the SMH might be. Chapter 2 will discuss several implementations of the SMH idea, as well as looking for evidence of the a preference for strong interpretations in online language comprehension.

All of this support for the idea of an SMH rests on an empirical question: do hearers really fix on the strongest possible interpretation? The original SMH of Dalrymple et al. made some strong claims that have been challenged by

subsequent researchers. For instance, according to Dalrymple et al. (1998:168) the sentence in (2) receives the strongest possible interpretation, where each of the men was hitting each of the others.

(2)   The four men were hitting each other.

Philip (2000) tested the availability of weaker readings. He presented adults[3] with the picture in Figure 1, and asked whether the girls were pointing at each other. This scenario satisfies 'weak reciprocity' (WR): each individual points at one of the others, and is pointed at by one of the others. Philip found that 100% of the adults tested answered affirmatively, despite the fact that the SMH would predict otherwise. (After all, it is possible for each girl to point at both of the others[4].)
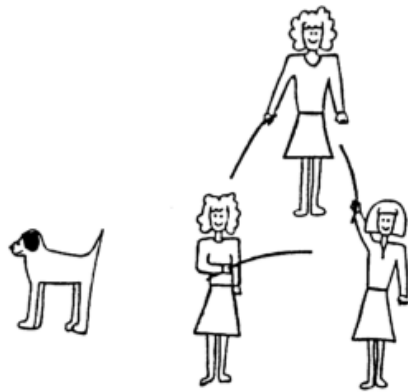
Figure 1: Philip's Condition T2 (2000)

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[3] In this case, native speakers of Dutch.

[4] If 'pointing' is taken to mean 'pointing with a stick', then because each girl only has one stick, one might argue that the stronger reading is not possible in this context, thus explaining the weaker reading. The other example tested by Philip had this same feature. But Kerem et al. (2009) found that weak readings were acceptable in scenarios without this feature.

Kerem, Friedmann & Winter (2009) found that the availability of weaker readings appears to depend on the choice of predicate. In a forced choice task, participants selected a strong interpretation of 'A, B and C are hugging each other' (a group hug) 90% of the time, but when the predicate was 'comb', they preferred the weaker interpretation where each person combs the hair of only one of the others. Even though it is possible for each person to comb the hair of both the others, participants selected this strongest possible interpretation only 35% of the time.

Using an incremental truth value judgement task, Dotlačil (2009) found that participants were satisfied with weak interpretations of reciprocal sentences. Participants were given a reciprocal sentence, and then subsequent sentences in the discourse spelled out – one at a time – the relations that held between the individuals in the reciprocal sentence. Participants were significantly more likely to judge the sentence true early in the discourse, once weak reciprocity was satisfied, than to wait until strong reciprocity held.

Philip (2000), Kerem et al. (2009) and Dotlačil (2009) provide evidence that comprehenders do not always insist on the strongest possible interpretation – this could be taken as direct evidence against the SMH. As we shall see in Chapter 2, Kerem et al. and Sabato & Winter (2012) suggest that the SMH can be modified to account for such data, but an alternate approach would be to question whether the SMH is necessary at all. Weak readings of reciprocal sentences are frequent and unremarkable, so why should we introduce this principle, only to then weaken it?

It is easy to find naturally occurring examples where the reciprocal receives a very weak interpretation, with no requirement that the relation hold

mutually. As one example, consider the sentence in (3), from Gardent & Konrad (2000:325). It does not require any mutual helping; rather we are likely to understand it as a statement about the frequency of events in which one of the students helps another.

(3)   The students often help each other with their homework.

Similarly, example (4) makes no claim that there have been any reciprocal cases of betrayal; it merely asserts that there have been instances of people betraying other people.

(4)   People have for centuries betrayed themselves in letters and diaries, and they have used them to betray each other.[5]

For another example, consider the excerpt in (5), from an interview on *The Splendid Table* radio program[6]:

(5)   Marlene Zuk: Some insects actually are farmers… There are also insects of course that eat plants, insects that eat EACH OTHER, and insects that eat EACH OTHER but they do it in a way that I think most humans would find a little grisly [5:26-5:55][7]

       Lynne Rossetto Kasper: For instance?

       Marlene Zuk: Well, so, going back to the cockroaches, there's a kind of wasp called an emerald jewel wasp that actually paralyzes its prey so that it can carry it to a place where it can be used to feed the offspring.

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[5] Alec Wilkinson, 'Remember this?', *The New Yorker*, May 28 2007, p43. Notice that this one most likely involves contrastive stress on *each other*.

[6] Episode 493, Segment 1, 1:14 - 9:55.

[7] The small caps mark contrastive stress on both instances of *each other*.

The case Zuk describes does not involve mutual eating. Rather, she illustrates *There are… insects that eat each other* with a case where one kind of insect eats another kind of insect.

1.4   Psycholinguistics and reciprocals

As mentioned in §1.3, several recent studies (Kerem et al. 2009; Dotlačil 2009) have tested the predictions of the SMH, finding that contrary to the predictions of Dalrymple et al. (1998), WR interpretations are available or even preferred, even with small-numbered antecedents. A different question is addressed by Poortman (2011), who investigates the effect of spatial configuration. She finds that a sentence like (6) is accepted significantly more often when it describes individuals arranged in a line (71% of the time) compared with an 'open circle' configuration (44%), as shown in Figure 2. Poortman's conclusion is that SMH calculations do not consider alternative spatial arrangements: the SMH requires the largest number of relations to hold, given a particular configuration[8].

(6)   A, B and C are holding hands.
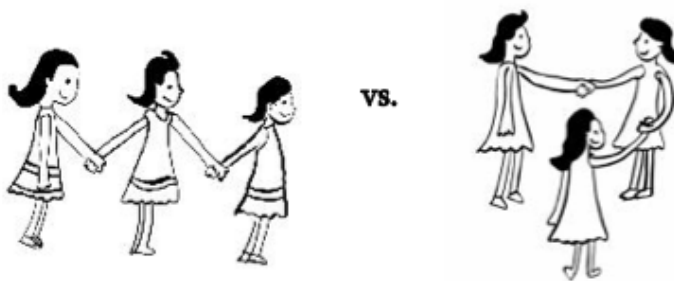
Figure 2: Line vs. open circle configuration (Poortman 2011)

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[8] That is, what is required is the locally maximal rather than globally maximal number of relations (Sabato 2006).

Syzmanik (2010) and Bott, Schlotterbeck & Syzmanik (2011) investigate the computational complexity of certain reciprocal sentences. They focus on reciprocal sentences with proportional and counting quantifier antecedents as in (7)[9]. Syzmanik (2010) shows how deciding whether an SR interpretation of these sentences is true in a model requires solving a CLIQUE problem: the verification is NP-complete (i.e. cannot be computed in polynomial time) (Garey & Johnson 1979).

(7)   a. Most of the dots are connected to each other.
        b. Four of the dots are connected to each other.

Citing a common assumption in cognitive science that 'cognitive capacities are limited to those functions that can be computed in polynomial time' (the 'P-Cognition Hypothesis') (van Rooij 2008:948), Syzmanik (2010) and Bott et al. (2011) argue that an SR interpretation of sentences like those in (7) should not be computed by the human sentence processor. They make the point that SR interpretations of these sentences are of a *schema* that is NP-complete; in a given situation with a small number of individuals, checking the truth-value of a particular sentence can be tractable (Syzmanik 2010:242; Bott et al. 2011:6). But Syzmanik and Bott et al. assume that even in such simple scenarios, the NP-complete schema should be dispreferred. Bott et al. (2011) provide some psycholinguistic evidence that SR interpretations are dispreferred. For example, in a picture completion task, participants were given a picture with dots, and

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[9] Kamp & Reyle (1993:466-469) discuss the unclear truth conditions of such sentences, specifically when it is not clear that there is only one 'cluster' of individuals that satisfies the reciprocal.

asked to illustrate sentences like 'All the dots are connected to each other' (a tractable schema) and 'Four of the dots are connected to each other' (an intractable schema). Participants drew pictures that satisfied SR 47% of the time for 'all', but significantly less frequently for 'four' (17.4%)[10]. All of Bott et al.'s experiments used the predicate 'be connected to', which is a transitive relation. As they note, this decreases the informativeness of their study somewhat[11].

There are a number of language acquisition studies on the semantics of reciprocals, including Matsuo (1999) and Philip (2000). Matsuo (1999) – testing an observation due to Fiengo & Lasnik (1973) – provides evidence that like adults, children (mean age 4;4) treat stative and eventive reciprocals differently. The eventive sentence (8a) is compatible with a scenario where the horses are arranged in two groups, and each horse fed only members of its own group (i.e. Partitioned Strong Reciprocity or Part-SR). The stative (8b) is rejected in such scenarios: it requires that each of the kids looked like all the others (i.e. SR). We will return to this contrast in Chapter 5.

(8)   a. These horses fed each other.
       b. These kids looked like each other.

Philip (2000) investigated adults' and children's interpretations of reciprocal sentences. Children are shown to be laxer than adults when it comes to scenarios like that in (9a); while adults respond affirmatively to question (9b) only 13% of

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[10] In the case of 'all', participants were given a picture of 4 dots. For 'four', it had seven dots. In both cases, only a completed picture where each of 4 dots is directly connected to the other 3 counted as SR.

[11] Notice that with a transitive relation, what Bott et al. code as an intermediate reading (where a continuous path connects all the dots) is equivalent to an SR reading (because each dot is connected directly or indirectly to every other dot).

the time, children (mean age 5;6) do so 62% of the time. Based on the results of a number of experiments, Philip argues that the SMH is a pragmatic principle, and that children acquire it late[12]. Chapter 3 will return to the question of when reciprocal sentences can felicitously describe scenarios like (9a).

(9)　　a. A → A → A → B
　　　　b. "Are the A's squirting each other?"

There is a body of psycholinguistic work on reciprocity that is unrelated to the SMH. This work concerns symmetric predicates such as *kiss*, *meet* and *be similar* (also known as reciprocal predicates). Gleitman et al. (1996) investigate a number of issues to do with symmetric predication. Work on the question of the conceptual representation of plurality has made use of reciprocal predicates. This line of inquiry began with Ferreira & McClure (1997), who studied garden-path sentences like (10a). There is a temporary ambiguity at the optionally transitive verb *signaled*, which leads to the garden-path effect of taking the following DP as the object. In contrast, Ferreira & McClure found that with an optionally reciprocal predicate like *kiss*, the garden-path effect was blocked.

(10)　　a. After Jose and the bride signaled the party began in earnest.
　　　　b. After Jose and the bride kissed the party began in earnest.

Subsequent work by Patson & Ferreira (2009), Patson & Warren (2010) and Huffman (2011) has found that the garden-path effect appears to be sensitive to the conceptual representation associated with the subject: morphological or semantic plurality is not sufficient to block the effect. Patson and colleagues

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[12] In another experiment with older (Dutch-speaking) children, Philip found that even the oldest (8 year olds) gave the adult-like 'no' response to sentences like (9b) only 49% of the time.

argue that a conjoined DP (*Jose and the bride*) has a more complex conceptual representation than a simple plural DP (*the lovers*, *the two lovers*), and it is only the more complex conceptual representation that blocks the garden-path effect[13].

1.5 The dissertation

Chapter 2 looks at the Strongest Meaning Hypothesis (SMH). More precisely, it looks at a variety of strongest meaning hypotheses; these include Dalrymple et al.'s original proposal as well as later work that makes use of SMH-like principles. As discussed above, it is unclear precisely what SMH-type analyses predict about the sentence processor's task in comprehending reciprocal sentences. The chapter considers a number of possibilities, and discusses two eye movement studies which looked for evidence of default commitments to strong interpretations in online sentence comprehension. In line with previous studies, these studies find no evidence that language users commit to the strongest possible interpretation of reciprocal sentences.

The rest of the dissertation addresses the question: what if there is no SMH? I assume an underspecified semantic representation, where all reciprocal interpretations arise from a cumulative semantic representation equivalent to WR (weak reciprocity). In the absence of an SMH, the question is how to account for interpretations stronger and weaker than WR.

Chapter 3 looks at interpretations weaker than WR. In particular, it focuses on what I call 'chain interpretations', as in a sentence like *The chairs are stacked on top of each other*, where the individuals at the endpoints of the chain only take part in the relation in one direction. It is argued, based on variable

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[13] For further discussion, see §5.7.2.

acceptability judgements of such sentences (especially when they describe the relations holding between only two individuals), that they cannot have truth conditions weaker than WR, as assumed by several SMH accounts. Instead, chain interpretations arise through pragmatic weakening from a cumulative semantic representation equivalent to WR.

Chapter 4 looks at interpretations that are stronger than WR. It presents the results of a questionnaire study showing that reciprocals and other plurals show a tendency for stative predicates to resist weak interpretations. It argues that extragrammatical preferences to do with natural groupings and uniformity can result in a preference for interpretations stronger than required by the semantics.

Chapter 5 looks at two issues. The first concerns the preference for reciprocal sentences to describe one 'general event' (Fiengo & Lasnik 1973). The results of a questionnaire study are used to argue that this preference is related to a more general preference that applies to all sentences, not just reciprocals. The second issue concerns partitioned interpretations: proposals by Fiengo & Lasnik (1973) and Sabato & Winter (2010) disallow partitioned interpretations for most stative predicates (Fiengo & Lasnik) or for reciprocals generally (Sabato & Winter). This chapter defends the idea that partitioned interpretations should always be available, given cumulativity.

Chapter 6 concludes.

CHAPTER 2

STRONGEST MEANING HYPOTHESES

As outlined in Chapter 1, most contemporary accounts of the semantics of reciprocals assume that a Strongest Meaning Hypothesis (SMH) chooses between possible interpretations. As mentioned in Chapter 1, some of the predictions of the original SMH of Dalrymple et al. (1998) have not been borne out: it turns out that weak readings are more prevalent than predicted (Philip 2000; Kerem et al. 2009; Dotlačil 2009). Previous work on this topic used questionnaire studies and incremental truth value judgement tasks; this chapter discusses two eye movement studies.

The chapter begins by looking at four different SMH analyses. Section 2.2 presents an experiment looking for evidence of the language processor making a commitment to the strongest reciprocal interpretation (SR). Consistent with previous work, the experiment found no sign that the processor commits to SR. Section 2.3 looks at how SMH accounts deal with the problem of weak reciprocity (WR). Section 2.4 considers the question of whether we should expect to see SMH effects in online comprehension. Distinctions are drawn between the various accounts and possible predictions about the weakest reciprocal interpretation: the chain interpretation. Section 2.5 presents an experiment testing these predictions. Section 2.6 concludes.

2.1 Four strongest meaning hypotheses

2.1.1 Dalrymple et al.'s SMH

Dalrymple et al. (1998) is an account of the meaning of the reciprocal which integrates linguistic and extralinguistic factors. On their view the reciprocal has a single, context-sensitive, meaning: it is a quantifier with parameters filled in with the help of contextual information. They propose that there are six possible reciprocal meanings, as shown in Table 1.

Strong Reciprocity (SR)	$\|A\| \geq 2$ and $\forall x,y \in A\ (x \neq y \rightarrow Rxy)$
Intermediate Reciprocity (IR)	$\|A\| \geq 2$ and $\forall x,y \in A\ (x \neq y \rightarrow$ for some sequence $z_0, \ldots, z_m \in A\ (x = z_0 \wedge Rz_0z_1 \wedge \ldots \wedge Rz_{m-1}z_m \wedge z_m = y))$
Strong Alternative Reciprocity (SAR)	unattested
One-way Weak Reciprocity (OWR)	$\|A\| \geq 2$ and $\forall x \in A\ \exists y \in A\ (x \neq y \wedge Rxy)$
Intermediate Alternative Reciprocity (IAR)	$\|A\| \geq 2$ and $\forall x,y \in A\ (x \neq y \rightarrow$ for some sequence $z_0, \ldots, z_m \in A\ (x = z_0 \wedge (Rz_0z_1 \vee Rz_1z_0) \wedge \ldots \wedge (Rz_{m-1}z_m \vee Rz_mz_{m-1}) \wedge z_m = y))$
Inclusive Alternative Ordering (IAO)	$\|A\| \geq 2$ and $\forall x \in A\ \exists y \in A\ (x \neq y \wedge (Rxy \vee Ryx))$

Table 1: Six reciprocal meanings (Dalrymple et al 1998)

They arrive at this set of six meanings by considering the interaction of two parameters. One parameter is how the relation covers the domain. This has three possible settings: each pair of individuals participates directly ('FUL'); each pair participates directly or indirectly ('LIN'); each individual takes part with one other ('TOT'). The other parameter concerns whether we count relations that are

in the extension of the predicate or its symmetric closure. If A saw B, then the

binary relation 'saw' has as its extension <A,B>, whereas its symmetric closure

includes both the extension <A,B> and its inverse <B,A>. The six possible

meanings are in the entailment relation shown in Figure 3.

SR: FUL$\backslash I(A, R)$

IR: LIN$\backslash I(A, R)$

SAR: FUL$\backslash I(A, R^{\vee})$

OWR: TOT$\backslash I(A, R)$

IAR: LIN$\backslash I(A, R^{\vee})$

IAO: TOT$\backslash I(A, R^{\vee})$
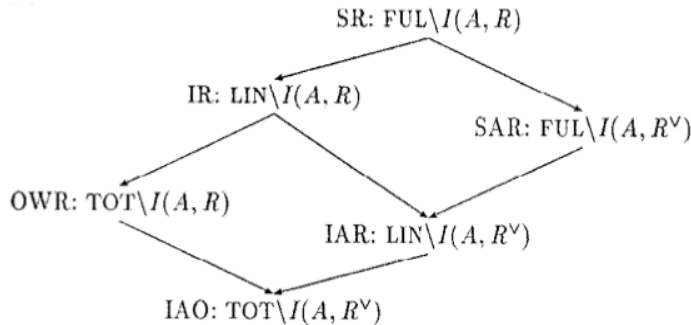
Figure 3: Entailment relation (Dalrymple et al. 1998)

The SMH, defined in (1), selects the strongest reciprocal meaning available in the

context, and takes linguistic and extralinguistic information into account

(1998:193).

(1)   Strongest Meaning Hypothesis (SMH):

A reciprocal sentence S can be felicitously used in a context c, which
supplies non-linguistic information I relevant to the reciprocal's
interpretation, provided the set Sc has a member that entails every other
one:
$Sc = \{p \mid p$ is consistent with I and p is an interpretation of S obtained by
interpreting the reciprocal as one of the six quantifiers in [Figure 3]}
In that case, the use of S in c expresses the logically strongest proposition
in Sc.

Consider the sentence in (2), which is based on an example from Dalrymple et al. (1998). According to their analysis, the SMH, combined with linguistic and non-linguistic information results in the appropriate interpretation of this sentence.

(2)   Five Boston pitchers sat alongside each other.

Because 'sitting alongside' is a symmetric relation, the six different possible truth conditions collapse down to three. In decreasing order of strength, they are SR(=SAR), IR(=IAR), and IAO(=OWR)[1]. Because of the non-linguistic fact that people only have two sides, SR cannot hold – it is impossible for every one of the five pitchers to be in the 'sitting alongside' relation with every other. Therefore, the SMH predicts that the sentence is interpreted with the strongest available reading, which is IR. That is, every pitcher is related directly or indirectly via the 'sitting alongside' relation.

In this account, SR has a privileged position: it should be the default interpretation. A sentence like (3), on this view, can only be interpreted as SR. That is, the only possible interpretations are either SR as in (4i), or partitioned SR[2] (part-SR) if the four men are arranged in pairs as in (4ii).

(3)   The four men were hitting each other.

(4)   (i)   A → B,C,D   (ii)   A ←→ B
               B → A,C,D   C ←→ D
               C → A,B,D
               D → A,B,C

---

[1] That is, distinctions that rest on the 'directionality of the arrows' are irrelevant with a symmetric relation.

[2] Dalrymple et al. prefer the term 'distributed strong reciprocity' (1998:178).

If the men were standing in a circle, and each was hitting the man to his left, is

(3) true? According to Dalrymple et al.'s system, the answer is no: the SMH

requires that (3) have the strongest meaning it can, which is SR. Dalrymple et al.

do allow for SR to be used 'in a loose way' (1998:168), but they stress that such

imprecision is incompatible with situations like that in (3) where the antecedent

denotes a small group. Rather, they allow for the imprecise use of SR in the case

of a sentence like *The men were hitting each other,* used to describe a bar-room

brawl (1998:167).

The SMH only allows resort to other interpretations if linguistic or non-

linguistic information rules out SR. The prediction is that if SR is possible, then

that is the only interpretation available. And more generally, a particular

sentence in a particular context will have one interpretation only: the strongest

one. However, given the role of contextual information in this system, we should

allow for the possibility that in the case of a sentence or utterance that does not

provide enough contextual information, the system may leave the interpretation

underspecified.

The SMH is described as a semantic principle (Dalrymple et al. 1998:197).

Dalrymple et al. distinguish it from pragmatic principles (like Grice's). They do

not claim that listeners use this principle to work out which reading of an

ambiguous expression a speaker might intend. Rather, the SMH chooses the

single literal interpretation (given the context) of particular kinds of expressions

– those with a set of interpretations that are related by entailment[3].

---

[3] Though it was proposed to account for reciprocal interpretations, Dalrymple et al. hypothesize
that the SMH applies more generally (1998:198).

2.1.2 Beck's SMH

Beck's (2001) analysis differs from Dalrymple et al.'s in a number of important respects, yet she too makes use of a version of the SMH. Beck proposes that *each other* has a single meaning, as shown in (5): it always denotes the group made up of all of the members of the antecedent other than the individual that is being looked at in terms of the distribution[4]. In this, she follows Heim, Lasnik & May (1991a,b).

(5)   [[each other]]   = 'the other one(s) among them'
                           $= \max(*\lambda z[\neg z \circ x_1 \ \& \ z \leq x_3 \ \& \ Cov(z)])$
                           = [max [* [Cov [[other x_1] (of) Pro_3]]]]

The various reciprocal interpretations arise from the application of the ordinary mechanisms of plural predication. In all, Beck proposes that there are four distinct LFs associated with reciprocal sentences. Strong Reciprocity (SR) is a distributive interpretation; as shown in (6). There is distribution over both the antecedent and the set A-x (the antecedent minus the individual being looked at in terms of the distribution).

(6)   a. Mary, Sue and Bill like each other.
        b. Strong Reciprocity (SR):
        [[Mary, Sue and Bill]$_3$ [*[Cov[1 [[max [*Cov[[other x_1] (of) Pro_3]]
        [*[Cov[2 [t_1 like t_2]]]]]

Beck's Collective interpretation, as in (7), has distribution over the antecedent, but not over A-x. Each individual in the antecedent is related to the remaining individuals collectively.

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[4] 'Max' is a maximality operator (it is the contribution of the definite determiner). 'Cov' stands for Cover (Schwarzschild 1996). A cover C of P is a set of subsets of P, where every member of P is in some set in C. Beck uses covers to account for subgroup effects and exceptions.

(7)   a. Our committees are made up of each other.
        b. Collective:
        [Our$_3$ [*[Cov[3 [t$_4$'s committee is made up of [max[*[Cov[other x$_4$ (of) Pro$_3$]]]]]]

Beck's Weak Reciprocity (WR) is a cumulative interpretation, as shown in (8). A cumulated relation holds between the group denoted by the antecedent and that same group (in the form of Pro). Beck proposes that the subject and Pro are Quantifer-Raised, and then the resulting relation is cumulated. If we assume that the cover provides singularities, this results in the translation in (8c). As Beck points out, this is a 'funny' QR operation in that only part of the meaning of *each other* – Pro – moves.

(8)   a. The children hit each other.
        b. Weak Reciprocity (WR):
        [Pro$_3$ [[the children]$_3$ [**[1 [Cov[2 [t$_2$ [Cov [hit [max [* [[other x$_1$] (of) t$_2$]]]]]]]
        c. <children, children> $\in$ **$\lambda x \lambda y[x$ hit max($*\lambda z[z \neq x$ & $z \leq y]$)]

In Beck's system, there is a second type of cumulative interpretation: Situation-based WR. Example (9a) is analysed by Beck in this way. It is typically understood as describing a line of poles, each 500 feet from the next. Beck proposes that examples of this kind involve pluralization of the situation/event argument with the situation-based cumulation operator ***, defined in (10). According to Beck's analysis, each pole is part of a situation consisting of two neighbouring poles, and in every situation of that kind the poles are 500 feet apart.

(9)   a. The telephone poles are spaced 500 feet from each other.
        b. Situation-based WR:
        [[the telephone poles]$_3$ [Pro$_3$ [***[2 [1 [$\lambda s'$ [t$_1$ is 500 feet apart from [max [other$_1$ of t$_2$]]]]]]]]]

c. <poles, poles, s> ∈ [***λxλyλs' . @(x≠y) & C(x) & C(y) & C(s') & x is 500 feet apart from y in s']

d. C(s') iff s' is a minimal situation containing two neighbouring poles[5]

(10)   *** is that function: D <e,<e,<s, t>>> →<e,<e,<s, t>>> such that for any R:

$$[***R](y)(x)(s) = 1 \ \text{iff}$$
$$R(y)(x)(s)$$
or
$$\exists x_1 x_2 y_1 y_2 s_1 s_2 [(s = s_1 \ \& \ s_2) \ \& \ (x = x_1 \ \& \ x_2) \ \& \ (y = y_1 \ \& \ y_2) \ \&$$
$$***R(y_1)(x_1)(s_1) \ \& \ ***R(y_2)(x_2)(s_2)]$$

These operators (distributive, cumulative) and LF operations (QR) are commonly assumed to be optional. So then the question is, why do we not usually observe a four-way ambiguity? Beck uses a version of the SMH to explain the lack of ambiguity; rather than selecting between quantifiers as in Dalrymple's system, Beck's SMH operates on sets of interpretations associated with these LFs that are in an entailment relation.

(11)   <u>Beck's SMH</u>:

Let S_a be the set of theoretically possible alternative interpretations for a sentence S. Then, S can be uttered felicitously in a context c, which supplies non-linguistic information I relevant to S's interpretation, provided that the set S_c has a member that entails every other one.
$S_c = \{p: p \text{ is consistent with I and } p \in S_a\}$
In that case, the use of S in c expresses the logically strongest proposition in S_c.

Of the four possible interpretations in Beck's system, three of them are in an entailment relation: SR entails situation-based WR, which entails WR. Thus Beck's SMH chooses SR whenever possible. When it is not, it selects situation-based WR, and when that is not possible, WR. Since the collective interpretation

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[5] @ marks a presupposition

is not in an entailment relation with the other three, it is not part of the set of interpretations that the SMH chooses among[6].

Beck suggests (2001:136) that the SMH is at work in codistributives (relational plurals)[7]. She points out that (12a) typically requires that both women know both men, while (12b) does not require that both women marry both men.

(12)   a. The two women know the two men.
         b. The two women married the two men.

On Beck's view, the SMH would choose the doubly distributive interpretation (as in (12a)) when possible, and only selects the cumulative interpretation (as in (12b)) when the doubly distributive interpretation is impossible/implausible.

The fact that in Beck's system the SMH chooses between interpretations arising from distinct linguistic structures should give us pause. Krifka (1996) points out that the SMH should be limited to operating on a single linguistic structure. He has us consider the quantifier scope ambiguity in (13). If the SMH applied here, it would always select the strongest interpretation (where *a student* has wide scope)[8]. On Krifka's view, we should assume that because scopally ambiguous sentences are distinct at LF, the SMH does not apply.

(13)   Every data set was checked by a student.

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[6] It's unclear how this is supposed to work. Beck (2001:132, fn 14) mentions some possibilities: either the collective interpretation is outside of the SMH system (so a sentence can be ambiguous between a collective or SMH-derived interpretation) or else the entailment requirement of the SMH is too strong and should be weakened to allow the collective interpretation into the set of interpretations that the SMH chooses among.

[7] Winter 2001 makes the same argument.

[8] The reading where *a student* has wide scope (for some student, every data set was checked by him/her) entails the one where a student has narrow scope (for each data set, there was a student that checked it).

2.1.3 Sabato & Winter's MIH

Sabato & Winter (2005b, 2012) build on Dalrymple et al. (1998), but make some major changes. As we have seen, Dalrymple et al. (1998) use the SMH to choose among a small set of reciprocal quantifiers. Sabato & Winter (2012) present a different picture. Their analysis does not assume that there is a particular set of reciprocal meanings that is being chosen from. In their analysis, the reciprocal is unambiguous: it is a quantifier that is sensitive to the semantic restrictions of the relation within its scope. Reciprocal meanings are derived directly from those semantic restrictions.

Consider the relation 'follow' in (14). The relation has certain logical properties: it is asymmetric and acyclic. (Compare a scenario where the kids are following each other in a circle, where the relation of following has neither of these properties.) These logical properties define the domain of interpretation of the relation. The reciprocal requires the relation to denote the maximal relation within its domain of interpretation. If there are three kids, the maximal number of following relations is two (e.g. A follows B, who follows C) as in (15). When the relation is one with no logical restrictions, like 'know', the maximal relation is equivalent to SR.

(14)   The kids followed each other into the treehouse.

(15)   A – B – C → treehouse

Sabato & Winter's system uses the Maximal Interpretation Hypothesis to select the maximal relation:

(16)   <u>Maximal Interpretation Hypothesis</u> (MIH):

    Let P be a complex predicate with a reciprocal expression RECIP that has a
    relational expression REL in its scope. Reciprocity requires REL to denote a
    relation in REL's domain of interpretation Θ_{REL} that is not properly
    contained in any other relation in Θ_{REL}. In this case we say that REL
    denotes a maximal relation in Θ_{REL}.

Their formal statement of what it means for reciprocity to hold in the MIH

system is shown in (17). A set of individuals, *A*, and a relation, *R*, satisfy MIH-

based reciprocity if for all relations *R'* in the domain of interpretation (restricted

to A and ignoring identities), if *R* is a subset of or equal to *R'*, then *R* and *R'* are

identical. (That is, *R* is not the proper subset of any other relation in the domain

of interpretation; it is the maximal relation.)

(17)   Let $\Theta \subseteq \wp(E^2)$ be a set of binary relations over E.
    The MIH-based reciprocal function $\text{RECIP}_{\circ}^{\text{MIH}}$ is defined for all sets $A \subseteq E$
    and relations $R \in \Theta$ by:
    $\text{RECIP}_{\circ}^{\text{MIH}}(A,R) = 1$ iff for all $R' \in \Theta\!\downarrow_A : R\!\downarrow_A \subseteq R' \Rightarrow R\!\downarrow_A = R'$ (2012:208)[9]

    Sabato & Winter's system has an advantage over Dalrymple et al.'s in

being quite restrictive about the kind of contextual information that can affect

possible interpretations: it is only information that affects the semantic properties

of the relation that can do so. Consider example (18), with *know*, with no logical

restrictions. The context provides the fact that Amy doesn't know Bill. This

accidental fact about the world cannot weaken the interpretation of the reciprocal

in the subsequent sentence, because it does not change how we understand the

concept of 'knowing'.

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[9] $\Theta\!\downarrow_A = \Theta$ restricted to A, disregarding identities

(18)   Amy doesn't know Bill. #Amy, Bill and Carl know each other.

2.1.4 Dotlačil's SMH

In Dotlačil's (2010) proposal, reciprocal interpretations arise from a single

cumulative semantic representation.

Like Beck (2001), Dotlačil's system treats reciprocals as a part of the

regular plural semantics. Like Kratzer (2001), Dotlačil assumes that predicates

and thematic roles are inherently cumulative. Consider example (19). The *-

operator marks the cumulative predicate *call* and the cumulative thematic roles

of *Agent and *Theme[10].

(19)   a. Sam and Ben called Amy and Bella.
        b. ($\exists$e)(*call(e) $\wedge$ ^{C}*Agent(Sam+Ben)(e) $\wedge$ ^{C}*Theme(Amy+Bella)(e))

The cumulative predicate *call* has as its denotation individual events of calling,

plus all of the pluralities that can be formed from those events. This means that

(19b) can be true in a variety of different scenarios with varying numbers of calls,

as long as Sam and Ben are the plural agent, and Amy and Bella are the plural

theme of those calling events. If Sam and Ben are the plural agent of a possibly

plural event, that means that Sam+Ben, or the subparts of that plurality (Sam,

Ben) are the agents of that event or its subevents.

This can be satisfied in a variety of ways: one possibility is the branching

reading where both boys call both girls, as in (20a). Another is the cumulative

reading, where each boy calls one of the girls and each girl is called by one of the

boys, as in (20b).

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[10] For the thematic roles, Dotlačil uses the pluralizer ^{C}* which is the *-operator, but restricted to
covers.

(20)   a. branching: <Sam, Amy+Bella, e_1> <Ben, Amy+Bella, e_2>
        b. cumulative: <Sam, Amy, e_1> <Ben, Bella, e_2>

A reciprocal sentence like (21a) has the interpretation in (21b). There is a possibly plural event of calling, in which the boys are both agent and theme, and that event can be split into subevents which have distinct agent and theme. Dotlačil uses a slightly unusual convention here: the square brackets in (21b) are to be understood as equivalent to another cumulation operator.

(21)   a. The boys called each other.
        b. $(\exists e)(*call(e) \wedge$ <boys, boys, e> $\in [\{$<a, b, e'>:
           $^{C}*Agent(a)(e') \wedge {}^{C}*Theme(b)(e') \wedge e' \leq e \wedge \neg a \circ b\}])$

Just like the plural sentence in (19), Dotlačil argues that the reciprocal in (21) potentially has branching and cumulative readings. The equivalent of the branching reading is SR: each boy calls all of the other boys. The cumulative reading is WR[11]: each boy calls and is called by one of the other boys. In Dotlačil's system, there are only three reciprocal readings: these two, which are derived from the cumulative semantic representation, and the chain reading (his IAR) which arises some other way[12].

Dotlačil's approach situates the semantics of reciprocals within the general theory of plurality: the weakest reading of a reciprocal sentence should be no weaker than a cumulative reading. On this point, his analysis contrasts with Dalrymple et al. (1998) and Sabato & Winter (2012). Dotlačil illustrates a problem with Sabato & Winter's account using the following example (from Øystein

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[11] Dotlačil calls this interpretation IR.

[12] Like Beck (2001), Dotlačil does not see chain interpretations as arising from the regular reciprocal semantics.

Nilsen). Example (22) cannot felicitously describe a situation where the lecturer stares at one audience member, and all the audience members stare at the lecturer. The cumulative account predicts this: each person must stare at someone and be stared at by someone, hence the sentence is false in the given scenario. In contrast, in Sabato & Winter's system, the MIH predicts that as *stare at* is a function, a scenario in which every person is staring at someone should be felicitous.

(22)   The people in the lecture hall are staring at each other.

Dotlačil (2010:73,173) proposes that the SMH selects the branching interpretation over the cumulative interpretation whenever possible[13]. This holds for plural sentences and reciprocal sentences alike. Dotlačil sees the SMH as a requirement that an event exemplify the strongest proposition. Since branching readings always have cumulative readings as their parts – in Dotlačil's words, 'the proposition interpreting the branching reading entails the proposition interpreting the cumulative reading' (2010:73) – the SMH chooses the branching reading whenever possible.

2.2   Experiment 1: SR default experiment

We have just seen four different SMH accounts. All four predict that whenever possible, a reciprocal sentence should receive the SR interpretation. In this sense, SR could be seen as the default interpretation.

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[13] He does note that typicality preferences (as in Kerem et al. 2009, which will be discussed below) seem to play a role (2010:173).

Imagine that the sentence processor makes use of such a default interpretation. If the processor makes an initial commitment to SR, then there should be evidence of disruption if later information is inconsistent with that construal.

(23)   SR default hypothesis:
        The processor fixes on an SR construal of a reciprocal sentence by default.

It is important to note that the SR default hypothesis makes a very simplistic and strong claim that is not directly related to any particular one of the SMH accounts we have seen. All those accounts include ways for the context to influence the interpretation, for example, whereas the SR default hypothesis is a simple default.

According to the SR default hypothesis, the reciprocal sentence in (24) should be interpreted as SR: each kid hit every other kid. Accordingly, if the discourse continues as in (25a), it is consistent with that default interpretation. But if it continues as in (25b), it is inconsistent[14].

(24)   I saw a group of kids playing. The kids hit each other on the arm.

(25)   a. Each kid hit every other kid. (=Strong disambiguation)
        b. Each kid hit one of the other kids. (=Weak disambiguation)

The prediction that the reciprocal sentence should require that each kid hit every other kid assumes that the kids form a single group. Imagine that the kids are grouped in pairs: if each kid hits and is hit by their partner, that too is an SR interpretation, but in such a case, the strong disambiguation would be the one

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[14] Assuming that 'Each kid hit one of the other kids' is interpreted as 'exactly one' not 'at least one'.

that is inconsistent. To make the assumption that the strong disambiguation in (25a) is consistent with SR, and the weak disambiguation (25) is inconsistent with SR, means assuming that comprehenders, upon reading the sentence *I saw a group of kids playing*, will not posit that the kids are grouped in pairs, and will posit that they are in a single group (and that that grouping is salient/relevant)[15]. While it seems reasonable to assume that comprehenders will not posit more complicated scenarios than they have evidence for, it is important to recognize that we are making this assumption.

In a small pilot study, seven participants rated six discourses like (24) that continued with either a strong or weak disambiguation as the third sentence. They were instructed to rate the discourses according to difficulty, on a scale from 1 to 5. The discourses with strong disambiguations were rated as less difficult (1.86) than those with weak disambiguations (2.14). This was significant by participants ($t_1(6) = 6.0$, $p<.001$), but not by items ($p>.5$)[16].

The results of the pilot study are consistent with the predictions of the SR default hypothesis. But it is possible that the discourses with weak disambiguation sentences were dispreferred for some other reason than that hypothesized by the SR default view. To test the SR default hypothesis, we need

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[15] In fact, the strong and weak disambiguations would work the same way with multiple groups, as long as they are large enough groups for the strong disambiguation's *every other kid* to be felicitous. In such a case, the strong disambiguation is felicitous if it is understood with implicit quantification to subgroups (i.e. *In each group, g, each kid in g hit every other kid in g.*)

[16] Inspection of the means for each item showed that two items had higher difficulty ratings for the strong disambiguation than the weak disambiguation. These are items 3 and 5 in Experiment 1A in the Appendix. These two items differed from the others in that their reciprocal sentences were open to a non-episodic interpretation, where they described a procedure rather than the actions of a particular set of individuals. Furthermore, due to an oversight, item 3 differed from the rest in not explicitly introducing the antecedent group in the first sentence. It is possible that these differences discourage the SR interpretation. In Experiment 1, the materials were constructed more carefully to encourage episodic interpretations.

a new variable: the order of the reciprocal and disambiguation sentences. By varying the order, so that the disambiguation sentence either precedes or follows the reciprocal as in (26), we can separate any difficulty associated with the disambiguation sentence itself from any difficulty associated with following the reciprocal sentence.

(26) a/b. I saw a group of kids playing.
            The kids hit each other on the arm.
            {a. Each kid hit every other kid./
            b. Each kid hit one of the other kids.}

      c/d. I saw a group of kids playing.
            {c. Each kid hit every other kid./
            d. Each kid hit one of the other kids.}
            The kids hit each other on the arm.

We already have reason to doubt the SR default hypothesis. As mentioned in Chapter 1, a number of studies (Philip 2000; Kerem, Friedmann & Winter 2009; Dotlačil 2009) have found that reciprocal sentences are not always interpreted in the strongest possible way. These studies found evidence that weaker interpretations are possible, and sometimes preferred. All of these studies involved judgement tasks. Experiment 1 looks for online evidence of an SR default in an eye movement study.

In Experiment 1, evidence in support of the SR default hypothesis should take the form of processing difficulty on the weak disambiguation following a reciprocal sentence. That is, (26a) should be read faster than (26b). The conditions in (26c) and (26d) act as controls, since another account of the result in the pilot study is that result was due to the length/complexity difference between the weak and strong disambiguation sentences. Thus the SR default hypothesis predicts an interaction between region and disambiguation type, such that the

region the disambiguation appears in (before the reciprocal, or after it) should have more of an effect on the weak disambiguation than the strong.

This design also allows us to compare reading times on the reciprocal sentence in different contexts. If the processor commits to SR regardless of context, we might expect the processor to encounter difficulty when the reciprocal follows a weak disambiguation (as in (26d)). But if the SR default is sensitive to context, and selecting a weaker construal than SR is not associated with any cost, then we would expect no difference between reading times on the reciprocal sentence in conditions (26c) and (26d).

2.2.1 Method

Materials and design   Twenty items like (27) were constructed. Each item consisted of a three sentence discourse, with the first sentence introducing a group[17]. The next two sentences were a reciprocal sentence and a disambiguating sentence (which disambiguated the reciprocal sentence to either SR or WR). As shown in (27), in conditions (a) and (b), the disambiguating sentence followed the reciprocal sentence; in conditions (c) and (d) the disambiguating sentence preceded the reciprocal sentence. Thus it was a 2x2 design (disambiguation type x sentence order).

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[17] This was done by using a collective noun/partitive (*a group of kids*), a numeral (*those four workers*) or a universal (*all the boys*). The first sentence made it clear that an episodic interpretation was intended, and that the group was all together at the same place/time.

(27) a/b. I saw a group of kids playing.
            The kids hit each other on the arm.
            {a. Each kid hit every other kid./   (=R2 Recip R3 Strong)
             b. Each kid hit one of the other kids.}   (=R2 Recip R3 Weak)

      c/d. I saw a group of kids playing.
            {c. Each kid hit every other kid./   (=R2 Strong R3 Recip)
             d. Each kid hit one of the other kids.}   (=R2 Weak R3 Recip)
            The kids hit each other on the arm.

The predicates used in the reciprocal sentence were all eventive. The contexts and predicates allowed SR, and were intended not to favour construals with group objects or partitioned interpretations. The complete set of items appears in the Appendix.

The items were separated into 4 counterbalanced lists. There were 65 filler items, and 7 practice trials. Items were presented in an individually randomized order.

Participants   Twenty five members of the University of Massachusetts community received course credit or were paid for participating. All participants were native speakers of English and had normal or corrected-to-normal vision (soft contact lenses).

Apparatus   Eye movements were recorded by a Fourward Technologies Dual Purkinje eye tracker, interfaced with an IBM compatible computer. Viewing was binocular, but only the right eye was monitored. Stimuli were presented on a 15-inch NEC 4FG monitor. Participants were seated 61cm from the monitor; 3.8 characters equaled 1° of visual angle. The monitor allowed for 80 character spaces per line, and the experimental items consisted of three-sentence paragraphs, each sentence of which appeared on a separate, single line. All three sentences were presented at once.

Procedure   Participants were tested individually. On arriving at the

laboratory, participants were given instructions, and had a bite bar prepared for

them (in order to minimize head movements). The eye tracker was calibrated for

9 points in a procedure that took approximately 5 minutes. At the beginning of

each trial, a set of fixation boxes were presented. Calibration was checked

throughout the experiment, and when necessary, the eye tracker was recalibrated.

Participants were instructed to look at the centre fixation box and then the left-

most box, at which point the entire sentence (in the case of some filler items) or

paragraph (in the case of the experimental trials, and some filler items) appeared.

They were instructed to read at a normal rate, for comprehension. Once they had

finished reading, participants pressed a button to end the trial.

2.2.2   Results

Trials on which there was a track loss were excluded from the analysis (less than

4% of all trials). Trials with fixations of longer than 800ms were excluded from

analysis, because they are likely to reflect track losses. If a fixation of less than

80ms was within one character of a neighboring fixation, it was incorporated into

the neighboring fixation. Other fixations of less than 80ms were deleted on the

assumption that readers do not extract useful information from such short

fixations (Rayner & Pollatsek 1989).

The experimental items consisted of three sentence discourses; they were

divided into three regions for analysis, with each region consisting of a whole

sentence. The results of Experiment 1 appear in Table 2. As can be seen by

comparing first pass and total time, there was very little rereading of previous

sentences, so I omit discussion of second pass time, go past time and regressions

out. First pass time is the sum of all fixations in a region from first entering the region until leaving it. Total time is the sum of all fixations in a region. The number of fixations is the average number of fixations in the region.

Measure	R1 (Sentence 1)	R2 (Sentence 2)	R3 (Sentence 3)
First Pass Time			
R2 strong, R3 recip	**1410** (61)	**1354** (57)	**1313** (68)
R2 recip, R3 strong	**1408** (53)	**1359** (45)	**1304** (55)
R2 weak, R3 recip	**1460** (56)	**1412** (37)	**1243** (45)
R2 recip, R3 weak	**1448** (63)	**1353** (39)	**1379** (48)
Total Time			
R2 strong, R3 recip	**1415** (61)	**1362** (60)	**1316** (69)
R2 recip, R3 strong	**1444** (56)	**1374** (50)	**1329** (66)
R2 weak, R3 recip	**1468** (58)	**1433** (61)	**1256** (52)
R2 recip, R3 weak	**1477** (68)	**1368** (51)	**1406** (66)
Number of Fixations			
R2 strong, R3 recip	**6.32** (.24)	**5.55** (.21)	**5.39** (.25)
R2 recip, R3 strong	**6.30** (.23)	**5.75** (.20)	**5.38** (.27)
R2 weak, R3 recip	**6.42** (.22)	**5.98** (.22)	**5.10** (.19)
R2 recip, R3 weak	**6.52** (.27)	**5.59** (.21)	**5.85** (.27)

Table 2: Experiment 1 Participant Reading Times (ms). (Standard error of the mean in parentheses)

The experiment had a 2x2 design (disambiguation type vs. sentence order). Two-way repeated measures ANOVAs found significant interactions between disambiguation type (strong vs. weak) and sentence order (reciprocal first or second) in both Region 2 and Region 3. But these interactions boil down to a simple observation: the weak disambiguation sentence appears to be associated with longer reading times than both the strong disambiguation sentence and the reciprocal sentence. This is unsurprising, since it is longer than the strong disambiguation sentence. For instance, consider Region 3, where there was a significant interaction between sentence order and disambiguation type on all three measures, as well as a main effect of sentence order. Simple effects tests

revealed that there were significant differences between the condition where Region 3 contained the weak disambiguation and that where it contained the reciprocal; in this region the reciprocal had lower reading times and fewer fixations than the weak disambiguation. There were no significant differences between the strong disambiguation and the reciprocal. Analyzing the data in this way is quite uninformative, given the hypothesis the experiment is testing.

To test the SR default hypothesis, we are looking for an effect of the reciprocal sentence on the disambiguation sentence, and possibly for an effect of the type of disambiguation sentence on the reciprocal sentence. To test the SR default hypothesis, we need to look at the effect of sentence order by comparing reading times for a given sentence when it appears in Region 2 vs. Region 3. Table 3 presents the relevant data for the disambiguation sentence.

Measure	Disambiguation sentence (S or W)	R2 – R3
First Pass Time		
S in R2, before reciprocal	**1354**	
S in R3, after reciprocal	**1304**	**50**
W in R2, before reciprocal	**1412**	
W in R3, after reciprocal	**1379**	**33**
Total Time		
S in R2, before reciprocal	**1362**	
S in R3, after reciprocal	**1329**	**33**
W in R2, before reciprocal	**1433**	
W in R3, after reciprocal	**1406**	**27**
Number of Fixations		
S in R2, before reciprocal	**5.55**	
S in R3, after reciprocal	**5.38**	**0.17**
W in R2, before reciprocal	**5.98**	
W in R3, after reciprocal	**5.85**	**0.13**

Table 3: Experiment 1 Participant reading times, difference between R2 and R3 (disambiguation sentence)

Two-way repeated measures ANOVAs (region x disambiguation type) found marginal main effects of both region ($F_1(24)=3.5$, $p=.072$; $F_2(19)=.927$, $p=.35$) and disambiguation type ($F_1(24)=3.4$, $p=.079$; $F_2(19)=3.81$, $p=.066$) on first pass time. The pattern is that Region 3 was read faster than Region 2, and the strong disambiguation sentence was read faster than the weak disambiguation sentence. However, simple effects tests found nothing significant. For total time, there was a marginal main effect of disambiguation type, again with the strong disambiguation sentence associated with a faster reading time than the weak disambiguation sentence ($F_1(24)=3.82$, $p=.062$; $F_2(19)=3.56$, $p=.075$). Simple effects tests found that this was marginally significant for Region 3 ($t_1(24)=1.9$, $p=.07$; $F_2(19)=1.34$, $p=.19$), but not significant for Region 2 (p's>.2). As for number of fixations, there was a main effect of disambiguation type ($F_1(24)=11.3$, $p<.005$; $F_2(19)=.010$) such that there were fewer fixations in the strong disambiguation sentence than the weak. This was significant for both Region 2 ($t_1(24)=2.59$, $p=.016$; $t_2(19)=3.01$, $p=.007$) and Region 3 ($t_1(24)=3.3$, $p<.005$; $t_2(19)=1.70$, $p=.11$). The effects of disambiguation type are all consistent with the length difference between the weak and strong disambiguations: the weak disambiguation sentence was longer, and was associated with longer reading times and more fixations than the strong disambiguation sentence.

Now we turn to considering the reciprocal sentence. Table 4 presents the relevant data.

Measure	Reciprocal sentence	R2 – R3
First Pass Time		
In R2, Pre-disambiguation to S	**1359**	
In R3, Post-disambiguation to S	**1313**	**46**
In R2, Pre-disambiguation to W	**1353**	
In R3, Post-disambiguation to W	**1243**	**110**
Total Time		
In R2, Pre-disambiguation to S	**1374**	
In R3, Post-disambiguation to S	**1316**	**58**
In R2, Pre-disambiguation to W	**1368**	
In R3, Post-disambiguation to W	**1256**	**112**
Number of Fixations		
In R2, Pre-disambiguation to S	**5.75**	
In R3, Post-disambiguation to S	**5.39**	**0.36**
In R2, Pre-disambiguation to W	**5.59**	
In R3, Post-disambiguation to W	**5.10**	**0.49**

Table 4: Experiment 1 Participant reading times, difference between R2 and R3 (reciprocal sentence)

Two-way repeated measures ANOVAs (region x disambiguation type) found main effects of region on both the first pass time and total time measures for reciprocal sentences. The effect was close to significant for first pass time ($F_1(24)=4.178$, $p=.052$; $F_2(19)=4.32$, $p=.051$) and marginal for total time ($F_1(24)=3.82$, $p=.062$; $F_2(19)=5.32$, $p=.032$). The two measures show the same numerical pattern: while the reciprocal sentence was read faster in Region 3 than Region 2, it is the reciprocal following a weak disambiguation sentence that shows the greatest speed-up. However, neither measure showed a significant interaction (p's >.25). Simple effects tests revealed a significant effect of region in the case of reciprocal sentences preceding or following the weak disambiguation: the reciprocal sentence was read significantly faster following the weak disambiguation (first pass: $t_1(24)=2.77$, $p=.010$, $t_2(19)=2.12$, $p=.047$; total time: $t_1(24)=2.32$, $p=.029$,

$t_2(19)=2.17$, $p=.043$). There was no significant difference between a reciprocal

sentence preceding and following the strong disambiguation sentence (p's>.3). If

following the weak disambiguation sentence decreases reading time on the

reciprocal sentence, then we would expect that there would have been a

significant main effect of disambiguation type, but there was not. Simple effects

tests found no significant difference between first pass or total time on the

reciprocal sentence in Region 3 when it followed the weak disambiguation

versus when it followed the strong disambiguation (p's>.22). While there was no

significant effect of disambiguation type on first pass or total time, there was an

effect on the number of fixations. There were main effects of both region

($F_1(24)=16.99$, $p<.001$; $F_2(19)=12.68$, $p=.002$) and disambiguation type ($F_1(24)=5.85$,

$p=.024$; $F_2(19)=1.40$, $p=.25$) on the number of fixations. Simple effects tests found

that there were fewer fixations on the reciprocal sentence when it appeared in

Region 2 versus Region 3. This held for both disambiguation types (Strong:

$t_1(24)=2.13$, $p=.044$, $t_2(19)=1.89$, $p=.074$; Weak: $t_1(24)=3.16$, $p=.004$, $t_2(19)=2.62$,

$p=.017$). As for the effect of disambiguation type, simple effects tests found only a

very marginal effect in Region 3 ($t_1(24)=1.72$, $p=.098$). The pattern was that the

reciprocal sentence had fewer fixations in Region 3 when it followed the weak

disambiguation sentence, versus when it followed the strong one.

2.2.3 Discussion

2.2.3.1 *Disambiguation sentences*

The SR default hypothesis predicts processing difficulty when a reciprocal

sentence (that is open to the SR construal) is followed by information

inconsistent with the SR construal. In Experiment 1, this predicts difficulty when Region 2 contained the reciprocal and Region 3 contained the weak disambiguation sentence.

Experiment 1 found no sign of such difficulty. The SR default hypothesis predicts an interaction between region and disambiguation type, such that region should have more of an effect on the weak disambiguation than the strong disambiguation. The prediction is that the weak disambiguation should show signs of processing difficulty when it follows the reciprocal. However, there was no sign of an interaction. Instead, there were marginal main effects of region and disambiguation type: the pattern was one of a general speed up (with Region 3 faster than Region 2), and of the weak disambiguation sentence being associated with longer reading times, presumably because it is longer / more complex than the strong disambiguation sentence.

2.2.3.2   *Reciprocal sentences*

It is unclear what the SR default hypothesis predicts about how the context will affect the processing of reciprocal sentences. The question is whether it should lead us to expect any difference between a reciprocal that follows a weak disambiguation and one that follows a strong one.

If the processor commits to SR regardless of context, then we might expect processing difficulty when the reciprocal follows a weak disambiguation, under the assumption that the default SR construal is incongruous in that context.

If the SR default is sensitive to context, and selecting a weaker construal than SR is not associated with any cost, then we expect no difference between a reciprocal that follows the weak disambiguation and one that follows strong. If

selecting a weaker construal than SR is associated with processing costs, then we might expect to see signs of processing difficulty on a reciprocal sentence that follows the weak disambiguation.

The results of Experiment 1 fit with none of these predictions. We saw evidence of a general speed up: the numerical pattern was that reading times on the reciprocal sentence decreased from Region 2 to Region 3. This decrease was significant in the case of the reciprocal following the weak disambiguation, but not significant for the reciprocal following the strong disambiguation. Rather than being associated with processing difficulty on the following reciprocal, it appears that the weak disambiguation context might actually facilitate it. However, there was no significant interaction.

2.3   A problem for SMH: Weak Reciprocity (WR)

Experiment 1 found no sign that the processor fixes on an SR interpretation of reciprocal sentences by default. This null result fits with previous research that finds weak readings of reciprocal sentences are not only available, but sometimes preferred, even when SR is an available interpretation (Philip 2000; Kerem, Friedmann & Winter 2009; Dotlačil 2009).

Philip (2000), Kerem et al. (2009), and Dotlačil (2009) all provide evidence that reciprocal sentences that the SMH predicts should receive the SR interpretation actually can be interpreted as Weak Reciprocity (WR), as in (28) (Langendoen 1978).

(28)   <u>Weak Reciprocity</u>:
       $\forall x \in A \; \exists y,z \in A \; (x \neq y \wedge x \neq z \wedge xRy \wedge zRx)$

This is a problem for SMH approaches. This section reviews two proposed solutions: §2.3.1 considers whether these weak readings are due to nonmaximality. Section 2.3.2 discusses the approach of Kerem et al. (2009), which uses typicality preferences to explain weaker readings.

2.3.1 WR as nonmaximality

Dalrymple et al. explain that we should expect reciprocal sentences to allow exceptions (1998:167). They point out that just as speakers and hearers tolerate exceptions in the case of a sentence like (29) (we wouldn't say the sentence was false if the bartender were sober, and probably would allow for a few other sober people too), so too are reciprocal sentences open to weaker interpretations by the same mechanism.

(29)   Everyone in the room was drunk.

According to Dalrymple et al., sentence (30) has SR truth conditions, but can be used 'in a loose way' to describe a bar-room brawl (1998:167-8)[18]. They predict that nonmaximal interpretations are only available when the antecedent denotes a reasonably large group. If there are four men, Dalrymple et al. claim (1998:168) that a nonmaximal interpretation of (30) is impossible: the sentence can only be interpreted as SR[19].

(30)   The men were hitting each other.

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[18] Example originally from Fiengo & Lasnik (1973).

[19] Their system allows SR (i.e. each man is hitting the other three) or partitioned SR (e.g. pairs of men, each man hitting his partner).

We have already seen evidence that, contrary to Dalrymple et al.'s claim, people can interpret sentences like (30) more weakly than SR even when the antecedent denotes a small group (Philip 2000; Kerem, Friedmann & Winter 2009; Dotlačil 2009). For instance, Kerem et al. (2009) gave participants reciprocal sentences with three-person antecedents (e.g. 'A, B and C are verbing each other'), and had them choose between two drawings: one depicting SR and the other WR. Depending on the predicate, participants chose the WR drawing between 10% ('hug') and 65% ('comb') of the time. The fact that WR interpretations are available at all with an antecedent numbering only three is one count against the nonmaximality explanation.

Another question for this account concerns Fiengo & Lasnik's (1973:453) observation that the reciprocal (31a) can be interpreted more weakly than the *each-the-other* sentence (31b). If both have strong truth conditions, why is the reciprocal sentence more amenable to nonmaximality, even in cases with a small number of men?

(31) a. The men are hitting each other.
      b. Each of the men is hitting the others.

Bruening (2004:27) argues against the nonmaximality account using evidence from the nonmaximality canceller *all* (Brisson 1998). To see the nonmaximality canceling effect of *all*, consider the sentences in (32). Given a large enough group of boys, a nonmaximal interpretation (where for instance, one of the boys didn't eat a sandwich) is possible in the case of (32a), but the presence of *all* in (32b) rules this out – each boy must have eaten a sandwich.

(32)   a. The boys ate a sandwich.
          b. The boys all ate a sandwich.

Bruening points out that if the WR interpretation is a nonmaximal interpretation, then WR should be impossible in the presence of *all*. He uses example (33) to show that even in the presence of *all*, WR is still a possible interpretation. He concludes that WR is a separate phenomenon from nonmaximality.

(33)   Let's all help each other: John, you help Paul; Paul, you help George; George, you help Ringo; Ringo, you help me; and I'll help John.

Or consider another nonmaximality canceller: *without exception*. In a non-reciprocal sentence like (34), the effect of *without exception* is obvious: it explicitly cancels the possibility of a nonmaximal interpretation. There were no non-sandwich-eating boys.

(34)   The boys ate a sandwich, without exception.

However, *without exception*'s nonmaximality canceling does not transfer straightforwardly to reciprocal sentences. If the WR interpretation of a reciprocal sentence like (35a) were due to nonmaximality, then we would expect that the presence of *without exception* would serve to enforce the SR interpretation. But this is not the case. Rather, (35b) tends to be interpreted in one of two ways, neither of which requires SR. One interpretation is that all the boys took part in the activity of tickling others of the boys (there were no non-tickling boys). The other interpretation is that on all relevant occasions, the boys took part in this activity. Crucially, neither interpretation requires that each boy tickle every other boy.

(35)   a. The boys tickled each other.
        b. The boys tickled each other, without exception.

The fact that the nonmaximality cancellers *without exception* and *all* fail to enforce the SR interpretation suggests that non-SR interpretations are not due to nonmaximality.

2.3.2   Typicality

Kerem et al. (2009) argue that the SMH needs to be modified to take typicality into account. On their view, when a sentence like (36) describes a WR scenario like (37), it is not a counterexample for the view that the strongest possible interpretation is selected. Rather, it is evidence that the SMH chooses the strongest possible interpretation that is consistent with typicality preferences.

(36)   A, B and C pointed at each other.

(37)   A points at B
        B points at C
        C points at A

Just as a concept like BIRD has instances that we categorize as more typical (sparrow) and less typical (emu) (Rosch 1975), Kerem et al. suggest that a concept like POINT AT has more typical and less typical instances. They assume that scenarios like (38) and (39) are ranked according to typicality: the scenario with one agent and one theme is a more typical instance of POINT AT than the scenario with two themes.

(38)   A points at B
        No one points at C

(39)   A points at B and C

Kerem et al. (2009) modify the MIH of Sabato & Winter (2005b, 2012) (§2.1.3 above) to use typicality information related to the predicate concept rather than logical restrictions. Their informal statement of the Maximal Typicality Hypothesis (MTH) appears in (40).

(40)   Maximal Typicality Hypothesis (MTH):
       A reciprocal expression requires the denotation of its predicate antecedent to be a relation of maximal typicality relative to the predicate concept

Their definition of what it is for a set of entities and a binary relation to exhibit reciprocity in the MTH system appears in (41). A set of entities A and a binary relation R (with typicality greater than zero) are said to exhibit reciprocity if it is impossible to add more pairs to the situation without decreasing typicality. When looking at relations restricted to A, the definition in (41) says that if R is a subset of or equal to some relation R', and the typicality of R is less than or equal to the typicality of R', then R and R' must be identical. That is, it is not possible for R to be a proper subset of any other relation with greater typicality. Any relation R' that has R as a proper subset is of lower typicality.

(41)   Maximal Typicality Hypothesis-based reciprocity[20]:
       Given a typicality function $\Theta^{cl}: \wp(E^2) \rightarrow [0,1)$, a set of entities $A \subseteq E$ and a binary relation $R \subseteq E^2$ such that $\Theta^{cl}(R\mid_A) > 0$ EXHIBIT RECIPROCITY with respect to Θ^{cl} if and only if the following holds:
       $\forall R' \subseteq E^2 : R \subseteq_A R' \land \Theta^{cl}(R\mid_A) \leq \Theta^{cl}(R'\mid_A) \Rightarrow R =_A R'$

Consider sentence (42). If it is the case that POINT AT has a typicality preference for a single theme per agent, then the WR scenario in (43) is of maximal typicality: adding pairs would decrease typicality. Note that according

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[20] $[0,1)$ = the values in the interval between 0 and 1 (i.e. typicality values). The subscript A is read 'restricted to A', and $R\mid_A$ = R restricted to A minus identities.

to (41), it is also the case that the SR scenario in (44) exhibits reciprocity and is maximally typical[21]. As long as the SR scenario has a typicality greater than zero, it is of maximal typicality because adding pairs is impossible and therefore it is trivially true that there is no way to add pairs to the situation without decreasing typicality.

(42)   A, B and C pointed at each other.

(43)   A points at B
        B points at C
        C points at A

(44)   A points at B+C
        B points at A+C
        C points at A+B

That is, both the WR scenario in (43) and the SR scenario in (44) exhibit reciprocity according to the definition in (41). The definition in (41) is concerned with ruling out impossible reciprocal interpretations. For instance, the scenario in (45) does not satisfy reciprocity because the pair <B,C> could be added without decreasing typicality.

(45)   A points at B
        B points at no one
        C points at A

    But the definition in (41) does choose an SR interpretation over a WR interpretation in the following case: that where the concept does not have a typicality preference for a single patient. For example, Kerem et al. provide

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[21] As Sabato & Winter (2012:230) explain, it is not of 'globally' maximal typicality (that would be the WR scenario, since POINT AT prefers a single patient per agent). But it is of 'locally' maximal typicality. According to Sabato & Winter (2012), the MTH only requires that a relation R be of locally maximal typicality (i.e., 'maximal typicality with respect to all other relations that contain R in the relevant domain' (2012:230)).

evidence that HUG is such a concept[22]. If so, the scenario in (46) fails to exhibit

reciprocity because it is possible to add pairs (<B,A>, <C,B>, <A,C>) without

decreasing typicality.

(46)　A hugs B
　　　　B hugs C
　　　　C hugs A

As we have seen, Kerem et al. (2009) hypothesize that we arrive at

typicality judgements for complex reciprocal scenarios by considering the

typicality judgements associated with simple single agent scenarios. If a

particular concept has as its most typical instance a single agent acting on a

single patient, then that preference will carry over to more complex reciprocal

scenarios, allowing scenarios where each of the multiple agents acts only on a

single patient to satisfy reciprocity. They predict that, for a given concept, there

should be a correlation between the typicality of the single patient scenario and

the availability of the WR interpretation.

Kerem et al. (2009) report the results of four experiments investigating this

hypothesis[23]. Two of the experiments investigated typicality preferences in single

agent scenarios; the others looked at preferences regarding WR interpretations of

reciprocal sentences. They gathered data on typicality preferences in single agent

scenarios in two ways: one experiment gave participants sentences (e.g. *The boy is*

hitting) with a forced choice between two pictures as 'descriptions of the sentence'

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[22] In their experiment 1, participants were given two pictures: one where A hugs B (and not C), and one where A hugs B and C. They chose the hug with two patients to illustrate a sentence like 'A is hugging' 68% of the time.

[23] The experiments were conducted in Modern Hebrew.

(boy hits two people; boy hits one person[24]), the other experiment provided participants with an incomplete transitive sentence and had them complete it by choosing between a singular and plural object. Table 5 shows a subset of the results of the sentence completion task: the predicates range from those that strongly prefer a plural object (perfective 'see') to those that strongly prefer a singular object ('stab').

eventive predicate	translation	perfective	imperfective
ro'e	'see'	25	63.3
maxmi	'compliment'	62	77.1
macbia	'point at'	81.3	72.9
doker	'stab'	95.8	86

stative predicate	translation	perfective
mefake'ax	'supervise'	10.4
somex al	'trust'	25
sone	'hate'	81.3
Soxe'ax	'forget'	95.8

Table 5: Percentage of singular objects selected in sentence completion task (Kerem et al. 2009 experiment 3)

The other two experiments investigated preferences concerning WR interpretations of reciprocal sentences. In one, participants were given a reciprocal sentence and had to chose between two drawings, one depicting SR and the other WR. In the other, they read a reciprocal sentence ('A, B and C stabbed each other') and answered a question ('Is it necessary to conclude that A stabbed B?[25]). Overall, these experiments found that preferences for WR depended on the choice of predicate. Participants chose the SR drawing 90% of

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[24] The picture included a second person that the boy did not hit.

[25] Answering 'yes' means that the participant has arrived at an SR interpretation; answering 'no' is consistent with the WR interpretation

the time in the case of 'hug', but only 35% of the time in the case of 'comb'. Table

6 shows a subset of the results of the question-answering experiment. It shows

the percentage of answers consistent with a WR interpretation. The predicates

ranged from those that overwhelmingly received SR interpretations ('see', 'trust')

to those where the preference for SR was less strong ('point at', 'hate').

eventive predicate	translation	perfective	imperfective
ro'e	'see'	0	4
maxmi	'compliment'	12	14.3
macbia	'point at'	25	12
doker	'stab'	16	31

stative predicate	translation	perfective
mefake'ax	'supervise'	13
somex al	'trust'	4
sone	'hate'	19
Soxe'ax	'forget'	4

Table 6: Percentage of answers consistent with WR interpretation (Kerem et al. 2009 experiment 4)

As mentioned earlier, Kerem et al. predict a correlation between a

predicate's preference for a single patient and its acceptability on the WR

interpretation. They analyzed the results of the two picture-based experiments

and found a strong positive correlation, but it was not significant. As for the two

text-based experiments (their experiments 3 and 4; see Table 5 and Table 6), they

found a significant positive correlation, but only for the eventive predicates.

They found no correlation for the stative predicates.

As can be seen in Table 6, overall, WR interpretations were dispreferred.

That is, it is not the case that a preference for a single patient translates to a

preference for WR over SR. Compare 'stab' in Table 5 and Table 6; even with an

overwhelming preference for a single patient, this predicate allows the WR

interpretation at most 31% of the time. Rather, the correlation is such that a typicality preference for a single patient is merely associated with increased acceptability of WR.

In modifying the SMH to take account of typicality preferences, Kerem et al. (2009) have proposed a solution to the problem that WR interpretations cause for the SMH. On their view, when a WR interpretation is preferred over a SR one, it is not a counterexample for the SMH, but rather evidence that the SMH can choose the strongest interpretation consistent with typicality. Their evidence of a correlation between typicality preferences (patient cardinality), and the acceptability of WR interpretations supports this view. What is left unexplained is the behaviour of stative predicates. Why should typicality be relevant only for eventives? We will return to the stative/eventive contrast in Chapter 4.

2.4   SMH and online comprehension

In §2.1 we saw four versions of the SMH, and §2.3.2 added Kerem et al.'s MTH. This section considers the question of whether we can use these semantic accounts to make predictions about online sentence comprehension.

As discussed in Chapter 1, I am assuming a serial model in which the language processor is guided by structural principles in building a single parse for a sentence (Frazier & Fodor 1978; Ferreira & Clifton 1986; Frazier 1990; Frazier & Clifton 1996). This model has been extended to LF parsing (Tunstall 1998; Frazier, Pacht & Rayner 1999; Anderson 2004). On this view, the processor by default builds the simplest possible structure. (This kind of model contrasts with parallel, constraint-based models, where the processor makes use of

multiple sources of information to build potentially many parses simultaneously.)

On the serial, structure-driven approach, predictions about online comprehension are closely tied to the particular grammatical representation that is assumed. Take the Minimal Semantic Commitment (MSC) hypothesis of Frazier & Rayner (1990) and Frazier et al. (1999). According to this hypothesis, the processor only makes semantic commitments when those commitments are invited (e.g. there is evidence or bias in the context that encourages a particular commitment) or when a commitment is grammatically necessary (as in the case of a choice between distinct (uncollapsible) grammatical representations). On this view, processing evidence can be used to weigh in on the question of whether a given semantic representation is ambiguous or vague. If the semantic representation is underspecified or vague, then absent misleading context or bias, the processor will not make a semantic commitment to a particular interpretation during online processing. If the semantic representation is ambiguous, the choice is grammatically necessary and the processor must commit to a representation. According to the MSC hypothesis, semantic garden-path effects (in neutral contexts that do not bias a particular interpretation) can be taken as evidence that the particular semantic contrast involves distinct grammatical representations.

For the most part, the researchers who have proposed SMH analyses do not discuss their implications for sentence processing[26]. In many cases, these researchers see the SMH as part of a verification procedure, but asking questions

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[26] Sabato (2006:32) mentions that computational considerations favour looking at a specific situation and asking whether pairs can be added while staying within the interpretation domain (vs. considering other arrangements)

about how the sentence processor fixes on an interpretation means thinking about the problem from the other direction: the task is to instantiate individuals and relations in the mental model of the discourse, not to determine whether a reciprocal sentence is true in a given scenario.

As mentioned in Chapter 1 (§1.4), there is some relevant work from a computational perspective by Syzmanik (2010) and Bott et al. (2011), but their focus is on sentences with certain proportional and counting quantifier antecedents. Gardent & Konrad (2000) propose a computational implementation of the SMH; their system is discussed below.

Since most SMH proposals do not consider sentence processing, the discussion in this section is by necessity speculative. Section 2.4.1 looks at Dalrymple et al. (1998). Section 2.4.2 considers Gardent & Konrad's (2000) implementation of the SMH, and §2.4.3 concerns the MIH/MTH of Kerem et al. (2009) and Sabato & Winter (2012). Section §2.4.4 looks at Dotlačil (2010). Finally, §2.4.5 considers the predictions that each of these approaches might make about the processing of sentences with the weakest reciprocal interpretation, the chain interpretation.

2.4.1   Dalrymple et al.'s SMH

Recall that in Dalrymple et al.'s system, *each other* has a single, context-sensitive meaning. It is a quantifier with parameters that are filled in by the context. The interaction of two parameters results in 6 possible reciprocal meanings, and the SMH selects the appropriate one in a given context.

Dalrymple et al. are careful to explain that *each other* is not ambiguous. Nevertheless, since in their system the SMH chooses among a finite set of

possible reciprocal meanings, and thus resembles an ambiguity account in some respects, at this juncture it seems worth discussing the difference between ambiguity and underspecification in the context of sentence processing.

Frazier & Rayner (1990) argue that selecting the meaning of an ambiguous word (*bank* 'financial institution' vs. 'river's edge') is a necessary decision point for the language processor, but selecting between different senses of a single word (*newspaper* 'reading material' vs. 'publishing organization') is not a necessary decision point[27]. According to their Minimal Semantic Commitment (MSC) hypothesis, in the absence of evidence favouring a particular commitment, only necessary decision points require the processor to make a semantic commitment. In the case of different senses of a single word, if there is no biasing evidence pointing towards a particular sense, the processor can leave it underspecified. But in the case of an ambiguous word this is not possible; one of the meanings must be chosen.

Dalrymple et al. argue against seeing the reciprocal as ambiguous in the same way as *bank* (1998:190); they say it has a single context sensitive meaning. On the one hand, this suggests that choosing the appropriate reciprocal quantifier will not be a necessary decision point. But on the other hand, Frazier, Pacht & Rayner (1999:89) suggest that points where a decision is not necessary are ones where the grammar remains silent: 'The grammar will simply contain no instruction about what can or must be done concerning the matter. No grammatical choice point will be defined'. This does not seem to fit well with

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[27] They found that delaying disambiguation interfered with processing the less frequent ambiguous word, but not the less frequent sense of a single word.

Dalrymple et al.'s view: after all, they propose the SMH as a necessary part of the system, which derives the literal meaning of an utterance:

> We claim that the SMH is a semantic principle determining the literal meaning of utterances of certain expressions in any context appropriate for the expression. As employed here, the SMH is not a pragmatic principle – for example, for listeners to use in divining which reading of an ambiguous expression a speaker might intend on a given occasion. It does not concern how the speaker's meaning can diverge from literal meaning of an utterance. (1998:197)

But note that Frazier, Pacht & Rayner (1999) are talking about the grammar; it is unclear whether the Dalrymple et al.'s SMH should be considered a part of the grammar. They describe it as a semantic principle (1998:197), but it is not entirely clear whether such principles should be considered part of the grammar.

According to the SMH, in (47), the reciprocal is combined with its antecedent and scope, as well as relevant contextual information, resulting in a set of propositions. If they are in an appropriate entailment relation, the sentence is interpreted as the logically strongest proposition in the set.

(47)   Strongest Meaning Hypothesis (SMH):

> A reciprocal sentence S can be felicitously used in a context c, which supplies non-linguistic information I relevant to the reciprocal's interpretation, provided the set Sc has a member that entails every other one:
> $Sc = \{p \mid p$ is consistent with I and p is an interpretation of S obtained by interpreting the reciprocal as one of the six quantifiers…$\}$
> In that case, the use of S in c expresses the logically strongest proposition in Sc.

Let's assume that an SMH-like principle guides the language processor in fixing on an interpretation. In trying to translate Dalrymple et al.'s SMH account into a set of predictions about the task of the language processor, we need to

make some assumptions about the role of contextual information in this system. One might take the view that, absent relevant contextual information, this SMH-like principle cannot determine the logically strongest proposition and thus leaves the interpretation underspecified. But on the other hand, it seems plausible that comprehenders will fill in plausible values for contextual information when necessary.

Consider Dalrymple et al.'s discussion of example (48) (1998:194). After explaining how the relation *follow into the church* rules out various stronger reciprocal interpretations, they note that two possible interpretations remain: IAR (where the children entered as a single group, since IAR requires that each individual be related to every other individual directly or indirectly) and IAO (which allows more than one group to enter the church at the same time through different doors, since IAO only requires that each child follow or be followed by some other).

(48)   The children followed each other into the church.

Dalrymple et al. say of this example:

> In a situation where the context supplies the additional information that the children enter the church in multiple groups, IAO is the strongest possible meaning, and it is the one that is chosen. When the context does not supply this information, the stronger meaning IAR is chosen (1998:194)

Faced with a sentence like (48), a comprehender who is guided by an SMH-like principle might use plausibility and economy principles to posit a single entrance, and use that filled-in contextual assumption to derive the IAR interpretation.

It is not a simple matter to translate Dalrymple et al.'s SMH into a particular set of predictions about online sentence comprehension. Their system potentially allows for the reciprocal to remain underspecified, if the necessary contextual information is not supplied or assumed. That is, comprehenders need not make commitments to a particular construal. And an important feature of their system is that it allows (or requires) various kinds of linguistic and non-linguistic information to influence the interpretation. The question of how and when that information becomes accessible to the language processor is not one that I will address here.

Instead, I will discuss a toy version of Dalrymple et al.'s SMH, as translated into a prediction about sentence comprehension. This is the Online SMH hypothesis, in (49). I want to be very clear here: I am not claiming that the Online SMH hypothesis is the only way (or even a very good way) of translating Dalrymple et al.'s SMH into a principle of use to the sentence processor. In this toy version, the serial sentence processor starts with the strongest possible interpretation (SR) and shifts to the next weakest if that interpretation is impossible.

(49)   Online SMH hypothesis:

The SMH describes a process that occurs in online sentence comprehension. The processor applies the strongest reciprocal quantifier. If that conflicts with non-linguistic information, it applies the next strongest reciprocal quantifier.

According to the Online SMH hypothesis, processing a sentence where the non-linguistic information allows the strongest interpretation should be the least costly. The most costly would be the weakest interpretation.

One aspect of Dalrymple et al.'s system not addressed in §2.1.1 above is that the SMH involves calculating the meaning of the whole sentence, and in particular paying attention to polarity / monotonicity information. In downward entailing contexts, the strength ordering reverses. (The Online SMH hypothesis (49) would need to be modified to deal with this.) And in combination with some antecedents (non-monotone quantifiers, as in (50)) no proposition is stronger than any other, so the SMH does not choose one. (This leaves open the question of how people interpret these sentences[28].)

(50)   Exactly ten members of this club know each other[29].

2.4.2   Gardent & Konrad (2000)

Gardent & Konrad (2000) propose a computational implementation of the SMH. They argue that since Dalrymple et al.'s approach involves the SMH choosing among a set of possible reciprocal meanings it is problematic in computational terms; they suggest that there is no method of checking each of the possible readings for consistency that is guaranteed to always return a result. Instead, they propose that the reciprocal has a single, weak semantic representation equivalent to the weakest of Dalrymple et al.'s reciprocal meanings: IAO. In addition, they introduce a predicate $R that is true of assumptions that are

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[28] Dalrymple et al. (1998) agree with Kamp & Reyle (1993) that reciprocal sentences with non-monotone quantifiers do not have well defined truth conditions unless it is clear that only one 'cluster' of domain members satisfies the reciprocal. When it is clear that only one cluster satisfies the reciprocal, they argue that usual strength ordering is preserved (1998:206). Bott et al. (2011) provide some evidence regarding preferred interpretations of reciprocal sentences with non-monotone antecedents like 'exactly N'.

[29] Discussing this example, Kamp & Reyle (1993:466) point out that it is clearly true if there is a set of 10 club members, each of whom knows all the others, and the rest of the club members don't know anyone. It is clearly false if there is such a set, but with a cardinality different from 10. But intuitions are unclear if there are multiple clusters, or if there is no single cluster where SR holds.

considered costly (in this case, this corresponds to the pairs of individuals that are not in the relation). Putting these together, their representation of the meaning of *each other* is as in (51). Reciprocal sentences have the weakest reciprocal meaning (RCP_{IAO}) and every pair of distinct individuals in the antecedent that does not stand in the relation R is in the $R relation.

(51) $\lambda P \lambda R(RCP_{IAO}(P)(R) \land \forall x \forall y \ (P(x) \land P(y) \land x \neq y \land \neg R(x,y) \Leftrightarrow \$R(x,y)))$

Gardent & Konrad's version of the SMH is the Maximize Meaning Hypothesis (MMH).

(52)   <u>Maximize Meaning Hypothesis</u> (MMH):
The valid interpretations of a reciprocal sentence S in a context Γ (where Γ includes knowledge about the previous discourse, the discourse situation and the world) are those which (a) are consistent both with the IAO form of reciprocity and the information provided by Γ, and (b) whose contributions to the scope relation are the strongest.

Their system implements the MMH as a requirement for minimality: what is minimized is the number of pairs not in the relation (i.e. $R). Their model generator enumerates possible models consistent with contextual knowledge, and determines the $R cost for each. Once the lowest cost model is found, models with non-minimal cost are eliminated. Gardent & Konrad argue that this system never encounters undecidable logical problems. However, Winter (n.d.) points out that putting $R within the denotation of the reciprocal leads to problems with environments that are not upward monotone.

2.4.3 Maximal Interpretation (and Typicality) Hypotheses

As we saw in §2.4.1, the SMH of Dalrymple et al. requires a sentence-level calculation of which quantifier results in the strongest proposition. In Sabato & Winter's (2012) Maximal Interpretation Hypothesis (MIH) system, the calculations all occur at the level of the predicate[30]. Reciprocal interpretations are derived directly from the logical restrictions on the predicate.

There is nothing about Sabato & Winter's system that suggests or requires that the language processor make semantic commitments regarding reciprocal interpretations during online sentence comprehension. Since it is not an ambiguity account, according to the MSC hypothesis, we should in fact expect the processor need not make these commitments during immediate processing.

Sabato & Winter's (2012) and Kerem et al.'s (2009) discussion is generally phrased in terms of the task of verifying whether a reciprocal sentence is true in a given context. Their statements of the MIH/MTH have it that a reciprocal sentence is true in a context if it is not possible to add another pair of individuals to the relation (to which the MTH adds: 'without decreasing typicality'). Consider the sentences in (53). Kerem et al. assume that with 'know', typicality increases or remains constant when adding more pairs to the relation[31]. Because it is possible to add pairs to the scenario in (54) without decreasing typicality, the individuals and relations in this scenario do not exhibit reciprocity. In contrast,

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[30] They disagree with the sentential strategy of Dalrymple et al. (1998). When it comes to DE environments, they argue that there are confounding factors at work in Dalrymple et al.'s examples.

[31] Although they make this assumption, their experiments found that the relationship between typicality and reciprocal interpretations did not work as expected with statives like 'know'.

with 'point at', typicality would decrease if pairs were added to the scenario in (54). Therefore the individuals and relations do exhibit reciprocity.

(53)   a. The kids knew each other.
       b. The kids pointed at each other.

(54)   <A,B>
       <B,C>
       <C,A>

As for the question of how the sentence processor fixes on an interpretation of sentences like those in (53), it is unclear what the MIH/MTH should lead us to expect.

Given that the MIH/MTH is not an ambiguity account, according to the MSC hypothesis, in the absence of bias or evidence in the context favouring a particular interpretation, we should not expect that semantic commitments to particular reciprocal meanings are obligatory during immediate processing. ('Semantic commitments' here might broadly be understood to include positing certain relations between individuals in the mental model.) But one of the interesting features of the MIH/MTH account is the degree to which the reciprocal interpretation is available just by virtue of the meaning of the predicate. Recall that according to the MSC hypothesis, the processor may make semantic commitments that are invited by evidence or bias in the context. We might see the choice of predicate as inviting certain semantic commitments. In which case, we might expect commitments to particular reciprocal interpretations during online comprehension, potentially as early as during processing of the predicate. (So, potentially earlier than in the SMH system of Dalrymple et al., which requires computation of the meaning of the whole

sentence.) If we were to see online reflexes of the MIH, we would make different predictions from the Online SMH hypothesis discussed above: since the reciprocal interpretation is derived directly from the semantic restrictions on the predicate, the processor need never consider and discard stronger interpretations than are allowed given those semantic restrictions. The prediction is that – as long as information about the semantic restrictions on the predicate is available for free – there should be no difference in processing cost between the various reciprocal interpretations.

(55)   <u>Online MIH hypothesis:</u>

The MIH describes a process that occurs in online comprehension. The processor derives a reciprocal interpretation directly from the semantic restrictions on the predicate.

2.4.4   Dotlačil's SMH

In Dotlačil's system, most reciprocal interpretations arise from a single, cumulative semantic representation. The SMH selects the branching (i.e. SR) interpretation over the cumulative (e.g. WR) when possible.

Given that this is not an ambiguity account, the MSC hypothesis would suggest that fixing on a particular reciprocal interpretation is not a necessary decision. In the absence of evidence in the context pointing towards a particular interpretation, the processor need not make a semantic commitment.

On the other hand, the cumulative semantic analysis that Dotlačil assumes raises questions for the MSC. In particular, note that Dotlačil's account assumes that reciprocals and plural sentences alike are associated with cumulative semantic representations. Frazier, Pacht & Rayner (1999) argue that the

collective/distributive distinction is one based on structural ambiguity. They provide evidence that the processor commits by default to the collective interpretation. According to the MSC, the processor only makes necessary or invited commitments. If there is nothing in the context that invites the collective interpretation, but the processor nonetheless makes this commitment, collective/distributive must be a necessary decision: it must be structural ambiguity. But Dotlačil assumes that a sentence like (56a) has a cumulative semantic representation along the lines of (56b) that can give rise to a variety of interpretations; it allows a collective interpretation (Sam and Ben together make a single phone call to the girls) as well as non-collective interpretations (e.g. Sam calls Amy and Bella, and Ben does likewise)[32]. If the processor commits to the collective interpretation in (56a) over a non-collective one, this is not due to structural ambiguity in Dotlačil's system.

(56) a. Sam and Ben called Amy and Bella.
      b. $(\exists e)(*call(e) \wedge {}^{C}*\Theta_1(Sam+Ben)(e) \wedge {}^{C}*\Theta_2(Amy+Bella)(e))$

We have evidence that the processor makes a commitment to a collective interpretation during online comprehension of sentences like (56a) (Frazier, Pacht & Rayner 1999; Frazier & Clifton 2001; Brasoveanu & Dotlačil 2012). If collective/distributive is not a structural ambiguity, the MSC cannot explain the commitment to the collective interpretation[33].

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[32] Distributive readings with covariation, where one argument scopes over the other (i.e. subject distributive, object distributive) do require a phrasal *-operator; the presence or absence of the *-operator is thus a matter of structural ambiguity. This is discussed further in Chapter 4.

[33] There are complications here to do with assumptions about phrasal cumulativity. Chapter 4 returns to this issue.

Dotlačil's account differs from Dalrymple et al.'s SMH and from the MIH/MTH in excluding chain interpretations from the productive reciprocal semantics. The SMH only chooses between SR and WR; weaker interpretations arise from what Dotlačil speculates is a lexical process.

2.4.5 Predictions about chain interpretations

Reciprocal interpretations range from strong (SR) to the very weakest, which I call the chain interpretation, as in (57)[34]. This section considers whether different accounts might make different predictions when it comes to the online processing of the weakest interpretations.

(57)   The chairs are stacked on top of each other.

First, let's consider the predictions of the Online SMH hypothesis. If the processor starts with the reciprocal quantifier that leads to the strongest interpretation (SR), and works down the list rejecting impossible interpretations, this suggests that the chain interpretation (because it is the weakest interpretation and requires the greatest number of rejected interpretations) will be associated with the most difficulty[35].

The Online MIH predicts no such difficulty. On this account, interpretations that are outside of the relation's domain of interpretation are not even considered. The kinds of predicates that receive chain interpretations are asymmetric and acyclic – as long as the processor can access this information at

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[34] In Dalrymple et al.'s nomenclature this is IAR/IAO.

[35] This prediction does not hold for DE environments, where the strength ordering reverses.

no cost, there is no difference predicted between different types of predicates and different reciprocal interpretations.

Another possibility is that Dalrymple et al.'s SMH, and the MIH/MTH, describe processes that are not computed during online processing. In which case, no difference is predicted between chain interpretations and other reciprocal interpretations during online processing.

For Dotlačil (2010), the chain interpretation is not one of the interpretations that the SMH is choosing between. Instead, it arises through a separate, lexical process. Other instances of the reciprocal are interpreted using the ordinary productive semantics, but chain interpretations are not. So the reciprocal can be seen as involving a lexical ambiguity: productive vs. limited to certain predicates/relations. We might expect that this would be a necessary decision point (Frazier & Rayner 1990). But we cannot look for evidence of a garden path effect because by the time the processor hits the reciprocal, the predicate has presumably already narrowed it down to the lexical interpretation[36]. It is possible that *each other* might have a preferred interpretation (presumably the productive one), and it is possible that the lexical process that results in arriving at the chain interpretation is not immediate. From this perspective, either no difference is predicted between chain and other reciprocal interpretations, or if there is a difference, chain interpretations may be associated with some difficulty.

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[36] This is most clearly true if the idea is that there is a finite list of predicates that receive chain interpretations (Beck 2001 seems to suggest this). Chapter 3 discusses the possibility of chain interpretations with predicates that are not asymmetric. In such cases, the predicates are open to other reciprocal interpretations too.

2.5 Experiment 2: Chain/nonchain experiment

2.5.1 Method

Materials and design   The experimental items consisted of 14 items like (58). The A and B conditions contained an unconstrained eventive predicate (that is, a predicate that allows SR); the C and D conditions had a chain predicate. This is a 2x2 design, with predicate type (chain/non-chain) and reciprocal (+reciprocal *each other*, -reciprocal DP) as factors. The complete list of items appears in the Appendix.

(58)   a/b. When the manuscript was printed out, the editors teased {a. each
             other / b. the intern} about the spelling errors.
        c/d. When the bell rang, the biologists followed {c. each other / d. the
             speaker} into the auditorium for the lecture.

As (58) illustrates, the A and B conditions contained entirely different lexical material from the C and D conditions. This is not an optimal design, but plausibility and other considerations made it necessary. (For instance, a number of the chain predicates used in the experiment prefer inanimate subjects and are stative – matching lexical material with the unconstrained eventive predicates proved impossible.) The idea behind this design is that the DP condition acts as a control for the reciprocal of the same predicate type.

Each item began with a temporal adverbial, which was meant to encourage a 'point' interpretation. The subject of the sentence was a definite plural DP. The predicates differed greatly in length. (Many of the chain predicates were complex, e.g. *be stacked on top of*, while all but one of the nonchain predicates consisted of a single verb).

The experimental items were arranged in two lists, with two versions of each item appearing on each list. For example, list 1 had A and D, and list 2 had B and C for item 1. Because they saw two versions of each of the 14 items, participants saw a total of 28 experimental trials. There were 72 filler items. The 100 trials were presented in an individually randomized order, following 8 practice items at the beginning of the experiment. Each predicate was used in two items. Participants thus saw each predicate twice, once with *each other* and once with a DP. (Other parts of the sentences were entirely different.)

Participants   Twenty eight members of the University of Massachusetts community were paid for participating in the experiment, or took part for course credit. All were native speakers of English and had normal or corrected-to-normal vision.

Apparatus   Eye movements were recorded by an Eyelink 1000 eyetracker. Viewing was binocular, but only the right eye was monitored. Stimuli were presented on a 17-inch Viewsonic monitor. Participants were seated 60 cm from the monitor; 3.2 characters equaled 1° of visual angle. The experimental items were displayed on a single line.

Procedure   Participants were tested individually. On arrival at the laboratory they read instructions, and then went through a calibration process. The accuracy of the calibration was checked after each sentence. Participants were instructed to read at a normal rate, for comprehension. When they finished reading a sentence, they pressed a button to remove it from the screen. The experiment took approximately 30 minutes.

2.5.2 Results

The experimental sentences were divided into 5 analysis regions, as shown in (59), with "|" marking the region boundaries. The first region is the adverbial, the second region is the subject and the third region is the predicate. The fourth region consists of *each other*/DP plus the following one to four words[37]. The fifth region is the sentence final region.

(59)   a. When the manuscript was printed out, | the editors | teased | each other about the spelling | errors. |
        b. When the manuscript was printed out, | the editors | teased | the intern about the spelling | errors. |
        c. When the bell rang, | the biologists | followed | each other into the auditorium | for the lecture. |
        d. When the bell rang, | the biologists | followed | the speaker into the auditorium | for the lecture. |

Trials on which there was a track loss were excluded from the analysis (less than 3% of all trials). When a fixation of less than 80ms was within one character of the neighboring fixation, it was incorporated into that neighboring fixation. Otherwise, fixations of less than 80ms were deleted, on the assumption that readers do not extract useful information from such short fixations (Rayner & Pollatsek 1989). Trials with fixations of longer than 800ms were excluded from analysis, on the assumption that such long fixations are likely to reflect track losses.

The results of Experiment 2 appear in Table 7.

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[37] As much as practical, the spillover region extended until the next content word.

Measure	R1 (*Adv*)	R2 (*DP*)	R3 (*verb*)	R4 (*eo/DP + spillover*)	R5 (*final.*)
First Pass Time					
Nonchain reciprocal	**819** (40)	**338** (14)	**319** (10)	**784** (38)	**547** (31)
Nonchain DP	**831** (34)	**339** (17)	**337** (18)	**764** (37)	**513** (33)
Chain reciprocal	**678** (31)	**357** (21)	**518** (25)	**750** (29)	**608** (33)
Chain DP	**676** (31)	**357** (16)	**523** (22)	**718** (31)	**615** (33)
Total Time					
Nonchain reciprocal	**936** (51)	**411** (24)	**391** (15)	**959** (39)	**648** (39)
Nonchain DP	**929** (42)	**400** (22)	**428** (24)	**1034** (44)	**603** (32)
Chain reciprocal	**763** (39)	**407** (25)	**587** (28)	**868** (38)	**700** (39)
Chain DP	**765** (41)	**413** (23)	**614** (28)	**869** (42)	**669** (37)
Go-Past Time					
Nonchain reciprocal	**861** (45)	**372** (20)	**361** (16)	**898** (34)	**889** (78)
Nonchain DP	**872** (38)	**350** (18)	**380** (19)	**988** (47)	**851** (66)
Chain reciprocal	**693** (34)	**383** (21)	**567** (25)	**828** (35)	**837** (35)
Chain DP	**692** (37)	**384** (18)	**579** (28)	**844** (37)	**835** (68)
Second Pass Time					
Nonchain reciprocal	**80** (24)	**55** (10)	**52** (9)	**103** (20)	**2** (1)
Nonchain DP	**88** (24)	**56** (10)	**73** (14)	**121** (22)	**0** (0)
Chain reciprocal	**70** (15)	**36** (9)	**40** (9)	**68** (14)	**5** (5)
Chain DP	**77** (21)	**45** (11)	**56** (11)	**73** (20)	**5** (3)
Regressions Out					
Nonchain reciprocal	**0**	**3.0** (1.3)	**8.2** (1.8)	**10.8** (2.4)	**25.8** (4.3)
Nonchain DP	**0**	**2.0** (0.9)	**6.0** (1.4)	**15.3** (2.3)	**27.9** (4.0)
Chain reciprocal	**0**	**4 .0** (1.2)	**7.1** (2.4)	**8.8** (1.9)	**17.1** (2.8)
Chain DP	**0**	**4.3** (1.3)	**7.4** (2.0)	**10.6** (2.1)	**17.9** (4.0)

Table 7: Experiment 2, participant mean reading times, in milliseconds. (Standard error of the mean in parentheses)

As a way of compensating for the region length differences between conditions, a deviation from regression analysis was computed. The reading times in Table 8 are in terms of deviations from the reading time expected based on the best linear fit between reading time and region length (Ferreira & Clifton 1986).

Measure	R1 (*Adv*)	R2 (*DP*)	R3 (*verb*)	R4 (*eo/DP + spillover*)	R5 (*final.*)
First Pass (DR)					
Nonchain reciprocal	-71	-43	-9	44	-56
Nonchain DP	-59	-41	11	5	-91
Chain reciprocal	-27	-5	52	10	-2
Chain DP	-30	-8	55	-23	3
Total Time (DR)					
Nonchain reciprocal	-99	-43	-1	104	-59
Nonchain DP	-92	-52	38	159	-104
Chain reciprocal	-53	-25	40	11	-12
Chain DP	-50	-23	63	14	-43

Table 8: Experiment 2, participant reading times (deviation from regression)

I will begin by discussing the three measures from Table 7 for which a deviation from regressions analysis was not calculated: go-past time, second pass time, and regressions out. As expected, there are significant main effects of predicate type on each of the measures, since the chain and non-chain conditions contained entirely different lexical material. Given that in the case of these measures there is no attempt to control for length differences, I will ignore effects of predicate type in the discussion of these three measures.

Go-past time is the sum of all fixations from the first fixation in the region until the eyes move out of the region, to the right. It includes time spent re-reading previous regions, and re-reading the region itself. Second pass time is

the sum of all fixations in the region after the initial first pass. Regressions out is the probability of regressing out of the region during the first pass.

Apart from the aforementioned main effects of predicate type, there were no significant effects in Region 1 or Region 2. In Region 3, second pass times showed a marginal main effect of reciprocal ($F_1(27)=3.23$, $p=.083$; F_2 not significant). The pattern was that sentences with *each other* in Region 4 had lower second pass times in Region 3, but simple effects tests found nothing significant.

In Region 4, the region containing *each other*/DP plus spillover, go-past times showed both a main effect of predicate type ($F_1(27)=20.73$, $p<.001$; F_2 not significant) and a close to significant interaction ($F_1(27)=4.09$, $p=.053$; F_2 not significant). For non-chain predicates, the presence of DP is associated with a longer go-past time in Region 4 ($t_1(27)=2.12$, $p=.043$), but for chain predicates, there is no significant difference between reciprocal and non-reciprocal ($t_1(27)=.46$, $p=.65$). It is likely that this marginal interaction is attributable to the different lexical material in the two conditions[1]. Unfortunately, the lexical items in Region 4 were not matched for frequency or plausibility. In fact, the mean frequency of the nouns[2] in the chain condition was numerically higher (55) than the non-chain (27) (Kucera and Francis frequency). The chain condition had a larger range (from 0 to 204) whereas all the nouns in the non-chain condition were below 86. And although there appears to be a numerical interaction in the regressions out data from Region 4, there were no significant effects.

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[1] An alternative view might have it that *each other* is read faster than DP in the non-chain condition (and that this can be taken as a baseline), but in the chain condition *each other's* advantage disappears and that this can be interpreted as difficulty associated with the chain interpretation. But I found no other evidence supporting this interpretation.

[2] i.e. the DP's noun

The rest of the discussion in this section is based on the deviation from regression analysis. Even with the deviation from regression analysis attempting to compensate for length differences, effects of predicate type are not unexpected, given that the chain and non-chain conditions contained entirely distinct lexical material. And indeed, 2 way repeated measures ANOVAs found main effects of predicate type in each of the five regions. In the discussion below I will describe all of the significant effects, but most are main effects of predicate type. Main effects of reciprocal were found in Region 3 and Region 5. There were no significant interactions in the deviation from regressions analysis.

In Region 1, there were main effects of predicate type on first pass time and total time. Non-chain sentences had lower first pass time ($F_1(27)=16.11$, $p<.001$; F_2 not significant) and lower total time ($F_1(27)=5.05$, $p=.033$; F_2 not significant). Simple effects tests show that for first pass time, this was significant for reciprocal ($t_1(27)=2.15$, $p=.041$) and marginal for non-reciprocal ($t_1(27)=1.78$, $p=.086$). As for total time, simple effects tests found only a very marginal effect for reciprocal ($t_1(27)=1.72$, $p=.098$).

Likewise, in Region 2 there was a main effect of predicate type on first pass time, with faster reading times in this region for non-chain sentences ($F_1(27)=16.04$, $p<.001$; $F_2(13)=2.88$, $p=.11$). This was significant for both reciprocal ($t_1(27)=2.90$, $p<.01$) and non-reciprocal ($t_1(27)=2.56$, $p=.016$). There were no significant differences on total time for this region.

In Region 3, we see the first sign of another kind of main effect: there was a main effect of reciprocal on total time in this region ($F_1(27)=5.57$, $p=.026$; F_2 not significant). Only the total time measure showed this main effect of reciprocal;

there was no first pass time effect. Numerically, the pattern is that the presence of a reciprocal in the following region (Region 4) is associated with a lower total time in Region 3. Simple effects tests found only that this was marginally significant for non-chain sentences ($t_1(27)=1.98$, $p=.059$). The rest of the significant effects in Region 3 were of predicate type. There was a main effect of predicate type on first pass time, with faster reading times for non-chain sentences ($F_1(27)=18.31$, $p<.001$, $F_2(13)=6.28$, $p=.026$; this was significant for both reciprocal ($t_1(27)=3.48$, $p=.002$; $t_2(13)=2.43$, $p=.030$) and non-reciprocal ($t_1(27)=2.53$, $p=.017$; $t_2(13)=2.02$, $p=.065$)). And there was a main effect of predicate type on total time in this region ($F_1(27)=4.85$, $p=.036$; F_2 not significant), with simple effects tests revealing a significant effect of predicate type for reciprocal sentences ($t_1(27)=2.20$, $p=.037$): non-chain sentences had lower total time in this region than chain.

In Region 4, the region containing *each other* / DP plus spillover, again the only significant effects were of predicate type. There were no significant differences on first pass time in this region. There was a main effect of predicate type on total time, with chain sentences associated with lower total time on this region ($F_1(27)=17.61$, $p<.001$; F_2 not significant). Simple effects tests found that this was significant for both reciprocals ($t_1(27)=2.99$, $p=.006$) and non-reciprocals ($t_1(27)=3.62$, $p=.001$). There was no sign of the interaction that we saw with respect to go-past times in the non-deviation from regression analysis.

In Region 5, we see a marginal main effect of reciprocal ($F_1(27)=4.07$, $p=.054$; F_2 not significant) on total time. The pattern is that the presence of a reciprocal in Region 4 is associated with longer total time in Region 5. However,

simple effects tests found no significant differences (p's>.3). In addition, there were main effects of predicate type on first pass time (F_1(27)=15.85, p<.001; F_2 not significant) and total time (F_1(27)=6.49, p=.017; F_2(13)=8.86, p=.011), with faster reading times for non-chain sentences. For first pass time, this was significant for non-reciprocal (t_1(27)=2.88, p=.008) and marginal for reciprocal (t_1(27)=1.76, p=.09). For total time, simple effects tests found nothing significant.

2.5.3   Discussion

2.5.3.1   *No difference between chain and non-chain reciprocals*

Experiment 2 found no clear evidence of any difference between chain and non-chain reciprocal sentences during online processing. A difference between the two would be expected to show up as an interaction between predicate type (chain/non-chain) and reciprocal (+reciprocal *each other* / -reciprocal DP).

For the most part, significant effects were of predicate type, and attributable to differences in length/lexical material between the chain and non-chain conditions. There were main effects of reciprocal in Regions 3 and 5, but no interactions.

The only close to significant interaction between predicate type and reciprocal was found with respect to go-past times in Region 4 in the non-deviation from regression analysis. The pattern was that in the non-chain condition, the non-reciprocal (DP) condition had higher go-past times in Region 4 than the reciprocal. In contrast, in the chain condition, go-past times were similar for the reciprocal and DP. As mentioned above, the interaction is likely to

be attributable to frequency and plausibility differences between the DPs in the chain and non-chain conditions.

A number of the hypotheses discussed in §2.4.5 predict no difference in online processing of chain and non-chain reciprocals. But two do predict a difference. First, the Online SMH hypothesis assumes that the processor starts with the reciprocal quantifier that leads to the strongest interpretation and works down the list rejecting impossible interpretations. This hypothesis predicts that the chain interpretation, the weakest interpretation, will be associated with the most difficulty[3]. Second, if the chain interpretation arises through a lexical process (as suggested by Dotlačil 2010), and if the productive reciprocal interpretation is preferred, we might predict difficulty in the case of the chain interpretation. Experiment 2 found no support for either of these hypotheses.

2.5.3.2   *The time course of processing reciprocals*

For the most part, the experiment found only marginally significant effects of reciprocal. Nevertheless, the results provide some interesting hints regarding the online processing of reciprocal sentences.

In Region 4, the region containing the reciprocal (or DP), there were no significant differences between reciprocal and non-reciprocal sentences, apart from the close to significant interaction on the go-past measure[4].

There was a difference between reciprocal and non-reciprocal sentences in the previous (predicate) region. Recall that there was a main effect of reciprocal

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[3] This excludes downward–entailing contexts, as mentioned in §2.4.1.

[4] As mentioned above, this is likely due to frequency / plausibility differences between the DPs in the chain and non-chain conditions.

on total reading time in Region 3, with reciprocal non-chain sentences having lower total times in Region 3 than their non-reciprocal counterparts. Numerically, chain sentences showed the same pattern: a reciprocal in Region 4 is associated with a lower total time in Region 3. (The same pattern occurs with second pass time in the non-deviation from regressions analysis, where there was a marginal main effect of reciprocal.) The total time and 2nd pass time results together suggest that there is more rereading of region 3 when region 4 contains a non-reciprocal DP.

Given the fact that the possible interpretations of the reciprocal depend almost entirely on the particular predicate involved, one might have expected that interpreting the reciprocal would be associated with more rereading of the predicate region. But what we see is the very opposite. One way of understanding this is to consider the fact that the non-reciprocal DP, as opposed to the reciprocal, involves the introduction of a new discourse referent. In this sense, the non-reciprocal is more complex and thus might require more rereading of the previous region.

Neither Region 3 nor Region 4 show any sign of processing difficulty for the reciprocal. But in Region 5, the sentence final region, there was a (marginal) main effect of reciprocal on total time. Though simple effects tests found nothing significant, numerically the pattern is that reciprocal sentences have longer total times in this region. That is, there is what looks like a sentence wrap-up effect associated with reciprocals (Just & Carpenter 1980).

2.6 Conclusion

This chapter presented the results of two eye movement studies which looked for and did not find evidence of SMH-like principles at work in online sentence processing. It is important to note that these experiments were testing very simple hypotheses: e.g. that the processor commits to SR by default. The null results of the experiments are informative insofar as they suggest that the processor does not make use of a default strong interpretation. These null results fit with previous studies (Philip 2000; Kerem et al. 2009; Dotlačil 2009) that have found evidence that language users do not commit to the strongest possible interpretation of reciprocal sentences.

The null result of Experiment 2 is interesting in the context of accounts like Beck (2001) and Dotlačil (2010) which treat the very weakest reciprocal interpretation (the chain interpretation) as a lexical phenomenon, distinct from the productive reciprocal/plural system. The experiment did not find evidence that the processor treats chain and non-chain reciprocal sentences differently.

We saw Kerem et al.'s (2009) modification of the SMH to include typicality preferences. Their Maximal Typicality Hypothesis (MTH) predicts that a reciprocal sentence can truthfully describe a scenario weaker than the strongest possible interpretation if that stronger interpretation would be associated with decreased typicality. Kerem et al. provide evidence of a correlation between typicality preferences concerning patient cardinality, and the acceptability of WR interpretations. But this correlation only held for eventive predicates, not statives.

In conclusion, the null results of the eye movement studies discussed in this chapter suggest that the processor does not by default make a commitment

to an SR interpretation. These results are not informative on the question of whether more sophisticated versions of SMH-like principles might guide comprehenders in the task of interpreting reciprocal sentences.

The rest of the dissertation takes a different approach to the question of whether an SMH-like principle guides the sentence processor to a construal of reciprocal sentences. It begins with the assumption that there is no SMH, and looks at whether SMH effects can be accounted for with other principles or preferences.

CHAPTER 3

NO WEAKER THAN WEAK RECIPROCITY

As we saw in the previous chapter, most contemporary accounts of the semantics of reciprocals subscribe to some version of the SMH. Is it possible to account for the range of reciprocal interpretations without the SMH? This is the question addressed by the rest of the dissertation.

I start with the assumption that all reciprocal interpretations arise from a cumulative semantic representation equivalent to WR (Dotlačil 2010). There are two issues for such an analysis: how to account for interpretations stronger than WR, and how to account for those weaker than WR. While Chapter 4 will look at stronger interpretations, the focus of the current chapter is on weaker interpretations. In particular, this chapter focuses on chain interpretations.

Chain interpretations of reciprocal sentences (e.g. *The tables are stacked on top of each other*) are a puzzle that researchers have dealt with in different ways. Some (e.g. Beck 2001, Dotlačil 2010) conclude that this use of the reciprocal is not a productive part of the system, and exclude it from their analyses. But others – notably Dalrymple et al. (1998) and Sabato & Winter (2012) – see the selection of the chain interpretation as an ordinary part of the system. Dalrymple et al.'s SMH, and Sabato & Winter's MIH, select this, the weakest reciprocal meaning, when no stronger reading is possible.

There are arguments in the literature against the kind of approach espoused by Dalrymple et al. and Sabato & Winter. For instance, Dalrymple et al. (1998:196) themselves note that their account overpredicts the availability of the

chain interpretation (e.g. it wrongly predicts a chain interpretation should be available for comparatives like #*Amy and Ben are taller than each other*.) Another line of argument notes that the truth conditions for chain reciprocals proposed by Dalrymple et al. and Sabato & Winter are even weaker than the cumulative reading of plural sentences. For researchers such as Beck and Dotlačil who hold that reciprocal sentences are a subtype of plural sentence, a weaker reading than cumulative should not be possible.

This chapter presents a novel argument against the SMH/MIH approaches of Dalrymple et al. (1998) and Sabato & Winter (2012), in particular against the notion that the reciprocal is ever associated with truth conditions weaker than WR. The key evidence comes from reciprocal sentences with antecedents denoting two individuals. It is argued that variability in acceptability judgements of such sentences is impossible to explain on the accounts of Dalrymple et al. and Sabato & Winter. The variable acceptability of such sentences argues against this interpretation being an ordinary part of the reciprocal system, as those accounts suggest. In contrast, the variability has an explanation if the chain interpretation arises through pragmatic weakening from a WR semantic representation.

Section 3.1 looks at the literature on the cumulative/WR semantic analysis and the evidence for weaker readings than WR. Section 3.2 looks at previous accounts of the chain interpretation, and sketches an account that derives this interpretation from a WR semantic representation. Section 3.3 uses the evidence from sentences with antecedents denoting two individuals to argue for the WR approach, and against analyses that assign weaker-than-WR reciprocal meanings. Section 3.4 looks at how the chain interpretation arises from the WR semantic

representation. Section 3.5 addresses the question of why chain interpretations are sometimes rejected. It suggests a Gricean account might explain some of the variability in acceptability judgements. Comparisons are made with the account of Mari (2014). And in §3.6, the question of whether the chain interpretation is truly a productive part of the system is addressed.

3.1 WR semantics, and readings weaker than WR

3.1.1 The cumulative/WR semantic representation

Langendoen (1978) introduced Weak Reciprocity, defined in (1), as a possible interpretation of reciprocal sentences.

(1) $\forall x \in A \; \exists y,z \in A \; (x \neq y \wedge x \neq z \wedge xRy \wedge zRx)$

Langendoen pointed out the parallels between 'elementary relational plural sentences' like (2a) and 'elementary reciprocal sentences' like (2b). Both are open to a strong reading with universal quantification (Every girl tickled every boy; Every girl tickled every other girl) and a weak one with existential quantification (Every girl tickled some boy; Every girl tickled some other girl and was tickled by some other girl).

(2)   a. The girls tickled the boys.
       b. The girls tickled each other.

Sternefeld (1998) showed that a cumulative semantics provides the tools necessary to capture Langendoen's generalization. Sternefeld argues that cumulation is responsible for WR readings of reciprocal sentences. On this view, the weak (i.e. cumulative/WR) readings of both kinds of sentences in (2) are as in

85

(3) – the only difference is that the reciprocal (3b) involves an anaphoric relation and a non-identity statement.

(3)   a. <Girls, Boys> ∈ **λyλx[x tickles y]
        b. <Girls, Girls> ∈ **λyλx[x tickles y & x ≠ y]

Getting this kind of analysis to work compositionally is another matter. Sternefeld and others since (notably Sauerland (1998), Beck (2001) and Dotlačil (2010)) have offered different ways of implementing it. While the specifics of Sternefeld's analysis have been challenged, the main idea – that cumulativity is behind weak readings of both reciprocal and plural sentences – has proven to be a fruitful one.

Beck (2001) argues that reciprocal sentences are semantically ambiguous, with four distinct LF representations: SR, collective, WR and situation-based WR. The WR and situation-based WR representations involve cumulative operators. Even though in principle a cumulative (WR) LF would be compatible with a range of interpretations (for instance, SR), in Beck's system it is only responsible for the WR interpretation.

In contrast to Beck's ambiguity account, Dotlačil (2010) proposes a single equivalent to WR. This single representation is argued to give rise to all reciprocal interpretations (except chain interpretations[1]). Dotlačil represents a sentence like (4a) as in (4b)[2].

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[1] As mentioned previously, Dotlačil (2010) and Beck (2001) both exclude chain interpretations from their analyses.

[2] Recall that Dotlačil uses square brackets to covey another cumulative operator.

(4)   a. Carl, Dan and Fern photographed each other.
       b. $(\exists e)(*\text{photograph}(e) \wedge \langle c+d+f, c+d+f, e\rangle \in [\{\langle a, b, e'\rangle:$
       $^{C}*\Theta_1(a)(e')\wedge^{C}*\Theta_2(b)(e')\wedge e'\leq e \wedge \neg a \circ b\}])$

This is true if Carl, Dan and Fern and an event *e* can be split into parts that are in

the set $\{\langle a, b, e'\rangle: {}^{C}*\Theta_1(a)(e')\wedge^{C}*\Theta_2(b)(e')\wedge e'\leq e \wedge \neg a \circ b\}$. As usual with a

cumulative representation, there are many equally valid ways of satisfying this

requirement:

(5)   a. $\langle c, d, e1\rangle$; $\langle d, f, e2\rangle$; $\langle f, c, e3\rangle$
       b. $\langle d+f, c, e1\rangle$; $\langle c, d, e2\rangle$; $\langle c, f, e3\rangle$
       c. $\langle c, d+f, e1\rangle$; $\langle d, c, e2\rangle$; $\langle f, c+d, e3\rangle$

        In each of these cases, C+D+F are the plural agent and theme of the

photographing. Informally, we can think of it this way: what (4b) wants is for

C+D+F to fill the roles of both agent and theme of the photographing. It does not

care how this is accomplished, so long as subevents where the agent of that

subevent overlaps with the theme of that subevent are not involved. In each of

the scenarios in (5), the events can sum together to give the event $\langle c+d+f, c+d+f,$

e1+e2+e3$\rangle$.

        In the rest of the dissertation I assume Dotlačil's analysis, where the

various reciprocal interpretations arise from a single semantic representation

equivalent to WR. I refer to this as the 'WR' or 'cumulative' account. Like Dotlačil,

I am committed to the idea that reciprocal sentences, like other plural sentences,

have semantic representations no weaker than WR. The next section looks at

reciprocal interpretations that appear to cause problems for this stance.

3.1.2 Readings that are weaker than WR

Dalrymple et al. (1998) propose three reciprocal interpretations that are weaker than WR: one-way weak reciprocity, intermediate alternative reciprocity (IAR) and inclusive alternative ordering (IAO). (Beck (2001), Dotlačil (2010) and Sabato & Winter (2012) collapse the distinction between IAR and IAO[3]. In what follows, I will refer to both as instances of chain interpretations.)

Dalrymple et al. provide (6) as an instance of their one-way weak reciprocity, which is defined in (7). The truth conditions are weaker than WR in that each pirate need only take part in the relation in the first argument position; not every pirate needs to be stared at. Sentence (6) can describe the scenario in Figure 4, even though nobody stares at pirate 6.

(6)   "The captain!" said the pirates, staring at each other in surprise.

(7)   One-way weak reciprocity: $|A| \geq 2$ and $\forall x \in A \, \exists y \in A \, (x \neq y \wedge Rxy)$
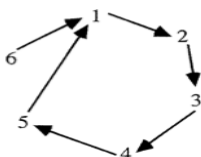
Figure 4: Pirates staring at each other (Beck 2001:75)

As Beck (2000) argues, such examples can be analyzed as WR plus exceptions. In the case of the pirates in Figure 4, pirate 6 isn't stared at, so we just remove him (via nonmaximality (Brisson 1998)). Beck argues that getting rid of

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[3] Sabato & Winter (2012) and Dotlačil (2010) discard IAO in favour of IAR. Beck (2001) keeps IAO and gets rid of IAR. The main difference between IAR and IAO is that IAR requires that all pairs be connected directly or indirectly, while IAO does not have that requirement.

one-way weak reciprocity in favour of WR accounts for the contrast in the acceptability of (8) in the scenarios in (9a,b). It seems fine as a description of the scenario in (a), but not (b). The love triangle scenario in (a) satisfies WR: each person wants to marry one of the others, and has one of the others that wants to marry them. The problem with scenario (b) is that no one wants to marry C. This is wrongly predicted to be felicitous if one-way weak reciprocity is a possible interpretation. In contrast to one-way weak reciprocity, the WR analysis cares about both directions: everyone has to be a wanter, and a wantee. And unlike the pirates case, with only three people it is apparently impossible to treat C as an exception.

(8)   Those three want to marry each other.

(9)   a. A wants to marry B. B wants to marry C. C wants to marry A.
        b. A and B want to marry each other. And C wants to marry B.

The other kind of weak reading, the chain interpretation, is more problematic for the WR account, and will be the focus of the rest of the chapter. Consider the sentence in (10a) which describes the scenario in (11). The problem for the semantic representation in (10b) concerns the endpoints of the chain: table 3 is not stacked on top of any table, and table 1 does not have a table stacked on top of it. If you were to sum the events of *being stacked on top of* in scenario (11), you would end up with the event in (12) which does not satisfy (10b).

(10)   a. The three tables are stacked on top of each other.
        b. $(\exists e)(^*\text{BE.STACKED.ON.TOP.OF}(e) \land <\text{tables, tables}, e> \in [\{<a, b, e'>:$
        $^{C*}\Theta_1(a)(e') \land {}^{C*}\Theta_2(b)(e') \land e' \le e \land \neg a \circ b\}])$

(11)   Table$_1$
         Table$_2$
         Table$_3$

(12) $<T_1+T_2, T_2+T_3, e_1+e_2>$

Such examples do not seem amenable to the kind of approach we took

with the pirates case. If the problematic individuals at the endpoints are removed,

via nonmaximality, the problem shifts to the middle table[4]. (Sauerland 1998

makes a similar point.)

Dalrymple et al. (1998) have as their weakest reciprocal interpretation IAO,

as defined in (13). All it requires is that each individual take part in the relation

in either first or second argument position.

(13)   IAO: $|A| \geq 2$ and $\forall x \in A \, \exists y \in A \, (x \neq y \wedge (Rxy \vee Ryx))$

They claim that the IAO interpretation appears in negated reciprocal sentences[5].

For instance, sentence (14) requires that nobody know anybody's name – it

would be false if even one person knew another's name.

(14)   The people in the room don't know each other's names.

But such examples are open to another analysis: Beck (2001) and Dotlačil (2010)

argue that they can be dealt with using the homogeneity presupposition that

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[4] This will be discussed further in §3.4 below.

[5] The SMH chooses the strongest meaning; in the scope of a downward entailing expression, the
ordinarily weakest meaning IAO is the strongest meaning.

90

plurals are subject to[6]. If we follow Beck and Dotlačil in this, it leaves only chain examples like (10a) as a problem for the WR account.

3.2 Various approaches to the chain interpretation

Section 3.2.1 surveys the literature on the chain interpretation. Section 3.2.2 sketches the approach I will adopt here.

3.2.1 Previous approaches

Some researchers propose that chain interpretations have truth conditions weaker than WR. Dalrymple et al. posit IAR and IAO, in (15), while Sabato & Winter (2012:19) dispute the need for IAO, and analyse all chain interpretations as IAR[7].

(15)   IAR: $|A| \geq 2$ and $\forall x,y \in A$ $(x \neq y \rightarrow$ for some sequence $z_0, \ldots, z_m \in A$
                      $(x = z_0 \wedge (Rz_0z_1 \vee Rz_1z_0) \wedge \ldots \wedge (Rz_{m-1}z_m \vee Rz_mz_{m-1}) \wedge z_m = y))$
    IAO: $|A| \geq 2$ and $\forall x \in A \, \exists y \in A \, (x \neq y \wedge (Rxy \vee Ryx))$

The account of Mari (2014) is somewhat similar, in that all reciprocal sentences must satisfy the condition in (16)[8]. As with IAR and IAO, this condition allows for an individual to take part in either first or second argument position[9].

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[6] When a predicate is applied to a plurality, there is a presupposition that the plurality is homogeneous with respect to the predicate – either it applies to each member of the plurality, or none of them. For example, *The children are asleep* means all the children are asleep, yet *The children are not asleep* does not simply mean that not all of the children are asleep, it means that all of them are awake (Löbner 2000).

[7] More precisely, their system includes several reciprocal meanings that are variants of IAR, but the main point is that they get rid of IAO.

[8] "A\{x}" is read "the set A minus the individual x".

[9] There are a number of other conditions that reciprocals must satisfy in Mari's system.

(16)   a. $\forall x \in A \, \exists y \in A \setminus \{x\} \, \exists J \subseteq I \, (R(\langle x,y \rangle, w_0, J) \vee (R(\langle y,x \rangle, w_0, J)$
        b. In the actual world, every element $x \in A$ is or has been involved in
        the relation R with some element $y \in A$ (either as the first or second
        element of the ordered pair), in I or in a subinterval J of I.

Other researchers, who seek to capture the parallels between reciprocal

sentences and other plural sentences, are committed to WR being the weakest

possible interpretation of a plural sentence. Because chain interpretations appear

to have weaker truth conditions than WR, Beck (2001) and Dotlačil (2010) argue

that we have reason to believe that they arise through some other mechanism

than the ordinary productive reciprocal semantics. Beck (2001:130) cites the fact

that the chain interpretation is limited to a small set of spatial/temporal relations

to support her view that the chain interpretation arises through a 'lexical process

different from ordinary reciprocity and limited to [that set of relations]'[10].

Dotlačil (2010:141) agrees.

Schwarzschild (1996:128) sketches an approach whereby the asymmetry of

the predicate (and hence the impossibility of satisfying WR) pushes the hearer

towards a more elaborate cover[11]. He suggests that understanding a sentence like

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[10] Beck (2001:129) also points out that chain examples don't interact with scope the way ordinary reciprocals do. She compares the following sentences:

(i) *These people were introduced to each other by a linguist.*
(ii) *The glasses were lined up behind each other by an apprentice magician.*

Beck points out that (i) can involve different linguists, while (ii) requires that the same apprentice magician lined up all the glasses. I am not sure what to make of this.

[11] In Schwarzschild's (1996) analysis, a cover is a way that the domain of discourse is structured. A cover of a set of entities P is a set of subsets of P; we say that a cover groups the individuals in P into cells (with one subset per cell). Take *the plates*. There is a cover in which each individual plate is in its own cell. Schwarzschild uses such a cover to explain distributive interpretations (e.g. 'The plates cost $5 (each)'). Or the plates might all be in one cell – this gives the collective interpretation 'The plates cost $5 (altogether)'. Other covers can be made salient by the context. For instance, imagine the plates come in sets of 4 (there are 4 floral plates; 4 geometric plates; 4 striped plates etc). In this scenario, the cover might put each set in its own cell. We would then understand the sentence 'The plates cost $5' to mean 'per matching set'.

The plates are stacked on top of each other might involve a cover where half the plates are in one cell and half in another cell. As I understand it, the idea is that *These plates are on top of those plates* and *Those plates are on top of these plates* are both true if the two groups of plates are interleaved, and team credit is allowed (not every one of the plates has to be on top of a plate or have a plate on top of it)[12].

For Sauerland (1998), chains involve a contextual restriction that has us considering pairs or neighbours. In a sentence like *The children followed each other into the room*, the 'other' part of *each other* provides, for each child, the child that preceded them. In the case of a chain interpretation, there is a presupposition failure for the first child, for whom there is no preceding child. This cannot be fixed by accommodating a restrictor for *the children* that excludes the first one, because then the problem would just shift to the second child in line. He proposes using the ENOUGH operator in (17), which makes a predicate true of a group if it is true of a substantial part of that group. Sauerland's representation of *The children followed each other into the room*, with the ENOUGH operator, appears in (18).

(17)   ENOUGH$(P)(y) = 1$ if and only if there is an x such that x is a substantial part of some y and $P(x) = 1$

(18)   ENOUGH$(\lambda y[\star \lambda x[[\star[\text{follow}]]([\text{the}](\kappa_{\text{other}} \cap [\text{other}](x)(y)))]](y))([\text{the children}])$

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[12] This approach would have trouble with a two-item chain.

Bruening (2004) does not go into much detail on this point, but makes the suggestion that chain interpretations arise from a WR semantic representation, with the individuals on the endpoints being treated as exceptions.

3.2.2   WR plus endpoint exceptions

In what follows, I will argue that the chain reciprocal interpretation arises from a semantic representation with truth conditions equivalent to WR. I follow Beck (2001) and Dotlačil (2010) in holding that reciprocal sentences are a type of plural sentence. Like Dotlačil, I assume that reciprocal sentences and other plural sentences have cumulative semantic representations. In the case of reciprocals, this means a semantic representation equivalent to WR. Like Sauerland (1998) and Bruening (2004), I argue that the chain reciprocal interpretation arises through pragmatic weakening.

Sections 3.4 and 3.5 work through the details of this account, with §3.4 focusing on how the pragmatic weakening works, and §3.5 looking at why chain interpretations are not always possible. Before we get into the details of the analysis, though, §3.3 presents an argument for the WR approach over competing analyses.

3.3   Two-item chains support the WR approach

There is some variability in acceptability judgements when it comes to chains of only two individuals. This section will argue that this is a crucial piece of evidence in support of the WR (plus exceptions) approach. Analyses that propose weaker-than-WR truth conditions for chain reciprocals fail to explain the variable acceptability of two-item chains.

3.3.1 Variability in acceptability judgements

My informants on occasion will completely reject sentences like (19), explaining that it sounds nonsensical. In such cases, they report arriving at the impossible interpretation where Box 1 is on top of Box 2 and Box 2 is on top of Box 1.

(19)   Those two boxes are stacked on top of each other.

This judgement seems to be quite variable. An informant might reject the sentence emphatically, but after thinking about it for a while, or being presented with a similar example, will change their mind.

The fact that some speakers reject sentences like (19) has been noted by a number of researchers (e.g. Kamp & Reyle 1993:465). Bruening (2004:33) reports that he and others he consulted dislike the examples in (20), originally from Beck (2001:128). Likewise, Mari (2005) asserts that (21) 'cannot be interpreted if the plurality is composed of only two tables'.

(20)   a. The two books are lying on top of each other.
        b. The two students followed each other into the elevator.
        c. You put these two bowls inside each other.

(21)   The tables are stacked on top of each other.

While some speakers report finding two-item chains infelicitous, others find them relatively unexceptional. They are certainly not rare in naturally occurring text, and most research on this topic assumes that they are felicitous. Although one might be tempted to treat Bruening's and Mari's observations as a matter of a difference in idiolect, my own observations lead me to see this variation as linked to the process of allowing for endpoint exceptions.

3.3.2 Problems for previous accounts

Most of the accounts we have seen permit two-item chains with certain predicates without reservation (Dalrymple et al. 1998; Beck 2001; Sabato & Winter 2012; Mari 2014). And some accounts propose disallowing them completely (Bruening 2004; Mari 2005[13]). It is obvious that neither of these approaches captures the variability in judgements that we have just seen. I will argue that the variability is a crucial piece of evidence, and that it strongly suggests that the approaches of Dalrymple et al. (1998), Sabato & Winter (2012) and Mari (2014) are on the wrong track.

3.3.2.1 *A problem for all accounts with weaker-than-WR truth conditions*

The variability in acceptability judgements is a problem for all accounts in which the chain interpretation has truth conditions weaker than WR. Specifically, the accounts of Dalrymple et al. (1998), Sabato & Winter (2012), and Mari (2014) posit truth conditions for the chain interpretation that are disjunctive: satisfied by each individual taking part in the relation either in first or second argument position[14].

Given that they have these weak truth conditions as an ordinary, productive part of the reciprocal semantics, these accounts have no explanation for why the number of individuals denoted by the antecedent should matter.

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[13] Note that Mari (2005) makes an exception for multiple two-item chains. So *The tables are stacked on top of each other* cannot describe a single pair of tables, but may describe four tables arranged in two stacks of two.

[14] This is true of Mari's requirements for events in the actual world (not including requirements on events in possible futures).

3.3.2.2 A problem for Sabato & Winter

Recall that in Sabato & Winter's (2012) system, the logical properties of the predicate narrow the field of possible interpretations of the reciprocal. For instance, the relation *be stacked on top of* is acyclic, and Sabato & Winter assume that the relation and its inverse are both functions. This narrows the possibilities for the reciprocal interpretation down to IAR. While this system neatly accounts for possible reciprocal interpretations, it cannot explain why an informant might on occasion reject a sentence like (22).

(22)   Those two boxes are stacked on top of each other.

Given my informants' comments, I assume that when they reject a sentence like (22) it is because they have arrived at an interpretation equivalent to WR, which describes an impossible situation. Here is the problem for Sabato & Winter's system: if the logical properties of the predicate narrow down the possible interpretations of the reciprocal, there is no way for the sentence in (22) to receive an interpretation that is incompatible with acyclicity. And yet, that is what appears to happen when informants object to the sentence.

Sabato & Winter do not address this particular issue, but do point out that their system has some trouble with certain other asymmetric predicates. In particular, they note that comparatives are a problem for their account – rather than receiving an interpretation consistent with the asymmetry of the predicate, a sentence like (23) is interpreted as SR and is hence infelicitous.

(23)   #Anna and Bryan were taller than each other.

Sabato & Winter (2012:30) describe this as an 'unresolved interpretational conflict' and say that the topic requires further study.

3.3.2.3   Beck; Dotlačil

Both Beck (2001) and Dotlačil (2010) exclude chain interpretation examples from the regular productive system. Dotlačil agrees with Beck that it should be seen as a lexical process. Even so, it is surprising that the number of individuals denoted by the antecedent should matter for this lexical process. In contrast, I will argue that if chain interpretations arise from the WR semantic representation by way of allowing for exceptions at the endpoints, we have a natural explanation for the variable acceptability of two-item chains.

3.3.3   Conclusion: no weaker-than-WR truth conditions for reciprocals

Accounts that propose weaker-than-WR truth conditions cannot explain the variable acceptability of two-item chains.

3.4   Endpoint exceptions

I follow Bruening (2004) and Sauerland (1998) in seeing the chain interpretation as arising from the ordinary reciprocal semantics, with exceptions made for the individuals at the endpoints of a chain. But what is the pragmatic mechanism that allows this?

One well-worked out account of exceptions is that of Brisson (1998). Example (24) illustrates the kind of exceptionality Brisson accounts for: the sentence can be true even if not every kid is taking part in the raft-building. (Say there are 8 kids, and one didn't take part.) Brisson refers to this phenomenon as nonmaximality.

(24) The kids are building a raft.

Brisson's approach to nonmaximality builds on Schwarzschild's approach to distributivity and covers. In Schwarzschild's system, collective and distributive sentences alike involve a distributive operator (*Part*). The distributive operator has a context dependent domain selection variable, *Cov*. The value of *Cov* is a cover. A cover is a set of subsets of the domain of discourse[15].

Let's look at example (24) again. Assume that *the kids* denotes the set {a, b, c, d, e, f}. Some possible covers appear in (25). If *Cov* has the value in (25a), the sentence will be interpreted distributively (with no exceptions). If it has the value in (25b), it will be interpreted collectively (again with no exceptions). Brisson's innovation is to allow for the possibility of ill-fitting covers. A cover is ill-fitting with respect to a set if a union of the cells of the cover is not equivalent to the set. The covers in (25c) and (25d) are ill-fitting with respect to *the kids*, because kid f is in a cell with non-kids x, y and z. In Brisson's terminology, kid f is in the 'pragmatic junkpile'. For Brisson, the junkpile is a cell in the cover that contains all the individuals in the universe of discourse that we happen to not care about for the moment (1998:89-90). Since {f, x, y, z} is not a subpart of *the kids*, we in effect do not care whether kid f took part or not.

(25)   a. {{a}, {b}, {c}, {d}, {e}, {f}}
        b. {{a, b, c, d, e, f}}
        c. {{a, b, c, d, e}, {f, x, y, z}}
        d. {{a}, {b}, {c}, {d}, {e}, {f, x, y, z}}

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[15] *C* is a cover of a set of entities *P* iff: *C* is a set of subsets of *P*, every member of *P* belongs to some set in *C*, and ∅ is not in *C*. (Schwarzschild 1996)

The first objection to using Brisson's approach with the endpoint exceptions of a chain comes from the fact that, as we have seen, chain reciprocals can describe the relation holding between two individuals. Brisson notes that nonmaximality is sensitive to the size of the plurality; it is much more difficult to obtain a nonmaximal interpretation if the plurality is small[16]. Beck (2001:128) rejects an 'exception story' for chain reciprocals for just this reason.

The second objection concerns *all*. Brisson argues that *all* functions to select well-fitting covers (and hence rule out nonmaximality). For instance, while (26a) allows for some of the chairs to be elsewhere, (26b) does not allow exceptions: each of the chairs must be in the dining room. Since chain reciprocals necessarily involve exceptional individuals at the endpoints, if these exceptions were due to nonmaximality, we would not expect that *all* would be compatible with chain reciprocals. And yet (26c) is felicitous[17]. It seems that the endpoint exceptions are not due to an ill-fitting cover.

(26)   a. The chairs are in the dining room.
        b. The chairs are all in the dining room.
        c. The chairs are all stacked on top of each other.

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[16] For example, if there are two kids, and only one is building a raft, it is hard to judge (24) true. Note that Brisson (1998:50) provides an example from Lasersohn suggesting that given an elaborate enough context (for example, where two people form a team) it might be possible.

[17] Dotlačil (2010) provides evidence that such sentences are not always accepted. In a questionnaire study, Dotlačil and Nilsen found that chain sentences with *all* were accepted 52% of the time. This was significantly less often that chain sentences without *all*, which were accepted 88% of the time. Nevertheless, the fact that chain sentences with *all* are accepted at least some of the time tells us that the exceptional individuals at the endpoints of the chain are different from the exceptions Brisson deals with. We might account for Dotlačil and Nilsen's result if *all* has other effects than simply ruling out Brisson-type nonmaximality. I think it is likely that because chain interpretations involve pragmatic weakening, judgement tasks like Dotlačil and Nilsen's may encourage participants to apply stricter standards than they would in regular conversation.

Finally, consider what an account using Brisson-type nonmaximality would have to say about a sentence like (27). Recall that on the WR account, the problem with (27) is that both boxes are exceptional: one has no box stacked on top of it; the other is not stacked on top of any box. There is only one event: (28b). It does not seem possible for both boxes to be in the pragmatic junkpile[18].

(27)   Those two boxes are stacked on top of each other.

(28)   a. $(\exists e)(\text{*be-stacked-on-top-of}(e) \land \langle \text{box 1} + \text{box 2}, \text{box 1} + \text{box 2}, e\rangle \in$
         $[\{\langle a, b, e'\rangle: {}^{C}{*}\Theta_1(a)(e') \land {}^{C}{*}\Theta_2(b)(e') \land e' \leq e \land \neg a \circ b\}])$
       b. $\langle \text{box 1}, \text{box 2}, e\rangle$

Sauerland (1998) suggests a different approach: he proposes using the ENOUGH operator in (29), which functions to make a predicate true of a group if it is true of a substantial part of the group.

(29)   ENOUGH$(P)(y) = 1$ if and only if there is an x such that x is a substantial part of some y and $P(x) = 1$

The first problem with this approach concerns chain reciprocals with small-numbered antecedents. Given an intuitive understanding of what it takes

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[18] Brisson's (1998:106-7) discussion of pragmatically weakened interpretations of inherently reciprocal predicates like *collide* may be relevant, since she provides an example with only two individuals, one of whom is in the junkpile. She notes that a sentence like *Pete and Les collided* may be open to a pragmatically weakened interpretation, roughly synonymous with 'Pete collided into Les'. She suggests such an interpretation would arise if the cover assigns Les to the pragmatic junkpile. But note that *both* (which is a non-maximality canceller like *all*) rules out the weakened interpretation of the sentence (*Both Pete and Les collided*). In contrast, *both* can co-occur with chain interpretations, e.g. *I put both pieces on top of each other while cutting, they are perfectly identical.* http://www.mp3car.com/fabrication/78313-03-neon-sxt-in-dash-xenarc-install-2.html [Accessed 17 September 2013]

to be a substantial part, it is hard to understand how the level of exceptionality in a sentence like (27) could be allowed using ENOUGH[19].

Setting aside considerations of how to judge what is a substantial part, we need to modify Sauerland's definition of ENOUGH to deal with chain reciprocals. Imagine there is a stack of three chairs as in (30). There is no event that satisfies the truth conditions in (31), because we only have the subevents <C1,C2,e′> and <C2,C3,e″> to work with. Summing them gives us <C1+C2, C2+C3, e′+e″>. What we want ENOUGH to do is make the fact that the scenario satisfies the truth conditions in (32) enough to also satisfy the original truth conditions in (31). That is, make it such that C1+C2 is a substantial enough part of C1+C2+C3, and C2+C3 is a substantial enough part of C1+C2+C3.

(30)   Chair 1
       Chair 2
       Chair 3

(31) $(\exists e)(*\text{BE.ON.TOP.OF}(e) \wedge <\text{C1+C2+C3, C1+C2+C3, e}> \in [\{<a, b, e′>:$
       $^{C}\!*\Theta_1(a)(e′) \wedge {}^{C}\!*\Theta_2(b)(e′) \wedge e′ \le e \wedge \neg a \text{ o } b\}])$

(32) $(\exists e)(*\text{BE.ON.TOP.OF}(e) \wedge <\text{C1+C2, C2+C3, e}> \in [\{<a, b, e′>:$
       $^{C}\!*\Theta_1(a)(e′) \wedge {}^{C}\!*\Theta_2(b)(e′) \wedge e′ \le e \wedge \neg a \text{ o } b\}])$

Sauerland's definition does not work because there is no substantial part of C1+C2+C3 that 'be stacked on top of each other' is true of. Perhaps it would work to modify it as in (33).

(33)   ENOUGH(P)(y)(x) = 1 iff there is a z that is a substantial part of y and a w that is a substantial part of x, and (P)(z)(w) =1.

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[19] Indeed, Sauerland (1998:201) says of #*My mother and I gave birth to each other* type cases that the problem is that one person is not a substantial enough part of two people.

We might need a definition of what it is to be a substantial part that is specific to individuals that fit into a chain schema:

(34)   If individuals x_1 to x_n are a chain, then x_1 to x_{n-1} is a substantial part of the chain, and x_2 to x_n is a substantial part of the chain. (And no other subset of a chain is substantial.)

The idea behind such a stipulation would be to restrict exceptions to the endpoints of a chain. That is, I am open to the idea that the chain interpretation is not completely productive and may require that the scenario fit into the chain schema[20]. A crucial part of this approach is the definition of 'chain schema'.

What I have in mind is that there is a conceptual schema that can be satisfied by spatially/temporally ordered individuals or events. A chain both consists of a series of individuals/events, and is the larger object created by that ordering (an arrangement, like a stack; a pattern, like a series of events)[21]. In the kind of schema I have in mind, the individuals are less important than the pattern that they are arranged in. We might expect prototypicality effects: for instance, chains may be best when the individuals are alike or indistinguishable[22], and chains probably prototypically have more than two members[23]. At present, the notion of a chain schema remains in need of further development.

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[20] We will return to this in §3.6 below.

[21] Mari (2014) talks about 'paths'.

[22] Mari (2008) suggests that a chain reciprocal works better to describe a stack with two books of the same size than one with a tiny book stacked on top of a huge one.

[23] Such prototypicality effects may be involved in the phenomena described in §3.5 below, but are not explored here.

This section has discussed some possible ways of implementing the pragmatic weakening required to get from WR truth conditions to a chain reciprocal interpretation. The phenomenon of endpoint exceptions seems distinct from the nonmaximality dealt with by Brisson (1998). An approach along the lines of Sauerland's (1998) seems more promising. While I have contrasted the kind of pragmatic weakening involved in allowing for exceptions with the kind of nonmaximality Brisson (1998) was concerned with, the difference between them in essence has to do with the basis on which exceptions are allowed. Brisson's account concerns examples where the numerosity of the individuals described is generally what justifies excluding some of them as exceptional. But endpoint exceptions are allowed for a different reason: we make a distinction between middles and endpoints. Endpoints are by nature exceptional.

3.5   Chain reciprocals and pragmatics

I argue that the chain interpretation arises from the WR semantics via pragmatic weakening. This section first looks at factors involved in this weakening (§3.5.1), and then suggests a Gricean account (§3.5.2). Then §3.5.3 considers Mari's (2014) claim that chain reciprocals are only felicitous if the individuals in the chain are potentially able to be reordered. It is argued instead that Mari's examples involve a pragmatic effect related to the fact that reciprocal chains do not specify the ordering of the individuals.

The main idea of this section is that since the chain interpretation involves pragmatic weakening, we should expect that this process will be sensitive to various factors. In particular, this section focuses on two-item chains since they are associated with the most variable acceptability judgements, and this

variability makes visible the factors that affect the availability of the chain interpretation.

3.5.1 Why are two-item chain examples ever rejected?

If the chain interpretation arises from the WR semantics via pragmatic weakening (for instance, something along the lines of Sauerland's (1998) ENOUGH operator) then the question is: why is this interpretation not always available? As we saw above, two-item chains are sometimes judged to be infelicitous. This section discusses some factors that appear to affect the felicity of two-item chains.

One relevant factor is animacy. Two-item chain sentences with inanimate antecedents as in (35a) are more acceptable than those with human antecedents as in (35b). This isn't to say that individuals of high animacy are never described by two-item chain sentences. For instance, consider the naturally occurring examples in (36).

(35) a. The two tables are stacked on top of each other.
      b. ?#The two girls are standing on each other's shoulders.

(36) a. I open up the door to find my best friend and the love of my life half
         dressed on top of each other![24]
      b. After smoking marijuana, Peter and Lois are shown lying on top of
         each other on the sofa[25]
      c. Single luge can stay; we have all seen people on sleds before. But two
         people lying on top of each other on one sled is a little foreign and
         frankly, doesn't make a lot of sense.[26]
      d. He really looks like two people standing on each other's shoulders[27].

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[24] http://www.fanfiction.net/s/6079532/1/Cheated-and-Pissed-Rewritten (Accessed 24 April, 2013)

[25] http://en.wikipedia.org/wiki/Deep_Throats (Accessed 24 April, 2013)

[26] *The Michigan Daily*, Feb 14 1994, p3. (The writer is complaining about the sport of doubles luge.)

Such examples are, however, predicted to be infrequent (and rejected more often) compared to those with inanimates.

Another factor that is relevant is the number of two-item chains described. While a single pair of individuals cannot be felicitously described by (37), sentence (38) can describe a scenario with multiple pairs.

(37)   #The girls are sitting on each other's lap.

(38)   "Trying to get people to political fundraisers is never easy," he told [this reporter]. "But on this occasion, I think we're going to have people sitting in each other's laps."[28]

Similarly, Mari (2005) reports that (39) cannot describe a single stack of two tables[29], but can describe two such stacks.

(39)   The tables are stacked on top of each other.

How are we to understand the effect of animacy and number of individuals described on the acceptability of two-item chains? What evidence do these factors provide about the process of allowing for endpoint exceptions, and why it is that two-item chains are ever judged to be infelicitous?

One possible explanation for the decreased acceptability of two-item chains is that all of the individuals are exceptional[30]. Both individuals are at the

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[27] http://www.pilkipedia.co.uk/forum/viewtopic.php?f=1&t=9021&start=75 (Accessed 6 August 2014) (The writer is describing a very tall man.)

[28] *The West Australian*, January 13 2010, page 2.

[29] In later work, Mari does allow two-item chains.

[30] e.g. Bruening (2004) takes this position.

endpoints of the chain; with greater numbers, there are some non-endpoint and hence non-exceptional individuals. But we can rule out this explanation: if this were the case, then we would not expect that increasing the number of two-item chains as in (38) and (39) would make any difference.

In my account, chain reciprocal sentences have WR semantics. A chain scenario is always going to be an imperfect way of satisfying the WR truth conditions. We have observed several factors that play a role in how likely we are to tolerate the necessary endpoint exceptions:

1. Two-item chains are more frequently rejected than chains of greater number.

2. Animate/human two-item chains are more frequently rejected than inanimate ones.

3. Increasing the number of two-item chains described increases acceptability.

It is commonly observed that vague interpretations are easier to accept if the sentence describes a large number of individuals[31]. This gives us an explanation for points 1 and 3. And it would not be surprising if we have a lower tolerance for vagueness when it comes to discussing animates/humans. They are simply more interesting to us than inanimates, so treating them as exceptions should be associated with more of a penalty.

But this cannot be the whole story. Consider the contrast between (40a) and (40b). Simply adding one individual improves the sentence greatly. It is hard to believe that such a small increase in number should make such a difference – typically, when discussing the effect of the number of individuals on tolerance

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[31] e.g. Dalrymple et al. (1998), Brisson (1998).

for vagueness, we are talking about much larger numbers than this. The next section, §3.5.2, looks at a Gricean account of this contrast.

(40)   a. ?#Amy and Bella stood on each other's shoulders to reach the window.
       b. Amy, Bella and Caroline stood on each other's shoulders to reach the window.

3.5.2   A Gricean account

Let's assume that exceptions are dispreferred[32]. Why should a speaker utter (41a), violating this preference, when there is a competitor (41b) which does not violate it?

(41)   a. ?#Amy and Bella are standing on each other's shoulders.
       b. Amy is standing on Bella's shoulders.

Thinking about possible competitors might explain the contrast between two-item and three-item chains. If we assume that there is a preference for brevity (e.g. Grice's Maxim of Manner 'Be brief'), then a speaker has a reason for violating *EXCEPTION in (42a) – the competitor in (42b) is too unwieldy.

(42)   a. Amy, Bella and Caroline are standing on each other's shoulders.
       b. Amy is standing on Bella's shoulders and Bella is standing on Caroline's shoulders.

To my ears, the contrast between sentences (41a) and (42a) is quite stark. I take this as evidence against an account that would explain the problem with (41a) as being due to the proportion of exceptional individuals. Adding one more

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[32] This seems reasonable, but there will of course be preferences in favour of vagueness too, e.g. Grice's second Maxim of Quantity ('Do not make your contribution more informative than is required'). Krifka (2002) makes use of a preference for vague interpretations of measure expressions.

individual does not seem like it should be enough to remedy that. On the other hand, the starkness of the contrast is not surprising on an account that considers competitors.

If exceptions are dispreferred, then to describe chain configurations, we should see speakers preferring non-reciprocal competitors, unless there is some reason not to (e.g. brevity as in (42)). In §3.5.1 we saw that two-item chains of inanimates are more acceptable than those with animates/humans. We might be able to explain this contrast by thinking about the difference between animates and inanimates when it comes to the non-reciprocal competitor. In the case of humans, who are easily distinguishable and named, the competitor is clearly preferable, as in (41). But consider the case of two stacked tables. Tables are harder to tell apart than humans; they typically don't have names or distinguishing features. As mentioned in the previous section, it might be that the penalty for exceptions is simply not as large for inanimates as it is for animates, because we don't 'care' about them as much. Or it could be that the non-reciprocal competitor is itself somewhat disfavoured: in the case of the stacked tables, non-reciprocal descriptions like (43b) and (43c) involve taking a perspective on the scenario that distinguishes between the two tables (e.g. making one the figure and the other the ground as in (43b), or providing further distinguishing information as in (43c)) . Notice that these potential competitors to the reciprocal (43a) are approximately the same length as it; cf. (41) where the non-reciprocal competitor is shorter, and preferred.

(43)   a. The tables are stacked on top of each other.
        b. One table is stacked on top of the other (table).
        c. The teak table is stacked on top of the oak table.

3.5.3 Changeable ordering

Mari (2014) observes that chain reciprocals seem to require that the ordering of individuals is changeable, such that any individual could in theory be in any position. For instance, she points out that while the sentence in (44) cannot describe a living human being (where the spatial arrangement of head and body is fixed), it could possibly be used to describe an artwork made of a decapitated head and body.

(44)   (#)The head and the body are on top of each other.

In the case of a living being, the ordering of the body parts is 'permanent' and 'decided', and thus the use of a chain reciprocal is infelicitous (2014:245).

Likewise, she provides the case of the stacked pizzas (attributed to Barry Schein): while (45) can describe a scenario where mushroom and pepperoni pizza boxes are stacked randomly, it cannot describe one where pepperoni pizzas are, according to company policy, mandatorily stacked on top of mushroom pizzas (2014:217-218). While the ordering of boxes is non-permanent – you could rearrange the order of the stack – the company policy means that there is no reasonable future in which they might be so rearranged. That is, the ordering is decided (2014:245-246).

(45)   (#)The mushroom pizzas and the pepperoni pizzas are stacked on top of each other.

In Mari's system, decidedness is important because chain sentences are only felicitous if they can potentially satisfy SR, once plausible future events are taken into account. If the ordering is not decided or permanent, then there are

other orderings in possible futures that allow for SR to be satisfied. If it is fixed, there are no orderings in possible futures that would allow SR to be satisfied, and hence the reciprocal is infelicitous[33].

In this section, I will argue that changeable ordering is a pragmatic effect associated with the chain reciprocal. Reciprocal chain sentences do not specify the ordering of individuals. Via Gricean reasoning, we might conclude that a speaker who choses this form does not know or does not care about the ordering.

In support of this kind of approach, consider the fact that there are felicitous examples where the individuals described by a reciprocal chain sentence cannot be reordered in any possible futures. Mari herself mentions the problem that examples like (46) cause for her account – given that the dolls' sizes are fixed, there are no possible future events that allow for SR to be satisfied (2014:253n34). Likewise, the examples in (47) describe fixed orderings[34].

(46) The Russian dolls are nested inside each other.

(47) a. Collectively, the vertebral bodies comprise the boney building blocks of the spine. They are stacked on top of each other with a disc in between each one[35].
b. The jaw joint consists of two rounded bones sitting on top of each other, similar to a golf ball balancing on top of another golf ball[36].

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[33] This is true of sentences in present tense. Mari's system makes different predictions for past tense, because a constraint similar to the SMH requires that in the actual world, the maximum number of pairs allowed by contextual information stand in the relation (2014:233-234). In Mari's branching time framework, there is a unique actual world prior to speech time, but there is not yet an actual world after the time of utterance so this constraint does not apply to non-past sentences (2014:235)

[34] I am following Mari in assuming that the order of a living being's body parts is fixed. (As in her discussion of example (44) above.)

[35] http://www.spine-health.com/conditions/spine-anatomy/vertebrae-vertebral-column [Accessed 8 February 2014]

The examples that Mari uses to argue for changeable ordering, e.g. (44) and (45), are easy to account for if this is a pragmatic effect of choosing a form which does not specify the ordering of individuals. For instance, there are several reasons why we do not describe the arrangement of a living human's head and body as in (44) (repeated here as (48b)). First, why choose this form when there is a better competitor in (48a)? Second, why use a form that can be associated via Gricean reasoning with the conclusion that the speaker does not know or care about the ordering? On the other hand, if we are talking about artworks made of body parts, it seems likely that the precise ordering of the body parts is less interesting than the fact that they are stacked at all.

(48)   a. The head is on top of the body.
        b. #The head and the body are on top of each other.

Likewise, Mari's pizza example (45) simply shows that a speaker would not choose a form that does not specify the ordering when the precise ordering is salient, and particularly when there is a concise competitor that does specify that ordering (*The pepperoni pizzas are stacked on top of the mushroom pizzas*).

In my analysis, the question of whether the items can be rearranged is irrelevant. Sometimes the speaker's choice to use the chain reciprocal can be associated with this particular pragmatic effect. The effect is likely to arise if there are few (in particular only two) items in the chain. This is because such sentences have a concise non-reciprocal competitor that specifies the ordering. By not choosing the competitor, the speaker leaves themselves open to the hearer

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[36] http://pvpost.com/2013/05/28/active-injury-free-pop-pop-ow-all-about-jaw-pain-18670 [Accessed 8 February 2014]

concluding that the items are freely ordered. In the case of the Russian dolls in (46), there is no such effect because of what we know about the world: there is only one possible ordering.

Speakers can have various reasons for choosing the reciprocal – which does not specify the ordering – over a competitor that does. Consider the headline in (49), from a news story about two students. What happened was that student A moved from one town to another, and then student B made the same move. Then Student A graduated at the top of the class, and student B was runner-up. In both cases, B 'follows' A.

(49)   [East Greenwich]'s top grads have followed each other before[37]

What is interesting about this example is that it has characteristics that typically make the chain interpretation more difficult: two individuals of high animacy. The writer could have chosen to describe the scenario as "Student B follows Student A again" but seems to be trying to focus on the pair of them, in a noncompetitive way. The writer has a reason (e.g. politeness) for not choosing the non-reciprocal competitor. The Gricean reasoning associated with the choice of the chain reciprocal over its non-reciprocal competitor does not always lead to the conclusion that the individuals are freely ordered[38].

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[37] http://www.independentri.com/local/article_55cce459-16a7-5884-92a2-4278b417cff7.html (Accessed 13 April 2013)

[38] Even in Mari's system, you wouldn't expect free ordering here, since both events (the presupposed one, and the asserted one) are prior to speech time. Mari's SMH constraint applies to events are prior to speech time. This constraint requires the maximum number of pairs to stand in the relation, given real world knowledge. There are two separate events of following; Mari's system could use the SMH constraint separately on each of them, resulting in the actual interpretation where SR does not hold over both events (since in both cases B follows A).

In conclusion, though it often seems that chain reciprocals describe scenarios where the individuals are freely ordered, it is better seen as a pragmatic effect.

3.6   Is the chain interpretation productive?

I am proposing an account where the chain reciprocal interpretation arises from the ordinary reciprocal semantics. What distinguishes the chain reciprocal is that there are exceptions – specifically, exceptions at the endpoints of the chain. Since the chain interpretation arises from the regular semantics, one of the tasks for this account is to explain why it is not always a possible interpretation.

It has long been observed that only certain predicates allow the chain interpretation. Consider the examples in (50) (Langendoen 1978).

(50)   a. They {followed / #preceded} each other into the elevator.
        b. The plates are stacked {on top of / #underneath} each other.

Langendoen explains these contrasts by saying that we simply have a particular preference for certain configurations of figure and ground:

> It would appear that the ordering of elements that is required in order for such sentences to be so used is, however, a natural (or possibly culturally determined) one. We normally stack things one on top of the other rather than the other way around, line up one behind the other rather than one in front of the other, and view time as progressing from earlier to later rather than from later to earlier. (1978:193)

Changing our assumptions about the world can change the acceptability of these sentences. Schein (2003) has us imagine a set of magnetic plates that are placed underneath a shelf, with each plate attracted to the one above it. These plates might be described as being stacked underneath each other.

Setting considerations of the preferred direction of ordering aside, the other thing to explain is why not all asymmetric predicates are allowed. Section 3.6.1 looks at comparatives. Section 3.6.2 looks at other asymmetric predicates. Section 3.6.3 considers other predicates.

3.6.1 Comparatives

The fact that comparatives disallow the chain reciprocal interpretation has been a longstanding puzzle for those accounts that see the chain interpretation as a productive part of the system. Dalrymple et al. (1998) note that it is a problem for their account. Recent work by Sabato & Winter (2012) discusses some possible approaches to the problem.

As we saw above, Mari (2014) has it that the reciprocal requires that it be possible for future events to rearrange the ordering so as to satisfy SR. In her system, this accounts for the unavailability of the chain interpretation for comparatives: in many cases, comparatives describe fixed states of affairs, thus there is no possibility of future reordering. For instance, (51) is infelicitous because we assume that buildings are of fixed height (2014:248)[39].

(51)   #The skyscrapers are taller than each other.

Mari (2014) shows that comparatives can co-occur with the reciprocal in certain circumstances. For instance, the adverbial in (52b) makes available a

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[39] Mari cites Dowty's (1979) notion of 'inertia'. Even though a future earthquake might change the buildings' heights with respect to each other, this event is not part of the plausible future.

reciprocal interpretation. It is not, however, a chain interpretation. Rather, it describes a situation that (at least) satisfies WR[40].

(52)   a. #My sons were taller than each other.
        b. My sons were taller than each other at different stages in their lives.

Other examples provided by Mari (2014) do seem to be able to receive chain interpretations. Consider (53). It can describe many kinds of scenario, but one example of a chain interpretation would be where there are a group of men, and each man runs a lap, and is faster than the previous man[41]. And the naturally occurring example from Mari (2008:30) in (54) receives a chain interpretation: the flowers are planted a few weeks apart, and the first planting and the last planting are endpoint exceptions.

(53)   These men are running faster than each other at each lap.

(54)   I try to have several varieties blooming throughout the growing season by either choosing ones that bloom progressively at certain times of the season or by planting them a few weeks later than each other in stages[42].

Sabato & Winter (2012) provide a number of naturally occurring examples where comparatives co-occur with the reciprocal, including ones that receive interpretations that are similar to chain interpretations, such as those in (55).

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[40] If there are two sons, each is taller than the other at some point (i.e. equivalent to WR/SR). If there are more than two, it is unclear to me exactly what is required.

[41] If each man runs only once, this is not available with only two men. It seems to require a reasonable number of men and runs (at least four?).

[42] Arlene Wright-Correll, *The Impractical Gardener*, 2007, p15. (Accessed via Google Books, 31 August 2013.)

(55)   a. To see if two numeric values are greater than each other, we use the
           comparison operator >.
         b. Do different liquids evaporate slower than each other?

Sabato & Winter note that verbs of comparison like *outrank* or *exceed* seem more open to chain interpretations than adjectival comparatives (2012:239). They provide example (56), which is a clear case of a chain interpretation with a verb of comparison. The personnel outrank each other from left to right, so the leftmost department is outranked by no one, and the rightmost outranks no one.

(56)   Personnel of equivalent-level ranks outrank each other by department
         on the chart below from left-to-right.

As we have just seen, comparatives can receive chain interpretations. Nevertheless, they typically do not. I think comparatives typically disallow exceptions (and hence the chain interpretation) because their very point is to convey ordering relative to some scale. The difference between *follow* and *be taller than* is that while both convey an ordering (A follows B; A is taller than B), *follow* has more to it. If A followed B in, then we know that they both took the same path and ended up in the same place and so on. If boxes are stacked on top of each other, then what is of interest that they form a particular configuration (a stack). But with *be taller than*, the ordering (on the tallness scale) is all that there is.

In some cases, whether the items can be ranked on a particular scale *at all* is what is of interest. This is how I would explain what is going on in the examples in (55) above. This brings us back to the pragmatic effect of choosing the chain reciprocal over a competitor expression. A speaker choosing the reciprocal typically leads the hearer to conclude that the ordering is not important. And since comparatives are usually used to express an ordering

relation, they are usually incompatible. They are compatible when the ordering itself is not important, for example when what is of interest is whether the items can be ranked at all[43].

When they receive chain interpretations, comparatives like those in (57) require that the antecedent denote more than two individuals (or in (57a) more than two laps). I would explain this using the reasoning familiar from §3.5.2: a non-reciprocal competitor is preferable for smaller numbers of individuals.

(57)   a. These men are running faster than each other at each lap.
         b. I plant them a few weeks later than each other in stages.

These examples also seem to depend on explicit adverbial modification to make available the chain interpretation, as the somewhat infelicitous examples in (58) show.

(58)   a. #?These men are running faster than each other.
         b. #?I plant several varieties later than each other.

Mari (2014:254) mentions the following example (attributed to Chris Kennedy):

(59)   The boys are successively taller than each other.

She notes of sentence (59) that:

> it can be uttered by someone describing the sizes of boys standing in a line, provided she/he goes from one boy to the other. The sentence describes a 'path' in which the criterion for moving on from one position to the other is to reach boys with greater sizes.

---

[43] This seems to fit the flower-planting example (54) too. The particular order in which they are planted is irrelevant, what matters is the spacing (weeks apart vs. being planted all at once). Similarly with the men running laps in (53): what matters is the pattern (each lap is faster than the previous one)

The adverbial in (59) is crucial. Without *successively* or something like it, the line

context Mari describes is not enough to make the chain interpretation felicitous,

as (60) shows.

(60)   Scenario: The boys line up, and as it happens they are arranged in
        order of increasing height. I am walking along the line and I say:
        a. #Hey, the boys are taller than each other.
        b. Hey, the boys are taller than each other as you go along.

It seems that comparatives require the adverbial modification to provide the

necessary chain structure. As Mari points out, the adverbial needs to draw

attention to the 'path'; a *for*-adverbial as in (61) does not work (2006:252).

(61)   #The skyscrapers are taller than each other for miles.

3.6.2   Other asymmetric predicates

If the chain interpretation arises from the ordinary reciprocal semantics, then we

need to explain why this interpretation is not generally available for asymmetric

predicates. Consider examples (62a,b) from Mari (2014) and (62c) from Beck

(2001). Why is it that these are not open to a chain interpretation?

(62)   a. #My mother and I gave birth to each other.
        b. #The two kings succeeded each other[44].
        c. #The three men buried each other on this hillside[45].

        Actually, it has been pointed out (Beck 2001) that such examples may

become acceptable when the antecedent denotes a large group:

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[44] In a context where succession happens after death, or where a king is not allowed to retake the
throne after giving it up. (It could describe two kings who alternate multiple times, but that
would satisfy WR so is not of interest here)

[45] 'Buried' in the sense of 'buried after death'.

(63)   a. The members of this family have inherited the shop from each other
           for generations.
         b. The settlers have buried each other on this hillside for centuries.
         c. The kings succeeded each other[46].

Mari (2014:253) reports that her corpus study found such examples 'almost exclusively… in historical and legend reporting contexts'. Beck (2001:128) says the effect of the size of the antecedent is evidence that 'it is possible to tell some kind of an exception story' about these. She contrasts this with predicates like *on top of* or *follow* that allow chain interpretations with small-sized antecedents. For Beck, an exception story is 'extremely implausible' in the case of these predicates[47].

Both Beck and Mari draw a distinction between these asymmetric predicates and the temporal/spatial ones (*on top of*, *follow*). For Mari it is that the temporal/spatial ones allow for possible futures with different ordering. For Beck, it is that the chain interpretation is lexically restricted to a small set of temporal/spatial relations. Both point to the fact that apparent chain interpretations of non-temporal/spatial asymmetric predicates require that the antecedent denotes a large group. For instance, consider the contrast between Beck's example in (64a) and one like (64b):

(64)   a #The three men buried each other on this hillside.
         b. The three men stood on each other's shoulders to reach the ceiling.

---

[46] Example from Mari (2014).

[47] By an 'exception story' I assume that Beck means something like Brisson-type nonmaximality, in which case I agree: as argued above in §3.4, that does not explain *on top of* and *follow*.

Here are some ideas. First is that there is something special about the chain interpretation – say it needs to have a particular configuration, a 'chain schema'. While these asymmetric predicates can map onto this kind of structure temporally, it is indirect. So we might say that we simply require a larger number of individuals in order to justify seeing the situation as involving the required configuration.

Another idea: dramatic changes of state like those in (62) disincline us from allowing for endpoint exceptions (and/or choosing to express the relation with a chain reciprocal which does not specify the ordering). To test this, we would need to think about asymmetric predicates that are not 'interesting' in this way – for instance, of low transitivity (e.g. no impact on the object).

From my point of view, the reason that #*My mother and I gave birth to each other* is out is that there is a perfectly good competitor: *My mother gave birth to me*. Examples of this type improve with larger numbers because the competitors become more cumbersome. (What this leaves unaccounted for is that with the familiar temporal/spatial examples, there is a dramatic improvement going from two to three items in the chain. These other asymmetric predicates seem to require much larger numbers.)

Unlike Beck (2001) and Dotlačil (2010), I do not think that the chain interpretation is limited to a particular set of spatial/temporal relations (e.g. Beck 2001:128 provides a very short list). I think it is fairly productive. Consider the following examples describing relay races[48]:

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[48] In the context of a relay race, we understand *pass the baton* as an asymmetric predicate.

(65)   There were no mistakes this time as the four Americans passed the
        baton to each other safely and quickly but they were beaten on merit[49].

(66)   As a demonstration of the family ties within the club, a unique
        occurrence was observed where 3 sets of family members passed the
        baton to each other[50].

The context of example (66) makes it clear that what is described is three two-

item chains, as shown in in (67).

(67)   Family 1: mother passes to daughter
        Family 2: father passes to son
        Family 3: sister passes to sister

Like other chain reciprocals, judgements are variable when it comes to chains of

only two individuals. To my ears, sentence (68) sounds somewhat odd as a

description of a chain scenario. However, it is easy to turn up naturally occurring

examples with only two individuals, as in (69).

(68)   ?Today we had a mother and daughter pass the baton to each other.

(69)   a. The brothers pass the baton to each other in the 4x100 relay with
           Stephen the third leg and Courtney the anchor[51].
        b. Kristel watches as two of the other people in her relay try to pass the
           baton to each other[52].

        The example in (70) involves a chain interpretation of *evolve into* with a

three-membered antecedent.

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[49] http://mobile.reuters.com/article/olympicsNews/idUSL6E8JB32H20120811?irpc=970
[accessed 23 December 2013]

[50] http://www.valleyaths.org/results/s06_07/winter/road_rlys.html [accessed 23 December
2013]

[51] http://onlineathens.com/stories/051304/jef_20040513077.shtml [accessed 22 January 2014]

[52] http://jesus-deafchurch.blogspot.com/2010_11_01_archive.html?m=1 [accessed 22 January
2014]

(70) Those protohumans are generally known as *Australopithecus africanus*, *Homo habilus*, and *Homo erectus*, which apparently evolved into each other in that sequence[53].

I see examples like this as evidence that chain interpretations are available for more than just a short list of relations specified in the lexicon[54].

3.6.3   Other predicates

If the chain interpretation arises from the ordinary WR semantics, then it should be possible for non-asymmetric predicates to receive this interpretation.

In a production study, Hurst & Nordlinger (2011) found that participants sometimes used reciprocal sentences in describing chain-like scenarios with non-asymmetric predicates like *have a conversation with* or *talk to*. Specifically, in response to a video clip showing two people where one of them is speaking and the other is 'actively engaged in listening', participants offered descriptions like those in (71) (2011:83).

(71) a. Two guys having a serious conversation with one another.
      b. Person and boy talking to each other facing each other in a room.

Hurst & Nordlinger note that participants were less likely to offer reciprocal descriptions of other superficially similar scenarios involving events where one person hugged, hit or looked at another person (with that person not reciprocating). I think cases like those in (71) are not clear examples of a chain

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[53] Jared Diamond, *Guns, Germs and Steel*, Vintage, London, 1998, p36.

[54] This particular example is complicated in that the three individuals are kinds, and the evolution occurs over a long period of time. Mari (2014) might describe it as a 'historical reporting context' and Beck (2001) might see it as involving nonmaximality since these kinds involve countless individual members.

interpretation. Rather, in (71a), *have a conversation with* satisfies WR: speaking and listening are both ways of taking part in a conversation. In (71b), *talk to* seems to be being understood in the same way.

Philip (2000) found evidence that speakers sometimes accept chain interpretations with non-asymmetric predicates. In one experiment, English speaking adults allowed a chain interpretation of sentences like (72) 24% of the time. (This is how often they answered the question affirmatively in a scenario like Figure 5.)

(72)   Did the dog, the cat, the mouse and the rabbit squirt each other?

dog → cat → mouse → rabbit

Figure 5: Animals squirting (Philip's T1 condition)

In another of his experiments, Dutch speakers answered questions like (73) affirmatively in contexts like Figure 6 13% of the time. Generalizing over the two experiments, Philip (2000:14) reports that 'none of the adults tested gave the predicted no response one hundred percent of the time under the T1 condition'. In contrast, all of them gave the expected no response 100% of the time for the NO control condition[55].

(73)   Kietelen   de   katten elkaar?
        tickle   the   cats   RECIP
        'Are the cats tickling each other?'

---

[55] However, Philip reports that the difference between the T1 condition and the NO control condition was not significant.

cat1 → cat 2 → cat 3 → bird

Figure 6: Cats tickling (Philip's T1 condition)

Poortman (2011) discusses some pilot experiments in which Dutch speakers accepted the chain interpretation. Participants were given a drawing of the scenario in (74), and their task was to decide whether the picture was a possible depiction of the sentence in (75).

(74)   Cindy → Sofie → Emma

(75)   In   deze   tekening   kammen   Cindy, Sofie en Emma elkaar.
        in   this   drawing   combing   C.   S.   and E.   RECIP
        'In this drawing, Cindy, Sofie and Emma are combing each other('s hair)'

In Poortman's third pilot study, scenarios like (74) were judged acceptable 63% of the time. However, in the subsequent experiment (with a larger number of participants, test items, and verbs) the acceptance rate was much lower (around 20%).

These experiments suggest that the chain interpretation is fairly marginal for non-asymmetric predicates. Why should this be? The obvious difference between these predicates and the asymmetric ones we saw in §3.6.1 and §3.6.2 is that reciprocal sentences with non-asymmetric predicates have stronger readings available. This might be evidence that an SMH or other preference favouring strong interpretations is at work. Or it might be evidence that the predicate being non-asymmetric makes it harder to see the scenario as fitting a chain schema.

I have found some naturally occurring examples where non-asymmetric predicates receive chain interpretations. Consider example (76). This is the headline accompanying an online collection of 15 photos[56]. In each photo, a pet photobombs[57] another pet. (Note that *photobomb* is not asymmetric – I have found examples where two people are described as photobombing each other simultaneously, and the examples in (78) below are only felicitous if understood in this way.)

(76)   15 hilarious pets photobombing each other[58]

What is described is 15 instances of a two-item chain where one pet photobombs another. Likewise, example (77) is the jokey caption of a photograph of two mannequins. One is in the foreground and one in the background, as in a typical photobombing scenario. I see this as a chain interpretation: one mannequin photobombs the other[59].

(77)   Mannequins photobombing each other[60]

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[56] We should understand the headline as being short for something like '15 photos of hilarious pets photobombing each other'.

[57] "Photobombing is the act of inserting oneself into the field of view of a photograph, often in order to play a practical joke on the photographer or the subjects." [OED, from Wikipedia]

[58] http://wtfhub.com/2010/11/15-hilarious-pets-photobombing-eachother/ [accessed 16 May 2013]

[59] Given that it is possible for two people to photobomb each other simultaneously, it is also possible that the writer could have intended the SR interpretation.

[60] http://turbo-walking.blogspot.com.au/2013/07/mannequins-are-just-like-us.html [accessed 22 January 2014]

A complicating factor in (76) and (77) is that both are headlines/captions with the reciprocal in a participle phrase modifying the preceding noun. This seems crucial to their receiving a chain interpretation. According to my intuitions, the sentences in (78) all prefer non-chain interpretations.

(78)   a. In one photo, the pets photobombed each other.
        b. In one photo, the two mannequins photobombed each other.
        c. In this photo, the mannequins are photobombing each other.

It is unclear why it is that this structure aids the chain interpretation in (76) and (77). It is not the case that it generally allows for weak readings: a photo of one kid tickling another, where the other kid is not tickling them back, cannot be felicitously captioned *Kids tickling each other*.

For another example that we might see as a chain interpretation, consider (79).

(79)   The car rental company only has to fill it up the first time, and then
        after that the renters fill it up for each other.

Neither of these examples (photobombing, car-filling) is a prototypical example of a non-asymmetric predicate. I would say that photobombing is prototypically asymmetric. (It is tempting to see it as a case where typicality allows weaker readings ala Kerem et al. (2009), but if so why do the sentences in (78) prefer strong readings?) The car-filling example is asymmetric by virtue of the way that renters only use the car once usually, so they aren't around to have some other renter return the favour.

Though my account predicts that chain interpretations arise from the ordinary WR semantics, and so should be available no matter the predicate, the

chain interpretation appears to be fairly marginal for non-asymmetric predicates. This remains a puzzle for my account.

3.7 Conclusion

This chapter has defended the idea that all reciprocal interpretations arise from a cumulative semantic representation equivalent to WR. In particular, the chapter focused on the problem of interpretations that are weaker than WR: chain interpretations.

It was argued that approaches that see chain reciprocals as an ordinary part of the system, and assign them truth conditions weaker than WR (e.g. Dalrymple et al. 1998, Sabato & Winter 2012) fail to account for the variability in acceptability judgements of sentences with antecedents denoting two individuals. In contrast, such variability is a natural consequence of an approach where chain interpretations arise via pragmatic weakening from the WR semantics.

I argued for an analysis where, like other reciprocal sentences, chain reciprocals have a WR semantic representation. A chain interpretation is an imperfect way of satisfying the reciprocal truth conditions, since the individuals at the endpoints of the chain only take part in the relation in one direction. I suggested that getting to such an interpretation from the WR semantic representation involves a special kind of nonmaximality, distinct from the kind dealt with by Brisson (1998). The idea is that we can treat the individuals at the endpoints of a chain as exceptional. Unlike ordinary nonmaximality, allowing for endpoint exceptions is not restricted to cases where there are a reasonably large number of individuals – in the case of two-item chains, both individuals are treated as exceptions.

While this chapter has defended the WR semantics against weaker readings, the next chapter looks at the opposite problem: cases where reciprocal sentences are necessarily interpreted more strongly than WR.

CHAPTER 4

WEAK TRUTH CONDITIONS; STRONG CONSTRUALS

4.1 Introduction

I assume a semantic representation of reciprocal sentences that is equivalent to WR. Chapter 3 considered the question of how to account for chain interpretations, which are even weaker than WR. This chapter turns to the opposite issue: how to deal with stronger interpretations.

Here is a problem for the WR account: it seems that the sentence in (1) can only mean that each one of the kids hates every other one (i.e. the SR interpretation). This is much stronger than the requirements of WR, which would only require each kid to hate and be hated by at least one of the others.

(1)   Those five kids hate each other.

The WR account predicts that (1) should have other possible interpretations, notably WR. But this interpretation is not available. This kind of problem is not a new one. Proponents of lexical cumulativity likewise have weak semantics for plural sentences, and have observed that not all of the interpretations predicted by the cumulative semantics are actually available. Kratzer (2001) and Dotlačil (2010) propose that the cumulative semantics is constrained by a set of independently needed principles concerning natural groupings. This chapter looks at whether such principles can explain cases where only interpretations stronger than WR are possible.

The fact that many reciprocal sentences necessarily receive such strong interpretations seems to be damning evidence against the WR account. One approach, taken by Dotlačil (2010), is to supplement a semantic representation equivalent to WR with a version of the SMH that requires events to exemplify the strongest possible proposition. This chapter explores a similar approach, arguing that a preference for strong interpretations can be explained using economy conditions on mental representations, and specifically a preference for uniformity.

4.1.1 Where do we see stronger readings?

This section outlines the data that causes problems for the WR account.

First, there are stative predicates such as *know*, *like* and *resemble*. Reciprocal sentences with statives strongly resist WR interpretations – the stative (2a) requires that each kid hates the other four, while the eventive (2b) does not require that each kid hit and was hit by each of the others.

(2)   a. Those five kids hate each other.
        b. Those five kids hit each other.

By 'stative' here, I mean the class of lexically stative predicates. One test that picks out lexically stative predicates is awkwardness (or a meaning change) with the progressive as in (3).

(3)   Amy is {#hating/#knowing/hitting} Ben.

Both individual level and stage level stative predicates show this strong preference for SR. (Stative predicates like *know* and *hate* are individual level: roughly, they are understood to express permanent properties. Stage level

predicates like those in (4) express more transient properties, and resist WR interpretations just like individual level statives[1].)

(4)   The kids were {hidden from/available to} each other.

Second, there are neighbour interpretations[2]. Consider example (5). If we assume that the telephone poles are arranged in a line, then (5) means that there is a gap of 500 feet between each pole and its neighbour(s).

(5)   The telephone poles are 500 feet from each other.

Neighbour interpretations are stronger than WR in two respects: first, the relation must hold between an individual and its neighbour(s), not some arbitrary individual as WR would allow. Second, the relation holds between an individual and all of its neighbours. These two requirements are illustrated by the fact that example (5) is not felicitous in the scenarios in Figure 7, Figure 8 or Figure 9[3], even though each would satisfy WR.

A---250---B---250---C---250---D

Figure 7: Telephone poles, 250 feet apart

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[1] There are proposals (Kratzer 1989) that stage level and individual level predicates differ on whether they do (stage level) or do not (individual level) have an argument position for events. So the fact that both types of statives show this preference for SR is informative: it is not due to some quirk of individual level predicates.

[2] This is my shorthand for those reciprocal interpretations weaker than SR that are possible with symmetric predicates of temporal/spatial configuration. This is 'Intermediate Reciprocity' for Dalrymple et al. (1998).

[3] Dalrymple et al. (1998:166) point out that neighbour interpretations do not tolerate gaps. Schein (2003:334) discusses the problem that such scenarios cause for WR. Beck (2001) argues that the SMH chooses a stronger interpretation than WR (her situation-based WR) in neighbour examples.

B   500

100   A

C   500

Figure 8: Telephone poles, isosceles triangle

A---500---B -----700-------C---500---D---500---E

Figure 9: Telephone poles, with gap

Third, even the chain interpretations we saw in Chapter 3 must have truth

conditions stronger than WR according to Sabato & Winter (2012). They point

out that *The four circles contain each other* is felicitous in Figure 10's scenario (a),

but not in (b). The truth conditions of WR (plus endpoint exceptions as in

Chapter 3) would incorrectly allow both (a) and (b)[4].
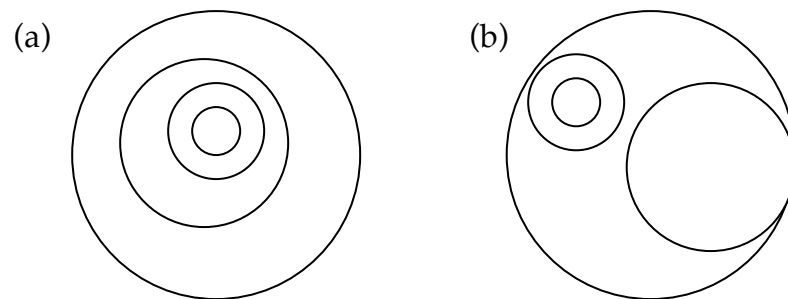
Figure 10: The four circles contain each other (Sabato & Winter 2012:224)

Finally, there is the question of the preferred interpretation of reciprocals

with eventive predicates. As discussed in Chapter 2, contra the predictions of

Dalrymple et al.'s SMH, eventive predicates allow WR interpretations. Not only

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[4] For the (b) scenario, I think the WR plus endpoint exceptions analysis from Chapter 3 would see
it as two separate chains: (naming the circles in order of size) one chain where <1,2>; the other
chain where <1,3><3,4> (and since *contain* is transitive, <1,4>)

are WR interpretations possible, but some evidence (Kerem et al. 2009; Dotlačil 2009) suggests that WR readings can be preferred. There is very little clear evidence that reciprocal sentences with eventive predicates are necessarily interpreted more strongly than WR[5].

To sum up, the clearest challenges for the WR semantic account come from statives like *know*, neighbour predicates like *sit next to*, and chain predicates like *contain*[6].

4.1.2   If SR is an implicature, it should be defeasible

One key piece of evidence against approaches with weaker truth conditions concerns examples like (6) (from Dalrymple et al. 1998:165).

(6)   #House of Commons legislators refer to each other indirectly; the most senior one addresses the most junior one directly.

Dalrymple et al. claim is that this example shows that the first clause must be understood as SR, and that that this is not a matter of pragmatic strengthening. If it were, they reason that it should be defeasible, and (6) shows that it is not. Likewise, Winter (n.d.:2) points out that (7) is infelicitous.

(7)   #Mary, Sue and Jane saw each other yesterday at 8pm, but it's possible that Mary didn't see Sue.

Is it necessary to conclude from the infelicity of (7) that *Mary, Sue and Jane saw each other* has a semantic representation with stronger truth conditions than

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[5] Certain eventive examples seem to receive SR interpretations. e.g. *A, B and C saw each other*. But I will argue that this is not generally true.

[6] Sabato & Winter (2012) point out that this problem is specific to relations that are strict partial orderings (i.e. are asymmetric and transitive). Not all chain predicates are strict partial orderings.

WR? One problem with this kind of evidence is that we know that people allow

or even prefer WR interpretations of reciprocal sentences with eventive

predicates, yet even in these cases asserting that some pair may not have taken

part in the relation sounds awkward. We know that a sentence like (8a) can

receive a WR interpretation (Philip 2000), so how are we to account for the fact

that (8b) sounds odd?

(8)   a. Alex, Bev and Chris pointed at each other.
      b. ?#Alex, Bev and Chris pointed at each other, but it's possible that
        Alex didn't point at Bev.

Given the evidence of weak readings for sentences like (8a) (Philip 2000; Kerem

et al. 2009; Dotlačil 2009), I do not consider the infelicity of (8b) as convincing

evidence that the sentence must have SR truth conditions.

4.1.3   Outline of the chapter

That some plural sentences necessarily receive interpretations stronger than the

cumulative truth conditions would suggest is not a new problem. Section 4.2

looks at proposals to limit the available interpretations based on salient

pluralities (§4.2.1), substantive pluralities (§4.2.2) and principles of natural

grouping (§4.2.3). Section 4.2.3 applies this approach to reciprocal neighbour and

chain examples.

Section 4.4 turns to the stative/eventive contrast: there is evidence that not

only reciprocals, but other plural sentences show a tendency for stative

predicates to resist weak/cumulative interpretations. Section 4.5 presents an

experiment that found evidence of the stative/eventive contrast both for

reciprocals and other plurals. Section 4.6 presents some approaches to the question of why statives require strong readings.

Section 4.7 looks at the question of how weak truth conditions can give rise to strong construals from the perspective of sentence processing. It argues that the stative/eventive contrast can be accounted for using economy principles at the level of discourse representation, moderated by plausibility considerations. Section 4.8 looks at evidence from reciprocals' co-occurrence with *except*-phrases.

4.2   Limits on cumulativity

The issue addressed by this chapter is not a new one. In assuming a weak/cumulative semantic representation, this approach to the semantics of reciprocal sentences faces a problem common to analyses of plurality that assume lexical cumulativity: not all of the construals predicted by the cumulative semantics are actually available. This section looks at proposals to limit possible construals by requiring that the pluralities referred to be salient (Schwarzschild 1996), substantive (Kratzer 2001) or available by natural principles of grouping (Dotlačil 2010).

4.2.1   Salient pluralities

Schwarzschild (1996:107) has us imagine two groups of prisoners, separated by an opaque barrier. He points out that (9) is likely to be judged false in this scenario, even though it is true that each of the prisoners could see and be seen by the other prisoners on their side of the barrier. That is, the scenario satisfies WR – even SR – within the subgroups.

(9)   The prisoners on the two sides of the room could see each other.

Schwarzschild argues that in this context, there are two salient subpluralities (the two groups on either side of the barrier), and those are the ones that are preferably understood to be in the reciprocal relation.

Here is the semantic representation I am assuming (Dotlačil's):

(10)   a. The prisoners see each other
        b. $(\exists e)(*see(e) \wedge <prisoners, prisoners, e> \in [\{<a, b, e'>: {}^{C}*\Theta_1(a)(e') \wedge {}^{C}*\Theta_2(b)(e') \wedge e' \leq e \wedge \neg a \circ b\}])$

The context supplies the two salient subpluralities of prisoners. Those two groups are preferably taken to be the experiencers and themes of the subevents. That is, even thought the cumulative semantic representation would allow for any collection of subevents that when summed together gave use <prisoners, prisoners, e> (as long as the non-identity condition is obeyed), our choice is constrained by which subpluralities are salient.

4.2.2   Substantive pluralities

Kratzer (2001:64) illustrates the need for limits on cumulativity with the sentences in (11), in the context of Figure 11 (based on Scha's (1981) example). We have the intuition that sentence (11a) is clearly true of Figure 11, while (11b) is not.

(11)   a. The sides of rectangle A are parallel to the sides of rectangle B.
        b. The sides of rectangle A are perpendicular to the sides of rectangle B.
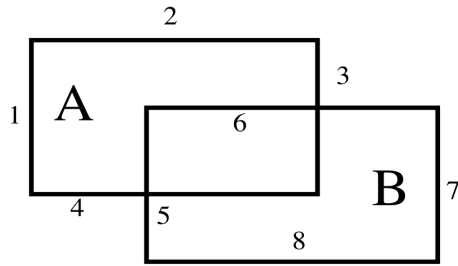
Figure 11: Rectangles

The infelicity of (11b) in this context is surprising, in light of the fact that cumulativity permits both of the inferences in (12) and (13). Lexical cumulativity leads us to expect that both of the sentences in (11) should be judged true in this context.

(12)   1+3 are parallel to 5+7
       2+4 are parallel to 6+8
       _____
       1+2+3+4 are parallel to 5+6+7+8

(13)   1+3 are perpendicular to 6+8
       2+4 are perpendicular to 5+7
       _____
       1+2+3+4 are perpendicular to 5+6+7+8

Kratzer's solution to this problem uses the concept of a 'substantive plurality'. Because we assume that the domains of individuals and eventualities are closed under sum, they include countless pluralities only some of which correspond to natural groupings in the actual world. These natural ones are the substantive pluralities. According to Kratzer's constraint for quantification over states, in (14), substantive pluralities restrict which states we are allowed to quantify over (2001:63).

138

(14)　Constraint for quantification over states:
　　　Quantification over states is restricted to sums of states whose participants
　　　are substantive pluralities

Kratzer uses this constraint to account for the puzzle concerning Figure 11.

Recall that of the two sentences in (15), only (15a) is judged to be clearly true of

Figure 11.

(15)　a. The sides of rectangle A are parallel to the sides of rectangle B.
　　　b. The sides of rectangle A are perpendicular to the sides of rectangle
　　　　B.

On Kratzer's view, each side of rectangle A forms a substantive plurality with

the corresponding side of rectangle B (e.g. sides 1 and 5 constitute a substantive

plurality, while a plurality made up of side 1 and side 8 is not substantive). Now,

all of these pairs of corresponding sides (which constitute substantive pluralities)

happen to be pairs whose members are parallel. Hence the states we need to

quantify over in the case of the *be parallel to* relation in (15a) are in our domain.

But in (15b), with *be perpendicular to*, we would need to quantify over states

whose participants are not substantive, an option ruled out by (14).

What makes something a substantive plurality? Kratzer (2001:32) stresses

the real-world basis of substantive groupings:

> You can't just stipulate the existence of substantive groups. They are there
> in reality. Actual teams, piles, bunches, flower arrangements, clubs,
> committees, congregations, and what have you - all correspond to
> substantive groupings of pluralities in the actual world.

Substantive pluralities can be based on temporal/spatial proximity. Kratzer

(2001:60-62) suggests that natural kinds can form the basis for substantive

pluralities. She has us imagine a situation where she owns a cat and a donkey,

and you own a cat and a donkey. The cats look alike and the donkeys look alike. In this scenario, she can truthfully say (16a) but not (16b).

(16)   a. My animals look just like your animals.
        b. My animals look very different from your animals.

The states where a donkey looks different from a cat are not available to us because those pairs are not substantive[7]. Only the states whose participants are a substantive plurality (in this case, both of the same kind) are available.

It seems that not just any similarity between individuals can be the basis for a substantive plurality. Consider Figure 12, where the perpendicular sides of the two rectangles share the quality of being dashed or solid lines. This similarity does not seem to be sufficient to justify seeing e.g. side 1 and side 6 as a substantive plurality: the sentence *The sides of rectangle A are perpendicular to the sides of rectangle B* does not seem to be true here[8].
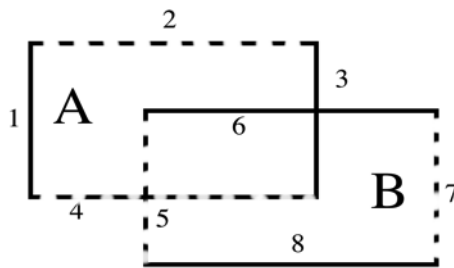
Figure 12: Rectangles with dashed/solid sides

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[7] In this context at least.

[8] It is certainly true that *The dashed lines of rectangle A are perpendicular to the dashed lines of rectangle B,* and *The matching sides of rectangle A and B are perpendicular.* That is, in order for the pattern to be involved in matching up the sides of A and B, it needs to be explicitly mentioned. It may be that 'parallel' and 'perpendicular' privilege certain kinds of properties (say, spatial location rather than e.g. colour) in determining the relevant substantive pluralities.

4.2.3 Principles of natural grouping

Dotlačil (2010) takes a similar approach to Kratzer. Going back to the rectangles example, for the sentence with *be parallel to*, we are looking for subevents where a side of rectangle A is parallel to a side of B. Splitting the plural event into subevents of this kind is natural – as shown in Figure 13, such subevents are 'convex spaces in which the two closest lines are put together' (2010:63). The split into subevents that would be required for the *be perpendicular to* case is not natural – the subevents would involve pairing up lines that are not closest to each other.
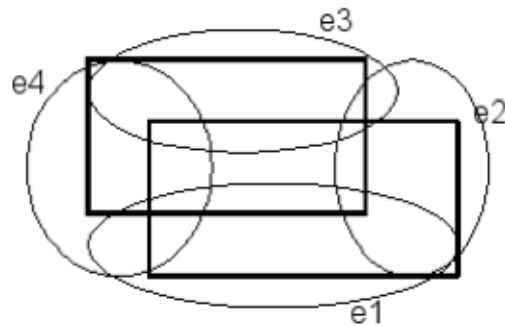
Figure 13: Split of events for 'parallel' (Dotlačil 2010:65)

Dotlačil (2010:64-68) cites Wertheimer's (1923) work on perceptual organization, in particular the principles that guide our categorization of visual stimuli into groups and objects. To illustrate, he provides the diagram in Figure 14. We perceive no grouping of the items in line A, other than the line as a whole. But in line B, the spacing leads us to perceive the items as being grouped in pairs ('principle of proximity'). In lines C and D, we see pairs again but this time based

on the principle of similarity. Line E illustrates the principle of common region: items within the same closed region of space are naturally grouped together.
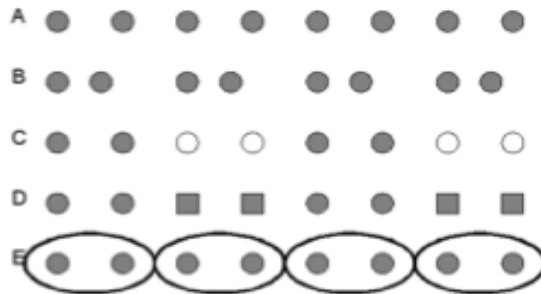
Figure 14: Demonstration of grouping principles (Dotlačil 2010:66)

In judging whether a sentence that describes a plural event is true in a given context, we are looking for atomic events which combine to make the sentence true. On Dotlačil's view, when we are splitting a complex event into its subevents, we do this in such a way as to respect principles of natural grouping.

4.3 Neighbours and chains

4.3.1 Neighbours

As we saw above, neighbour interpretations are stronger than WR in two respects: (1) the relation must hold between an individual and its neighbour(s), not some arbitrary individual, and (2) the relation must hold between an individual and all of its neighbours. This section looks at whether the requirements of salience / substantivity and natural groupings discussed in §4.2 can restrict the WR semantics appropriately.

I follow Dotlačil in seeing the neighbour interpretation as arising from WR semantics, constrained by natural principles of grouping. He provides (17a) as an instance of the weaker of his two reciprocal meanings, IR (for us this is WR).

(17) a. The telephone poles are 500 feet from each other.
    b. $(\exists e)(*\text{STAND}(e) \wedge <\text{the poles, the poles, } e> \in [\{<a,b,e'> : {}^{C}*\Theta_1(a)(e') \wedge {}^{C}*500 \text{ FT FROM}(b)(e') \wedge e' \le e \wedge \neg a \text{ o } b\}])$

This is true if the plurality of telephone poles can be split into parts such that each part is 500 feet from some other part. It can be true if the telephone poles are in a line and only the neighbouring ones are 500 feet apart. Dotlačil suggests that we can use grouping principles such as the principle of proximity ('all else being equal, the closest elements tend to be grouped together' (2010:65)) to only consider the spacing of poles that are adjacent. The principle of proximity correctly rules out the kind of grouping that would be required in order to judge sentence (17a) true in the scenario in Figure 15.

A---250---B---250---C---250---D

Figure 15: Telephone poles, 250 feet apart

Dotlačil does not go into detail on the question of how principles of natural grouping would rule out the scenarios in Figure 16 and Figure 17. In both cases, the subevents needed to satisfy WR would appear to be available via principles of natural grouping – each pole is 500 feet from a neighbouring pole (and the grouping into neighbours should be considered natural because of the principle of proximity).

A---500---B -----700-------C---500---D---500---E

Figure 16: Telephone poles, with gap

B   500

100   A

C   500

Figure 17: Telephone poles, isosceles triangle

Consider Figure 16. The WR semantic representation of sentence (17) has it that there is an event of the poles being 500 feet from the poles, and we are looking for subevents of 'being-500-feet-from' that can combine via cumulativity to make the sentence true. We require that these subevents be consistent with natural grouping principles. Looking at Figure 16, we can see 6 subevents of 'being-500-feet-from':

(18)   <A,B,e1>
        <B,A,e2>
        <C,D,e3>
        <D,C,e4>
        <D,E,e5>
        <E,D,e6>

If the principles of natural grouping provide the four pairs of neighbours (i.e. substantive pluralities) in (19), Kratzer's constraint in (20) means that the available events (states) of 'being-500-feet-from' are as in (21).

(19)   A+B
        B+C
        C+D
        D+E

(20)   Constraint for quantification over states:
        Quantification over states is restricted to sums of states whose participants
        are substantive pluralities

(21)   A+B: <A,B,e1>; <B,A,e2>
        B+C: none
        C+D: <C,D,e3>; <D,C,e4>
        D+E: <D,E,e5>; <E,D,e6>

But this would incorrectly predict that the sentence is true in this scenario,

because the events in (21) can sum to give the event required by (17):

<A+B+C+D+E, A+B+C+D+E, e1+e2+e3+e4+e5+e6>. What went wrong?

Here is one possibility: the assumption we made about what the available

substantive pluralities are was incorrect. What if we never have access to pairs of

neighbours as in (19)? The principle of proximity (or 'being neighbours' as a

basis for substantive plurality) never sees merely being a pair of neighbours as a

natural grouping. Consider pole D in Figure 18. What natural grouping principle

would group it with pole C but separate from pole E?

        A---500---B -----700-------C---500---D---500---E

Figure 18: Telephone poles, with gap

If 'being neighbours' is the basis for the substantive pluralities, each pole should

be grouped with all of its neighbours. On this view, the substantive pluralities

we have to work are in (22)[9]. According to the constraint for quantification over

states, we only have access to states whose participants are these pluralities, as

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[9] Alternatively, we would also have access to the substantive plurality consisting of all of the
telephone poles (since they are of the same kind/artifact), i.e. A+B+C+D+E. This also leads to the
sentence being infelicitous: there is no state of being 500 feet apart that involves all of those
participants.

shown in (23). Summing these five states does not result in an event that can satisfy (17b): note that pole C is missing from the first argument position in (24).

(22)   A+B
        B+A+C
        C+B+D
        D+C+E
        D+E

(23)   A+B: <A,B,e1>; <B,A,e2>
        B+A+C: none
        C+B+D: none
        D+C+E: <D,C+E,e3>
        D+E: <D,E,e4>; <E,D,e5>

(24)   <A+B+D+E, A+B+C+D+E, e1+e2+e3+e4+e5>

Alternatively, we might have it that the principle of proximity groups A+B together and C+D+E together, because of the 700 foot gap between them. If these are the substantive pluralities we have to work with, then the only states allowed under the constraint for quantification over states are <A,B> <B,A> and <D,C+E>. These cannot be summed to give the event required, hence the sentence is false in this context. It is unclear to me whether this version and the version where proximity groups an individual with all of its neighbours ever make different predictions.

4.3.2   A preference for stronger readings?

This section looks at some relevant empirical evidence on the preferred interpretations of reciprocal sentences in neighbour scenarios. Bott et al. (2011) and Poortman (2011) both find evidence that stronger readings than WR are available/preferred.

Bott et al. (2011) had participants read a sentence like (25) and then presented them with a picture like Figure 19's (a) or (b). They had 10 seconds to make a truth value judgement.

(25)   Exactly five dots are connected to each other[10].

(a)   (b)
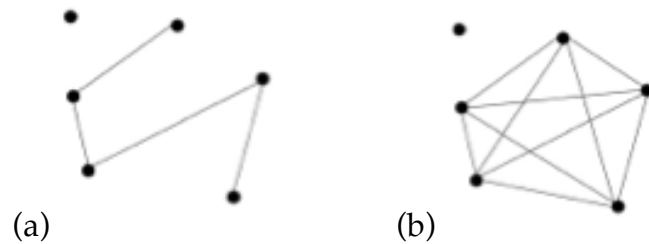
Figure 19: Intermediate (a) and Ambiguous (b) scenarios (Bott et al. 2011)

Rates of acceptance were fairly high for both[11], but Bott et al. found that sentences like (25) were accepted significantly more frequently in the Ambiguous scenario than the Intermediate one. Bott et al. assume that there are two possible readings of sentence (25): intermediate (which requires connectedness by a path) and strong (which requires pairwise connection)[12]. They interpret the preference for the Ambiguous scenario as evidence that people sometimes arrive at the strong interpretation[13]. This would explain why they reject the Intermediate

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[10] This experiment was conducted in German.

[11] Reading off their graph (2011:7) it appears that sentences like (25) were accepted about 88% of the time in the Intermediate scenario, and significantly more often (about 95% of the time) in the Ambiguous scenario.

[12] Their intermediate interpretation is like our neighbour interpretation (but disallowing partitioning). They also allow for a 'weak' interpretation which involves partitioning, but since in a picture completion task no participants provided such pictures, they ignore this weak/partitioned interpretation in the rest of their experiments.

[13] Overall in their experiment intermediate interpretations are preferred over strong ones.

scenario (which only fits the intermediate interpretation) more often than the

Ambiguous one (which fits both strong and intermediate interpretations).

That is, Bott et al. interpret these results as saying that participants

sometimes arrive at an SR interpretation of (25) and hence reject the Intermediate

scenario, which only satisfies WR. This is a challenge to the argument that I am

making here, that the semantic representation is equivalent to WR. Both

scenarios satisfy WR.

Bott et al. point out that interpreting their experiments is complicated by

the fact that the relation 'be connected to' is transitive. If A is connected to B, and

B is connected to C, then A is connected (though not directly connected) to C.

This means that we cannot assume that accepting the sentence in the

Intermediate scenario means that a participant has arrived at an intermediate

(WR) interpretation – if *be connected to* is understood as 'be directly or indirectly

connected to', the sentence is also true on an SR interpretation. But this is

irrelevant to the problem for the WR account: if the semantic representation is

equivalent to WR, participants should accept both scenarios, whether *be connected*

to is understood as a transitive relation or not[14].

For the WR account, the question is: why should people (slightly) prefer

the Ambiguous scenario? Since both scenarios fit with the WR semantics, we are

left to explain the preference for the Ambiguous scenario in some other way. One

possibility is that it is due to a preference for uniformity (further discussed below

in §4.7). That is, the Ambiguous scenario is more appealing than the Intermediate

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[14] If *be connected to* is understood to allow indirect connections, then WR predicts that the
sentence is true in the Intermediate scenario. If it is understood strictly as involving direct
connection, the WR account likewise predicts that it should be true in the Intermediate scenario
(via a neighbour interpretation: each dot is connected directly to its neighbour(s)).

one, because of the way that each individual is in the relation with every other one. This scenario is 'uniform' since each dot connects to every other dot; cf. the non-uniform Intermediate scenario, where some dots are directly connected to two other dots, and some are directly connected to only one other dot.

Another issue for the WR account is raised by Poortman (2011), who tested the acceptability of reciprocal sentences as descriptions of individuals in line configurations and open circle configurations (similar to our isosceles triangle above), as shown in Figure 20[15]. She found that 'A, B and C are holding hands'[16] was accepted significantly more often in the case of the line configuration (71% of the time) compared with the open circle configuration (44%), even though both scenarios involve exactly the same number of relations holding between the individuals.
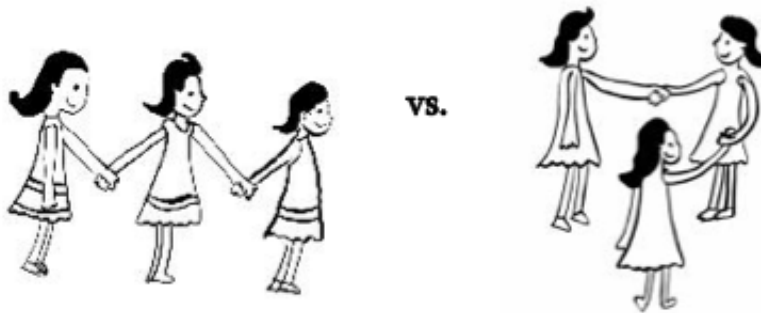
Figure 20: Poortman's (2011) line and open circle configurations

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[15] The majority of Poortman's test items were non-symmetric predicates, and the line and open circle configurations involved relations that held in one direction only. Poortman found no difference between line and open circle for these predicates – both had low rates of acceptability.

[16] The experiment was conducted in Dutch. The English translation is most natural with the implicit reciprocal (vs. *A, B and C are holding hands with each other*), but the Dutch sentence used in the experiment (I assume) involved the reciprocal *elkaar*.

Poortman concludes that the SMH is responsible for this difference. It insists on the maximal number of relations, given the configuration of the individuals. The problem with the open circle configuration is that A and C are not holding hands – thus not maximizing the number of relations of holding hands. When the girls stand in a line, the SMH respects the existing configuration: there is no way to add another instance of holding hands (without changing the configuration).

Here is the issue for the WR account: the WR truth conditions predict that both scenarios should be acceptable. In both cases, the very same relations hold, as shown in (26). The events in (26) can be summed as in (28) to satisfy the WR semantic representation in (27).

(26) <A, B, e1>
      <B, A, e2>
      <B, C, e3>
      <C, B, e4>

(27) a. A, B and C are holding hands (with each other).
      b. $(\exists e)(*hold.hands(e) \wedge <A+B+C, A+B+C, e> \in [\{<f,g,e'> : {}^{C*}\Theta_1(f)(e') \wedge {}^{C*}\Theta_2(g)(e') \wedge e' \le e \wedge \neg f \circ g\}]$

(28) <A+B+C, A+B+C, e1+e2+e3+e4>

So why is it that the line scenario is much better than the open circle scenario? Above, in the discussion the examples concerning the distance between telephone poles, we saw a similar preference for a line configuration (where each pole was 500 feet from its neighbours) over the open circle configuration (though there, we called it an isosceles triangle). There, we relied on principles of natural grouping to rule out the isosceles/open circle case: if being neighbours is the basis for the grouping or the basis for the substantive pluralities, then each individual should be grouped with all of their neighbours. In the line case, this

holds. In the open circle case, there are two neighbours that are not grouped together.

4.3.3 Chains

Sabato & Winter point out that *The four circles contain each other* is felicitous in Figure 21's scenario (a), but not in (b). The truth conditions of WR (plus endpoint exceptions) would incorrectly allow both (a) and (b).

(a)   (b)
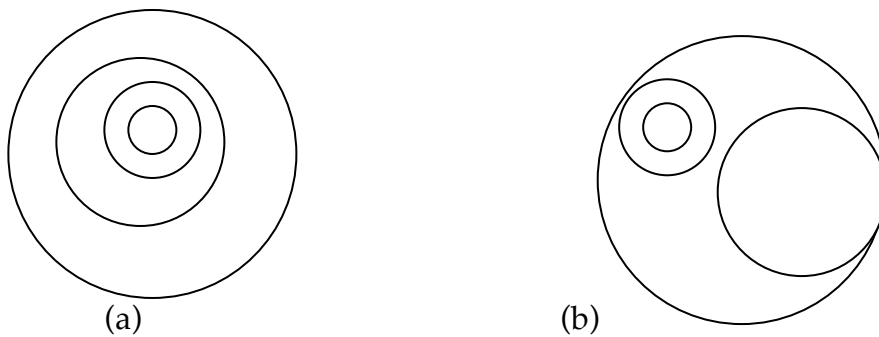
Figure 21: The four circles contain each other (Sabato & Winter 2012:224)

On Sabato & Winter's view, the problem is that the (b) arrangement does not allow the maximal number of containing relations. But it should be possible to rule out (b) using principles of natural grouping. Notice that the scenario in Figure 22 is similar to the (b) scenario, yet *The boxes are stacked on top of each other* seems felicitous. Perhaps the circles scenario resists being split into the subevents required because of the nature of the containment relation. (You cannot draw a convex space around circle 1 and 2 without including circle 3 and 4.)
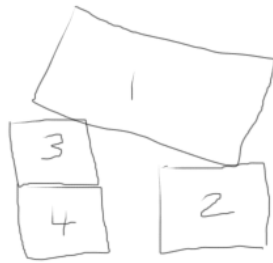
Figure 22: Boxes stacked on top of each other haphazardly

4.4 The stative/eventive contrast: plurals and reciprocals

We have seen that cumulative analyses have to deal with the fact that not all theoretically possible construals are actually possible. We saw that substantive pluralities / principles of grouping can restrict possible interpretations. This section looks at another area in which the WR analysis overpredicts: stative predicates resist weak readings.

4.4.1 The stative/eventive contrast for reciprocals

As we have seen, some of the strongest evidence for SR interpretations of reciprocals comes from sentences with stative predicates. For instance, Beck (2001:98) argues for the existence of SR with example (29).

(29) Susanne: We could take Amy, Bertha, Celia and Dave. They like
      each other.
      Ed: You're kidding! Bertha can't stand Dave!

As we saw in Chapter 2, unlike statives, eventive predicates do allow WR interpretations. We saw that Kerem et al. (2009) modified the SMH to take typicality into account: they explain that the WR interpretation can be the

152

strongest interpretation compatible with the typicality preferences of the predicate. Kerem et al. found a correlation between typicality preferences and the acceptability of the WR interpretation, but only for eventive predicates, not statives.

Evidence from intuitions seems to strongly confirm that stative reciprocals like (30) resist WR interpretations and must be interpreted as SR.

(30)   The five kids {know/like/resemble} each other.

However, the results of Kerem et al. (2009) bring this into question. They gave participants sentences like *A, B and C verbed each other*, and probed for a WR interpretation by asking whether it is necessary to conclude that A verbed B. They found similar rates of acceptance of WR (mostly less than 20%) for statives and eventives alike.

Experiment 3, below, looks for evidence of the stative/eventive contrast for reciprocals.

4.4.2   The stative/eventive contrast for plural sentences

There are some hints in the literature that this contrast between statives and eventives holds not only for reciprocal sentences, but plurals in general. Sauerland (1998) reports an observation made by Roger Schwarzschild that (31a) means 'Every student knows every professor', while (31b) is preferably taken to mean 'The students talked to one professor each'. Thus, the stative (31a) receives a strong interpretation, and the eventive (31b) a weak (cumulative) interpretation.

(31)   a. The students know the professors.
        b. The students talked to the professors.

This is not unexpected on the view that reciprocal sentences are a type of plural sentence, but the mechanism is unclear: why is it that statives resist cumulative interpretations?

Beck (2001), Winter (1996, 2001) and Dotlačil (2010) have argued that the SMH applies not only to reciprocal sentences but also other plural sentences. Beck (2001:136) argues that the cumulative interpretation is generally dispreferred, and 'seem[s] most natural when a doubly distributive interpretation is for some reason implausible'. So (32a) prefers the interpretation where both women know both men, while (32b) settles for the cumulative interpretation.

(32)   a. The two women know the two men.
         b. The two women married the two men.

The SMH approach faces the same issue with plural sentences as it does with reciprocals: while it has an account of why statives like *know* require strong readings, it overpredicts strong readings for eventives[17]. (Note Schwarzschild's observation about (31b).)

4.5   Experiment 3: Stative/eventive and weak interpretations

4.5.1   Introduction

This section describes an experiment designed to test two hypotheses. First, that the WR interpretation is less felicitous in the case of stative reciprocals than eventive reciprocals. (While evidence from intuitions suggests that this is the case,

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[17] As we saw in Chapter 2, Kerem et al. (2009) propose that this overprediction can be prevented if the SMH takes into account typicality preferences.

Kerem et al. (2009) did not find support for this.) The second hypothesis is that there are parallels between reciprocal sentences and other plural sentences in this regard. Experiment 3 looked at the acceptability of reciprocal sentences and those with two definite plurals as descriptions of 'cumulative/WR' situations. Participants were given a scenario, and were asked to decide whether the target sentence was a 'reasonable description' of that scenario.

4.5.2 Method

Materials and design   The experiment made use of a 2x2 design, with eventuality type (Stative/Eventive) and sentence type (Reciprocal/Plural) as factors.

Each item consisted of a short paragraph outlining a scenario, accompanied by a sentence which participants were asked to evaluate as a description of that scenario. The paragraph named a group of three individuals (in the case of the reciprocal condition, (33a/b)) or two groups of three individuals (in the case of the plural condition, (33c/d)). The paragraph went on to describe the relations that held between the individuals. In the reciprocal condition (33a/b), each of the individuals took part in the relation once in the first argument position and once in the second. In the plural condition (33c/d), each of the individuals in the first group took part in the first argument position once, and each of the individuals in the second group took part in the second argument position once. Conditions (a) and (c) involved stative predicates; conditions (b) and (d) were eventive.

(33) a/b. The magazine had three journalists at the press conference: Brown, Stewart and Mulligan.

        a.   Brown hated Stewart. Stewart hated Mulligan. And Mulligan hated Brown.

        b.   Brown quoted Stewart. Stewart quoted Mulligan. And Mulligan quoted Brown.

c/d. The newspaper had three journalists at the press conference: Moore, Martin and Thompson. And there were three actors: Tom Cruise, Brad Pitt and Harrison Ford.

        c.   Moore hated Tom Cruise. Martin hated Brad Pitt. And Thompson hated Harrison Ford.

        d.   Moore quoted Tom Cruise. Martin quoted Brad Pitt. And Thompson quoted Harrison Ford.

In the reciprocal condition, after reading the paragraph (33a/b), participants were asked to judge whether a reciprocal sentence (as in (34a/b) was 'a reasonable description'; in the plural condition, the sentence contained two definite plurals (as in (34c/d)). Participants could answer 'Yes' or 'No'.

(34) a. The journalists hated each other.
b. The journalists quoted each other.
c. The journalists hated the actors.
d. The journalists quoted the actors.

Fourteen items were constructed (see Appendix); there were fourteen stative predicates and fourteen eventive predicates. None of the predicates were symmetric, nor did they involve spatial/temporal ordering. This was important because they needed to be open to a strong interpretation, while not ruling out a weaker one. The diagnostic for stative predicates was awkwardness with the progressive.

The experimental items were included in a questionnaire with approximately 80 unrelated items. Two counterbalanced forms of the questionnaire were prepared. The items were counterbalanced so that each

participant saw two conditions of each item, but saw each predicate only once. A given participant saw either (33a) or (33b), and either (33c) or (33d); if they saw (33a) then they saw (33d).

Procedure   The materials were presented as part of a web-based questionnaire. The items were presented in an individually randomized order. Participants were unsupervised. They read the instructions, and then the program presented items one at a time. Participants selected their chosen answer by using the mouse to click one of two radio buttons ('Yes' or 'No'). Only when they had selected an answer would the program show the next item. Participants could work at their own pace, but in case of a period of inactivity of 10 minutes, the participant would be logged out and could not continue the experiment.

Participants   Forty-eight undergraduate students in Psychology courses at the University of Massachusetts took part in the experiment for course credit.

4.5.3 Results

Table 9 presents the mean acceptability rates for the four conditions in Experiment 3.

		Eventuality type	
		Stative	Eventive
Sentence type	Reciprocal	61%	79%
	Plural	71%	81%

Table 9: Acceptance rates in Experiment 3

Two-way repeated measures ANOVAs revealed significant main effects of eventuality type (Stative/Eventive) and sentence type (Reciprocal/Plural) as well as a significant interaction.

Sentences with stative predicates were accepted less often than sentences with eventive predicates ($F_1(47)=17.08$, $p<.001$; $F_2(26)=38.54$, $p<.001$). The results of simple effects tests confirm that this is the case for both reciprocals ($t_1(47)=4.46$, $p<.001$; $t_2(26)=6.96$, $p<.001$) and plurals ($t_1(47)=2.74$, p=.009; $t_2(26)=3.51$, $p=.004$).

The main effect of sentence type was significant by items and marginal by participants ($F_1(47)=3.88$, $p=.055$; $F_2(26)=15.17$, $p=.002$). And there was a significant interaction between eventuality type and sentence type – while both reciprocals and plurals showed a penalty for statives compared with eventives, this penalty was larger for reciprocals than plurals ($F_1(47)=6.36$, $p=.02$; $F_2(26)=9.42$, $p=.009$). Simple effects tests confirm that there was a significant difference between reciprocals and plurals in the stative condition ($t_1(47)=2.56$, $p=.02$; $t_2(26)=4.45$, $p=.001$), but not in the eventive condition ($t_1(47)=.6$, $t_2(26)=.97$, p's>.3). Figure 23 illustrates the interaction.
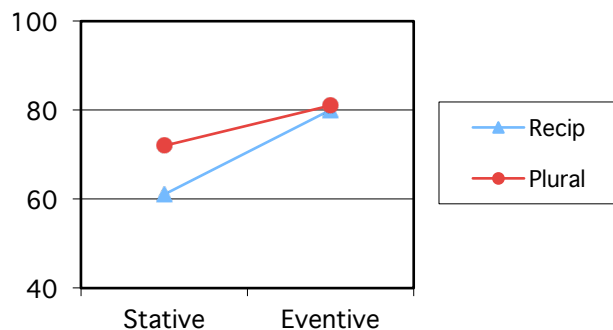
Figure 23: Results of Experiment 3

4.5.4 Discussion

4.5.4.1 *Parallels between reciprocals and plurals*

Experiment 3 found evidence that reciprocals and plurals pattern alike: for both, eventive predicates are more acceptable than stative predicates in cumulative/weak scenarios.

4.5.4.2 *Weak readings of statives are harder for reciprocals*

The experiment found an interaction between eventuality type and sentence type: while reciprocals and plurals pattern alike, the effect of eventuality type is greater for reciprocals. While there is no significant difference between reciprocals and plurals with eventive predicates, with statives there is a significant difference: reciprocals are accepted significantly less often.

In finding a contrast between stative and eventive reciprocals in terms of the acceptability of WR, the results of Experiment 3 differ from those of Kerem et al. (2009). It is likely that the difference is due to the fact that Experiment 3 had participants judge the acceptability of a sentence in the context provided, whereas Kerem et al. had participants read a reciprocal sentence (presumably fixing on their preferred interpretation), and then asked them a question about that interpretation[18].

How are we to understand the interaction in Experiment 3? In order to account for it, we need an account of why stative reciprocals and stative sentences with plurals should differ. And in fact there are reasons to expect that

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[18] This would suggest that in Kerem et al.'s experiment, participants preferred SR interpretations for both statives and eventives. Another difference between Experiment 3 and Kerem et al.'s experiment is the subject type: definite plural vs. conjoined names. Pragmatic and other effects of conjoined names will be discussed in Chapter 5.

coming up with the appropriate justification for a weak reading should be easier

for the sentences with two plural DPs.

Let's look at an example of a stative plural sentence from the experiment.

Given the context in (35), (represented in (36)) participants judged whether

sentence (37) was a reasonable description of the scenario.

(35)   There were three lawyers: Jesse, Mike and Robert. And there were
        three judges: Judge Green, Judge Rubin and Judge Stickney. Jesse
        understood Judge Green. Mike understood Judge Rubin. And Robert
        understood Judge Stickney.

(36)   s1: <Jesse, Judge Green>
        s2: <Mike, Judge Rubin>
        s3: <Robert, Judge Stickney>

(37)   The lawyers understood the judges.

Now, compare the corresponding stative reciprocal item. The context in (38)

spells out the existence of the three states in (39), and participants judged

whether sentence (40) was a reasonable description.

(38)   There were three lawyers: Amy, Steven and Ian. Amy understood Steven.
        Steven understood Ian. And Ian understood Amy.

(39)   s1: <Amy, Steven>
        s2: <Steven, Ian>
        s3: <Ian, Amy>

(40)   The lawyers understood each other.

There are some important differences. Note that in (36), each individual

takes part in only one of the states: each lawyer is paired with a judge. In contrast,

the individuals in (39) each take part in two states. It is easy to imagine a scenario

in which the pluralities in (36) are substantive – for instance, each lawyer is

arguing before a different one of the judges as in (41). In contrast, the overlap

amongst the participants in (39) doesn't allow such a scenario.

(41)   \<Jesse, Judge Green, s1\>   (in courtroom 1)
        \< Mike, Judge Rubin, s2\>   (in courtroom 2)
        \<Robert, Judge Stickney, s3\>   (in courtroom 3)

If this is what allows for the weak reading of (37), the prediction is that the

sentence will be less felicitous in a context that rules out the possibility that the

pairs are spatially / temporally separate. This seems to be the case – to my ears,

"The lawyers understood the judges" is an inappropriate description of (42).

(42)   There were some lawyers and judges standing by the fireplace. The
        lawyers were Jesse, Mike and Robert and the judges were Green, Rubin
        and Stickney. Jesse understood Judge Green. Mike understood Judge
        Rubin. And Robert understood Judge Stickney.

My argument here suggests that if we could come up with a way of

justifying separate situations for the stative reciprocal case, the description

would be more acceptable. The scenario in (43) attempts to do just that, but as a

description *The lawyers understood each other* still seems slightly odd.

(43)   There were three lawyers: Amy, Steven and Ian. They took part in a mock
        trial and each of them had to make a closing statement. When they made
        the statement, there was only one other person in the room: one of the
        other lawyers. That other lawyer gave them a pass-fail grade, based on
        whether they understood the argument. Steven made his statement in
        front of Amy. Ian made his statement in front of Steven. And Amy made
        her statement in front of Ian. It turned out that they all did well: Amy
        understood Steven's argument. Steven understood Ian's argument. And
        Ian understood Amy's argument.

        "The lawyers understood each other's arguments (so they all passed)."

4.5.4.3   No difference on weak readings for eventives

In the weak/cumulative scenarios tested in the experiment, there was no significant difference between the rates of acceptance of eventive reciprocals (*The journalists quoted each other*) and eventive plurals (*The journalists quoted the celebrities*).

The previous section explained the advantage that plural statives have over reciprocal statives by way of the difference between the two kinds of scenario: the reciprocal WR scenario has overlap, while the plural cumulative scenario can be viewed as three separate situations. The question then is: why does the plural advantage disappear in the eventive condition?

One possibility is that statives have a special requirement for substantivity. Another is that it is more difficult to view the subevents as separate situations in the case of statives versus eventives. Section 4.6 below explores these possibilities.

4.5.4.4   Comparison with a vagueness account

The experiment gave us two results to account for: first, the main effect that eventive predicates allow weak readings more readily than stative predicates. And second, the interaction between eventuality type and sentence type such that stative reciprocals are accepted significantly less often than stative plural sentences. This section looks at how an account that explains weak interpretations in terms of SR truth conditions plus nonmaximality (e.g. Dalrymple et al. 1998) fares against the results of Experiment 3.

The experiment can be seen to manipulate two factors that have been observed to encourage or aid nonmaximal interpretations: the eventuality type of the predicate, and the number of individuals described. Yoon (1996) claims that compared to sentences with eventive predicates, those with statives are less

162

likely to allow a nonmaximal interpretation. For example, the eventive predicate

in (44a) does not seem to require that every child got food-poisoning, but the

stative in (44b) does seem to require that all the children are 8 years old.

(44)   a. The children (who ate pizza here last night) got food-poisoned.
       b. The children (who are playing in the garden) are eight years old.

And, as discussed earlier, it is commonly observed that the larger the number of

individuals described, the more acceptable nonmaximal interpretations become

(Brisson 1998). It is easy to accept (45) as a description of a scenario where there

are ten kids, and one happens to be not taking part in the raft building. It is much

harder to do so if there are only three kids and one is not taking part.

(45)   The kids are building a raft.

The scenarios used in the reciprocal and plural conditions of the

experiment differ in the number of individuals involved: in the reciprocal

condition, the paragraph described the relations that held between three

individuals. In the plural condition, there were six individuals. Thus, the

reciprocal vs. plural manipulation of the experiment is confounded with a

difference in the number of individuals described.

Recasting the experiment in this way, we might expect an advantage for

plural sentences over reciprocal sentences. This is because plural sentences were

tested in a scenario with a larger number of individuals, which should be

associated with a greater tolerance for the nonmaximal interpretation. The other

prediction is that (following Yoon 1996) there should be an advantage for

eventive predicates over stative predicates: eventives should more easily allow

the nonmaximal interpretation. Putting these two predictions together, the eventive plural condition should be accepted most often (because it involves both factors hypothesized to aid nonmaximality). The eventive reciprocal and stative plural should be accepted less often. And the stative reciprocal should be accepted least.

On this view, the observed interaction – the lack of a difference between the eventive plural and the eventive reciprocal – is unexpected. There is no reason to expect the plural advantage to disappear in the eventive condition. The results of the experiment do not fit with an account that sees weak readings as arising from SR truth conditions via nonmaximality.

4.5.5   Conclusions

The results of Experiment 3 provide empirical support for the intuition that stative and eventive reciprocals differ regarding the availability of WR interpretations, with WR more difficult for statives. In addition, the experiment found evidence of the same kind of contrast for plural sentences: weak (cumulative) interpretations are more difficult for statives. The fact that the effect was larger for reciprocal sentences than those with definite plurals was argued to follow from the fact that the definite plural scenarios more readily allowed for a construal with separate situations, providing a way for the participants in those statives to be seen as substantive pluralities. It was left unresolved why this characteristic should matter for statives but not eventives, and the next section takes up this issue.

4.6 Statives and cumulative readings

As we saw in §4.2 and §4.2.3, substantive pluralities or natural grouping principles have been argued to restrict the possible interpretations that can arise from cumulative semantic representations. The discussion of Experiment 3 suggested that we might deal with the stative/eventive contrast in the same way: weaker readings are available for statives when the necessary subpluralities can be viewed as substantive, but it did not go into detail. Section 4.6.1 looks at how this kind of account might work. Section 4.6.2 compares this account with SMH approaches, and §4.6.3 looks at work by Schein (2003) and Mari (2014). Section 4.6.4 summarizes.

4.6.1 Substantivity and the stative/eventive contrast

As we saw in §4.2.3, it seems that natural principles of grouping (Dotlačil 2010) can account for neighbour/chain interpretations that are stronger than WR. This section addresses the question of whether the same is true of the stative/eventive contrast from Experiment 3.

Kratzer's constraint for quantification over states (2001:63) seems relevant:

(46) Constraint for quantification over states:
Quantification over states is restricted to sums of states whose participants are substantive pluralities

Could this explain the problem with WR scenarios for stative reciprocals?

This approach would have it that the problem with using sentence (47) to describe the WR scenario in (48) is that Amy+Steven, Steven+Ian, and Ian+Amy are not substantive pluralities.

(47)   The lawyers understood each other.

(48)   s1: <Amy, Steven>
        s2: <Steven, Ian>
        s3: <Ian, Amy>

But these same states are part of the SR scenario in (49), and (47) can truthfully

describe this scenario. Is Amy+Steven a substantive plurality in (49) but not in

(48)?

(49)   s1: <Amy, Steven>
        s2: <Steven, Ian>
        s3: <Ian, Amy>
        s4: <Amy, Ian>
        s5: <Steven, Amy>
        s6: <Ian, Steven>

If the lawyers are a substantive plurality, then the constraint for quantification

over states in (46) would seem to allow us to quantify over the states that they

participate in. If those states are as in (48), it is not clear why this is impermissible.

        Here is how the constraint for quantification over states could disallow

WR interpretations for statives. In an SR scenario, it is possible to look at it as

involving three states:

(50)   <Amy, Steven+Ian>
        <Steven, Amy+Ian>
        <Ian, Amy+Steven>

In each case, the participants are a substantive plurality: the three lawyers. The

three lawyers are the only substantive plurality in this context, so this is the only

way satisfying the WR semantics and satisfying the constraint for quantification

over states. States like those in (49) are unavailable because none of those pairs

are substantive pluralities. This would account for why stative reciprocals

166

demand SR interpretations: if the reciprocal's antecedent is taken to be a substantive plurality, and there are no other substantive pluralities, then only states where each individual is in the relation with every other are states which have participants that consist of substantive pluralities.

Angelika Kratzer (pc) has pointed out to me that the triangle scenario we saw with the telephone poles in §4.3.1 causes some difficulty for this kind of account. In Figure 24 we cannot rely on spatially defined principles of grouping to exclude the B+C pair.
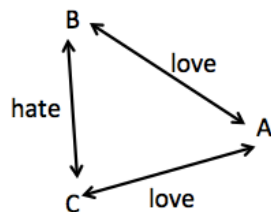
Figure 24: Love and hatred, in the triangle scenario

Imagine A is a polyamorous person with two partners. She loves both her partners and they love her back. But her two partners hate each other. We cannot say of these three people that they love each other. If each couple is a substantive plurality, on the account I am suggesting we might have expected that this would be possible. If we have access to the states of loving whose participants are substantive pluralities, then we would have <A+B, B+A, s1> and <A+C, C+A, s2>, and would predict that it is true that the people love each other. It is possible that the couples are not salient enough when they are not explicitly mentioned. While (51a) is false, it seems that (51b) is true in Figure 24.

(51) a. #They love each other.
       b. The couples love each other.

As we saw in Experiment 3, plural sentences – like reciprocals – show a stative/eventive difference when it comes to weak interpretations. If each girl chased at least one of the boys (and each boy was chased), sentence (52a) is a felicitous description. If each girl hated at least one of the boys (and each boy was hated), sentence (52b) is not a good description.

(52)   a. The girls chased the boys.
        b. The girls hated the boys.

One way of improving the stative sentence is to provide more context that pairs up the girls with boys (and then each girl hates her partner). But it needs to be noted that this is not merely a cumulative interpretation. It involves dependent definites: each girl hated 'her' boy. Notice that the indexical and numeral in (53) make the dependent definite analysis impossible, and while a weak reading is available in the case of (53a), it seems quite difficult for (53b). Thus, it seems that the weak reading of the stative reciprocal (52b) is because of the dependent definite.

(53)   a. Those three girls chased those three boys.
        b. Those three girls hated those three boys.

What we have just seen is that eventives can get a truly cumulative interpretation, whereas statives need a dependent definite interpretation or possibly a division into separate situations. This is because of the need for statives to obey the constraint for quantification over states. A doubly distributive interpretation (i.e. SR), where each girl hated each boy, satisfies the constraint because the participants are the two substantive pluralities: <girls, boys, e>. Any other grouping must be based on the participants in the state being

a substantive plurality. For instance, if the boy+girl pairs are in different rooms, then that could form the basis for the pairs being considered substantive.

This section has suggested that the stative/eventive contrast with respect to WR/codistributive interpretations might be accounted for using Kratzer's constraint for quantification over states.

4.6.2 Comparison with the SMH

This section looks at how SMH accounts fare against the stative/eventive contrast.

Dalrymple et al. (1998) can explain statives requiring SR by means of the SMH. In fact the SMH predicts SR whenever possible, so their account does not actually predict a stative/eventive contrast. They explain the weaker readings that sometimes arise with eventive predicates (*The men are hitting each other*) as SR truth conditions plus nonmaximality. I have argued against this (in §2.3.1), and as pointed out in the discussion of Experiment 3, that experiment found no evidence to support the nonmaximality approach to WR interpretations.

Beck (2001) and Winter (2001) claim that the cumulative interpretation is dispreferred, and only chosen when it is required by the context or the particular relation involved[19]. This applies not only to reciprocals, but plural sentences generally. Beck and Winter both see this as an SMH effect, since the doubly distributive (or SR) interpretation entails the merely cumulative (or WR) interpretation. Dotlačil (2010) presents a similar view. Dotlačil assumes a WR/cumulative semantics, and has the SMH choose strong (branching/SR) interpretations when possible. Dotlačil sees the SMH as related to a preference

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[19] Winter (2001) doesn't see it as cumulative, but as a weakened distributive.

for every subevent to be exemplified (2010:173). Like other SMH accounts, Dotlačil's has no difficulty explaining the SR preference for stative predicates: the SMH chooses the SR interpretation when possible, and statives are unrestricted (Sabato & Winter 2012). Dotlačil (2010:173) seems amenable to modifying the SMH to include typicality, so he might account for the acceptability of WR scenarios for eventives in the manner of Kerem et al. (2009). But recall from Chapter 2 that Kerem et al.'s account has a problem with statives: it seems that typicality does not license weak readings for statives. For this reason, the SMH+typicality approach does not provide a fully satisfactory account of the stative/eventive contrast.

4.6.3   Schein (2003) and Mari (2014)

This section looks at two accounts of reciprocal interpretations that specifically address the difference between events and states.

Schein (2003) follows Heim, Lasnik & May (1991) in analyzing *each other* as involving the distributive quantifier *each* and the definite description *the other*. On this type of account, the reciprocal requires the relation to hold between each member of the group denoted by the antecedent and 'the other(s)' (that is, the group denoted by the antecedent minus the individual that is being looked at in terms of the distribution). What is novel about Schein's analysis is his use of events. Consider Schein's (2003:346) analysis of the sentence *The plates are stacked on top of each other*:

(54)   ∃*E*[the *X*: plates[*X*]](stack[*E*} & Theme[*E*,*X*] & [ι*X*: Theme[*E*,*X*]]
       [Each *x*: *Xx*][ι*E'*: Overlaps[*E'*,*E*] & Theme[*E'*,*x*]] [∃*E''*: *t*(*E''*) ≤ *t*(*E'*)][ι*Y*:
       Others[*x*,*Y*] & Theme[*E''*,*Y*]] on-top-of[*E'*,*x*,*Y*])

Schein provides the following paraphrase of (54): 'The plates stack, (with) them

each stacking on top of the others stacked'. That is, according to Schein, this

sentence truthfully describes a stack of plates because we can imagine a set of

stacking events where each plate is stacked on top of the others that have already

been stacked[20].

Schein says of the stative/eventive contrast regarding the availability of

WR:

> If there is no unfolding event and evolution of prevailing conditions,
> reference to those in place at one moment coincides with reference to
> those in place at any other, from which the fundamental contrast between
> stative and eventive reciprocity follows. (2003:346-347)

That is, the aspectual difference between statives and eventives means that for a

stative like *know* or *like*, 'the others' is always going to pick out all of the others

for each individual. With an eventive predicate like *hit* or *photograph*, 'the others'

will pick out any others (if any) that have already hit or photographed someone,

in this temporally ordered set of events that we are positing. States specifying

temporal/spatial location (like 'being stacked on top of') are treated like events,

since they can be viewed as 'unfolding in time' like events[21].

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[20] Schein has it that the definite description in 'the others' should not actually be taken to assert the existence of any others – so e.g. the plate on the bottom of the stack is stacked on top of whatever others there are that have been stacked, which in this case is no other plates.

[21] Schein suggests that looking at the state in terms of events could be a sort of perspective adopted by the speaker.

The analysis of Mari (2014), though quite different in many respects from Schein (2003), makes use of a similar insight about the difference between stative and eventive predicates. In particular, Mari's analysis shares the idea that it is because statives do not unfold over time that the weakest interpretation available to them is SR.

As we saw in Chapter 3, in Mari's system the requirements of the reciprocal can be satisfied by events that do not occur in the actual world, but might occur in 'reasonable futures'. According to Mari's analysis, the truth conditions of the sentence *The two boxes are stacked on top of each other* are equivalent to SR. This works because we are allowed to consider not only the actual world, but also non-actual but reasonable futures. If the boxes are stacked as in Figure 25's (a), but might be arranged as in (b) at some point after speech time, then we are allowed to count this as satisfying SR: Box 1 is stacked on top of Box 2, and Box 2 is (i.e. could be) stacked on top of Box 1.

(a)   Box 1   (b)   Box 2
        Box 2   Box 1

Figure 25: Stacked boxes, actual and non-actual

Mari accounts for weak readings of eventive predicates in the same way: sentence (55) is true in the scenario in Figure 26 by virtue of the fact that there are events in the reasonable future that would make SR true. (That is, B could photograph A, C could photograph B, and A could photograph C.)[22]

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[22] In the interests of space, I am only discussing present tense examples here. Mari's system treats events prior to speech time differently: they are subject to a constraint similar to the SMH (2014:233-235).

(55)   The kids are photographing each other.

A → B
B → C
C → A

Figure 26: Kids photographing each other

However, according to Mari, it is not always possible to satisfy the reciprocal using events that occur in the reasonable future. Sometimes there is no reasonable future in which the relevant event occurs. This is the case with relations that are considered to be permanent, such as structures being of a certain height as in (56). There is no reasonable future in which one of the structures changes height[23].

(56)   #The Eiffel Tower and the Empire State Building are taller than each other.

In Mari's analysis, stative predicates such as *like* and *know* are similarly permanent. They 'denote a relation that holds permanently', and 'permanent properties close possibilities' (2014:236). Thus, we cannot judge (57) to be true if it is merely the case that John likes Mary, even though Mary might come to like John at some point after speech time.

(57)   John and Mary like each other.

It is not strictly true that a stative predicate such as *like* denotes a relation holds permanently. After all, my liking something begins at some point and can end. Mari does not go into detail on this point. We might understand it this way:

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[23] Any such scenario (a catastrophe, height being added/subtracted) doesn't count as a reasonable future. Mari cites Dowty's (1979) notion of inertia.

states describe a relation that simply holds, without beginning or end. (The beginning and end of a state are events.)

Both Schein (2003) and Mari (2014) link the stative/eventive contrast with respect to WR to statives holding permanently, not unfolding over time. In both analyses, this means that there is no choice but for SR to hold, because both analyses have an SR requirement that can only be escaped when the predicate is of a type that can change over time. Although both of them link the stative/eventive contrast regarding WR to the aspectual difference, both accounts require additional commitments[24].

4.6.4 Summary

So far in this chapter we have seen that the WR semantics can handle neighbour cases, if we assume principles of natural grouping as suggested by Kratzer (2001) and Dotlačil (2010).

Experiment 3 showed that reciprocal and other plural sentences both show a stative/eventive contrast when it comes to weak readings: stative reciprocals resist WR interpretations, and stative plural sentences resist cumulative/codistributive interpretations. However, the effect is stronger for reciprocals. This is because stative plural sentences are open to an interpretation where the subevents are viewed as separate situations (e.g. separate in space/time). This is not readily available for stative reciprocals because of the overlapping nature of the scenario. The importance of being able to be viewed as separate situations may be related to Kratzer's constraint for quantification over

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[24] Chapter 3 raised some issues for Mari's account.

statives: the subevents cannot be arbitrary, they must have participants which are substantive pluralities.

Section 4.6.1 suggested that stative reciprocals reject the WR interpretation because the only viable way of satisfying the cumulative semantics and also satisfying the constraint for quantification over statives is for the subevents to each involve all of the members of the antecedent.

Sections 4.6.2 and 4.6.3 looked at competing accounts of the stative/eventive contrast. Section 4.6.2 pointed out that SMH accounts have no difficulty with requiring SR interpretations for statives, but run into trouble explaining weaker interpretations for eventives. Section 4.6.3 looked at the accounts of Schein (2003) and Mari (2014), which both link the contrast in availability of WR to the aspectual difference, but require additional commitments to do so.

4.7 Cumulativity and the language processor

This chapter, and this dissertation, in assuming a cumulative/WR semantics for the reciprocal, assumes that the grammatical representation underspecifies the intended interpretation. This section looks at work on the collective/distributive ambiguity as a model for how the processor deals with such semantic representations. It is argued that the processor obeys economy principles at the level of discourse representation. These principles can account for the collective default, as well as preferences for branching over merely cumulative interpretations. It is proposed that the stative/eventive contrast can be accounted for using economy principles, moderated by plausibility considerations.

4.7.1 Semantic accounts of collective vs. distributive

In much work on this topic, the distinction between collective and distributive interpretations has been analyzed in terms of the presence or absence of a distributive operator. Consider the sentence in (58), which is ambiguous between a collective and distributive interpretation.

(58)   The kids ate a pizza.

On a collective interpretation, the kids shared one pizza. On a distributive interpretation each kid had their own pizza. The difference is often attributed to the presence of a DIST operator like the one in (59). For the collective reading, where they shared one pizza, 'ate a pizza' is simply predicated of the group of kids, (60a). But for the distributive reading, where each kid had their own pizza, DIST applies to the predicate as in (60b). This results in the predicate distributing down to each of the individual kids, as in (61).

(59)   DIST = $\lambda P\lambda x\forall y[y\in x \rightarrow P(y)]$

(60)   a. ate.a.pizza (the.kids)
          b. DIST(ate.a.pizza)(the.kids)

(61) $\forall x[x\in the.kids \rightarrow ate.a.pizza(y)]$

Kratzer (2001, 2005) presents a different view. She assumes a neo-Davidsonian, event-based semantics, and follows Link (1983) in assuming that the domain of individuals is cumulative, and includes atomic individuals and their sums (plural individuals). The domain of eventualities[25] works the same

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[25] The term 'eventuality' covers both events and states.

way: it is cumulative, and consists of atomic eventualities and their sums (plural eventualities).

Link uses the *-operator in (62) for pluralization. To see how it works, consider the predicates *cat* and *cats* in a world with only three cats: Tiger, Felix and Doug. The denotation of *cat* is the set of cats, as shown in (63a). The denotation of *cats* involves pluralization with the *-operator, as in (63b). The *-operator outputs all the pluralities that can be formed from the set of cats.

(62)   For any P, *P is the smallest property such that:
        i. $P \subseteq {}^*P$
        ii. if $a \in {}^*P$ and $b \in {}^*P$, then $a+b \in {}^*P$

(63)   a. $||cat|| = \{$Tiger, Felix, Doug$\}$
        b. $||cats|| = {}^*\{$Tiger, Felix, Doug$\}$

(64) ${}^*\{$Tiger, Felix, Doug$\} = \{$t, f, d, t+f, t+d, d+f, t+d+f$\}$

But in Kratzer's system, all predicates are plural from the start. The semantic representation of a sentence like (65a) is as in (65b)[26]. All of the predicates (*kid*, *agent*, *box*, *lift*) are inherently plural (they are marked with '*' to remind us of this). The representation in (65b) can be read 'There is a possibly plural event of lifting two boxes, with two kids as plural agent'.

(65)   a. Two kids lifted two boxes.
        b. $\exists e \exists x \exists y[{}^*kid(x) \ \& \ |x|=2 \ \& \ {}^*agent(x)(e) \ \& \ {}^*box(y) \ \& \ |y|=2 \ \& \ {}^*lift(y)(e)]$

This covers any collective, cumulative or iterative construal, as long as two kids did the lifting and two boxes were lifted in total. For example, imagine that Amy lifted Box 1 twice and then Amy and Bella together lifted Box 2. We have three

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[26] This still needs to be refined to account for subject/object distributives.

events as in (66). But because predicates are plural from the start, there are more than just three events. As shown in (67), there are many events of lifting. Sentence (65a) is true in this scenario because there are several variable assignments that make (65b) true, including that shown in (68).

(66) e1: Amy lifted Box1
      e2: Amy lifted Box1
      e3: Amy+Bella lifted Box2

(67) ||*agent|| = <Amy, e1> , <Amy, e2>, <Amy+Bella, e3>, <Amy, e1+e2>,
               <Amy+Bella, e1+e3>, <Amy+Bella, e2+e3>, <Amy+Bella,
               e1+e2+e3>
      ||*lift||= <Box1, e1>, <Box1, e2>, <Box2, e3>, <Box1+Box2, e1+e2>,
               <Box1+Box2, e1+e3>, <Box1+Box2, e2+e3>, <Box1+Box2,
               e1+e2+e3>

(68) e = e1+e3
      x = Amy+Bella
      y = Box1+Box2

The cumulative semantic representation in (65b) even covers the case where two kids each lifted the same two boxes (the branching reading, a distributive without variation). What it doesn't allow for is a distributive reading with variation, e.g. Amy lifted a pair of boxes and Bella lifted some other pair of boxes (i.e. the subject distributive reading). Such a plural event could have four boxes in it, not two as required by (65b). Nor does it cover the object distributive case where there are two boxes, each of which is lifted by two kids (so there might be four kids in all). These readings require phrasal cumulativity.

Traditionally, subject and object distributive readings are due to the presence of a DIST operator. For the subject distributive, the distributive predicate 'lift two boxes' applies to each of the atoms in the subject. For the object distributive, the object has wide scope and the distributive predicate is 'two kids

lift t₁'. Kratzer (2001) argues that rather than involving a DIST operator, such readings are due to a phrasal *-operator. Applying the plural operator at the phrasal level works much like a DIST operator would, except distribution does not have to be down to atoms. But a further difference is that pluralizing the predicate as in (69) does not just result in a subject distributive interpretation: pluralizing with the *-operator always retains the original extension. So (69) allows for all of the interpretations we saw before, plus subject distributive ones.

(69)   *λxλe∃y[*box(y) & |y|=2 & *lift(y)(e) & *agent(x)(e)]

Likewise, the object distributive interpretation arises when the object moves over the subject and then its sister predicate is pluralized as in (70). Again, this allows for all of the interpretations we saw before, but this time with the addition of object distributive ones.

(70)   *λxλe∃y[*kid(y) & |y|=2 & *lift(x)(e) & *agent(y)(e)]

Analyses that use DIST operators typically see them as optionally inserted, but in Kratzer's analysis, the presence of phrasal cumulativity is not optional: in her (2005) account, plural DPs bring along an extra plural operator – this plural operator obligatorily pluralizes the DP's sister predicate. On this view, a sentence like *Two kids lifted two boxes* has two distinct interpretations. Both of them allow collective/cumulative/iterative construals, but one groups these together with the subject distributive, and the other groups them with the object distributive. Kratzer (2005:17) predicts that the object distributive version should be

dispreferred, due to economy considerations[27]. This leaves the subject

distributive version as the default LF; this LF gives rise to collective, cumulative,

iterative and subject distributive construals (2005:17-18).

4.7.2   Psycholinguistics and collective/distributive

In Brooks & Braine's (1996) acquisition study, participants were given a sentence

(e.g. *Three boys are building a boat*) along with two pictures illustrating a

distributive reading with variation (each boy is building his own boat) and a

collective reading (the boys are working together on a single boat). Participants

were asked to choose the picture that went best with the sentence. The adults

tested overwhelmingly preferred the collective reading (97.5% collective vs. 2.5%

distributive).

In a series of questionnaire studies, Ussery (2008) investigated the

preferred interpretation of sentences with plural subjects and objects. Ussery

provided participants with sentences like (71), and asked them to select the

number of buildings that were designed (with two options: 4 or 12).

(71)   Three architects designed four buildings.

Choosing '4' fits with a collective (or cumulative) interpretation, while '12' is a

subject distributive. Ussery looked at a number of factors including the form of

the subject DP and the presence of a multiple-event bias (i.e. predicates that

prefer/require a noncollective interpretation), and found a reliable preference for

the non-distributive construal, regardless of these manipulations.

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[27] The object distributive is clearly a dispreferred interpretation (Gil 1982).

Frazier, Pacht & Rayner (1999) present evidence that the language processor commits to the collective reading during online processing. Their eye movement study compared sentences with distributive (*each*) or collective (*together*) disambiguations in either pre-verb or post-verb position, as shown in (72).

(72)   a. Sam and Maria {each/together} carried one suitcase…
        b. Sam and Maria carried one suitcase {each/together}…

They found evidence of a garden path effect when sentences were disambiguated to a distributive interpretation, but only when the disambiguation appeared in post-verb position. In pre-verb position, there was no significant difference between collective and distributive disambiguations. Frazier et al. interpret the interaction between distributivity and position thus: the processor fixes on a collective interpretation at the predicate. At the subject DP, the sentence is still vague as to distributive/collective and hence neither disambiguation is disruptive in the early position. But by the predicate, the processor has made a commitment to the collective interpretation, and so is garden-pathed if the sentence is then disambiguated to the distributive interpretation.

Brasoveanu & Dotlačil (2012) raise some worries about Frazier et al.'s use of *each* to disambiguate[28]. Their eye movement study has the same design as Frazier et al.'s, but they use *individually* to disambiguate. Like Frazier et al., they found that the distributive disambiguation in post verb position caused difficulty, and they interpret the results as showing that there is an online preference for the collective reading.

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[28] They argue that pre- and post-verbal *each* are distinct lexical items

Frazier & Clifton (2001) provide further evidence of an advantage for the collective interpretation. In a self-paced reading experiment, they compared two kinds of predicates: predicates biased towards a distributive interpretation (e.g. *resign, cough, put on makeup*), and unconstrained predicates which could receive either a collective or distributive interpretation (e.g. *call*, *arrive*, *dance*). They found evidence of a penalty for the distributive predicates. Specifically, there was an interaction such that sentences with a conjoined subject and an unconstrained predicate (73a) were read faster than their controls (73b,c), while those with distributive predicates (74a) were read marginally slower than their controls (74b,c).

(73) a. Jenny and David called.
      b. Jenny called and David did too.
      c. Jenny called. David did too.

(74) a. The accountant and the bookkeeper resigned.
      b. The accountant resigned and the bookkeeper did too.
      c. The accountant resigned. The bookkeeper did too.

Frazier & Clifton interpret the interaction as evidence that when the language processor encounters a sentence with a plural subject, it by default constructs a collective interpretation. There is a penalty associated with distributive predicates because the processor must give up the initial collective interpretation.

Brasoveanu & Dotlačil (2012) likewise investigated predicates that are pragmatically biased towards a distributive interpretation, like *drink an espresso*. Their eye movement study compared the effect of definite plural subject (75a), definite plural plus *all* (b), and definite plural plus *each* (c).

(75)   During the lunch break,
        a. the managers drank an espresso in the newly opened coffee shop.
        b. the managers all drank an espresso in the newly opened coffee shop.
        c. the managers each drank an espresso in the newly opened coffee
            shop.

Brasoveanu & Dotlačil found evidence of processing difficulty in the case of the definite plural (a) and *all* (b) compared with *each* (c). There were more regressions from the sentence final region for (a) and (b), and higher rereading time and total time on the predicate. This fits with Frazier & Clifton's (2001) results: even when the predicate is pragmatically biased towards a distributive interpretation, the processor appears to initially fix on a collective interpretation.

We have seen evidence in this section that there is a preference for collective (or non-distributive) interpretations, both in terms of the preferred final interpretation of an ambiguous sentence, and in online processing, where the processor appears to fix on a collective reading by default – even when it is pragmatically unlikely.

4.7.3   The view from lexical cumulativity

This section looks at how to explain the previous section's results in an account that assumes lexical cumulativity. On a view of the semantics where a distributive interpretation requires the presence of a distributive operator, the psycholinguistic results we saw in the previous section have a simple explanation: collective and distributive interpretations have distinct LFs (with the distributive requiring a DIST operator), and the collective LF is preferred for economy reasons. According to Frazier et al.'s (1999) MSC hypothesis, the psycholinguistic evidence supports the conclusion that collective / distributive is

a necessary semantic decision; collective and distributive interpretations arise from grammatical representations that are distinct/uncollapsible.

But on the lexical cumulativity account, the preference for a collective interpretation over a distributive one does not necessarily come from (economy considerations based on) the grammar. As we saw above, lexical cumulativity allows for both collective and distributive interpretations. Example (76a) can be interpreted collectively (77a) or distributively (77b); both interpretations arise from a single grammatical representation, (76b).

(76)   a. Two kids danced.
       b. $\exists e \exists x[*kid(x) \ \& \ |x|=2 \ \& \ *agent(x)(e) \ \& \ *dance(y)(e)]$

(77)   a. <Amy+Ben, e1>
       b. <Amy, e1> <Ben, e2>

The question then is how to account for the collective preference. One possibility is to note that collective and distributive interpretations differ in the mental representation of the discourse: the collective interpretation (77a) requires adding only one event to the mental model, whereas the distributive (77b) requires two. A preference for conceptual economy means that the processor should not instantiate more discourse entities (in this case events) than necessary[29]. (Frazier & Clifton (2001) suggest this as one possible account of their results[30].) Thus, the collective could be preferred for economy reasons even in a lexical cumulativity account (though it would be an economy preference at the level of

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[29] This is related to Crain & Steedman's (1985) Principle of Parsimony. Dotlačil (2010) casts it as a *REFERENT constraint.

[30] Frazier & Clifton do not assume lexical cumulativity, so their other suggestion is that the collective has a simpler LF than the distributive (which requires a DIST operator).

discourse/mental representation rather than at LF as in e.g. Frazier et al.'s (1999) account).

Explaining the preference for collective interpretations via economy at the level of the mental model means that we need to reevaluate Frazier et al.'s MSC. According to the MSC, barring misleading context, errors in interpretation are diagnostic of necessary grammatical choice points. But on the lexical cumulativity account, when the processor wrongly commits to a collective interpretation it is not because of a grammatically necessary choice. We might consider modifying the MSC, so that it operates at the level of mental/discourse representation.

Here's the picture we are working with: the processor builds a cumulative semantic representation and simultaneously instantiates a corresponding mental model. That mental model is built by a process that obeys economy: the processor by default instantiates a single event in the mental model.

Ussery (2008) showed that even with predicates that disprefer collective interpretations as in (78), the distributive interpretation with covariation is dispreferred. The preferred interpretation is cumulative. (Ussery's experiment does not tell us whether the preferred interpretation is branching (each of the boys kissed each of the girls) or merely cumulative.) The point is that in addition to a preference for collective interpretations, we also need the distributive with covariation to be dispreferred. This can also be explained using economy: the distributive with covariation is dispreferred because it requires the introduction of more individuals to the mental model (Dotlačil 2010[31]).

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[31] Dotlačil also discusses competition / the division of pragmatic labour in accounting for the effect of different kinds of subject DP on this preference.

(78)   a. Three boys kissed two girls.
        b. How many girls were kissed? [Two (not six)]

While Ussery's experiment using materials like (78) did not distinguish between branching and merely cumulative interpretations, Gil (1982) provides evidence that branching interpretations are preferred over merely cumulative ones. Gil's questionnaire study looked at sentences like *Three boys saw two girls* in Dutch, Hebrew and Bengali. Gil found a significant difference between the two scenarios in (79). Scenario (79a) illustrates the branching reading; scenario (79b) illustrates a cumulative reading. Participants judged the sentence to be true in scenario (79a) 90-98% of the time, but judged it true in scenario (79b) significantly less often (40-80% of the time[32]).

(79)   a. Boy 1 saw Girl 1, Girl 2
           Boy 2 saw Girl 1, Girl 2
           Boy 3 saw Girl 1, Girl 2

        b. Boy 1 saw Girl 1
           Boy 2 saw Girl 2
           Boy 3 saw Girl 2

Gil (1982) discusses only one predicate: *see*. One characteristic of *see* is that it can easily take a collective object – the most economical construal of *Three boys saw two girls* involves positing the existence of three events of seeing (where the pair of girls is seen together)[33]. Thus the branching and cumulative scenarios Gil used both minimally require three events of seeing. But consider the predicate *kiss* – the branching interpretation of *Three boys kissed two girls* would involve 6

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[32] This difference was significant for Dutch and Hebrew, but only approaching significance for Bengali.

[33] I'm excluding collective interpretations (e.g. where the boys are in teams)

events, while the cumulative would only require 3 events. If branching is still preferred over cumulative, then our economy-based account has something to explain. It would tell us something about economy: either we are measuring it incorrectly, or else there is another preference that is stronger. We could see the branching reading as more economical – despite involving more events – because of the uniformity: each boy kisses the same girls. It would be interesting to have some data on examples like Gil's, but with the same number of individuals in subject and object (*Two boys kissed two girls*), because a preference for one-one pairings might plausibly affect economy calculations too.[34] That is, it is plausible that the difference between the branching scenario in (80a) and the merely cumulative scenario with one-one pairing in (80b) is not so stark as the contrast between Gil's examples in (79).

(80)   a. Boy 1 kissed Girl 1, Girl 2
         Boy 2 kissed Girl 1, Girl 2

       b. Boy 1 kissed Girl 1
         Boy 2 kissed Girl 2

Gil provides evidence that merely cumulative interpretations are dispreferred compared with branching cumulative interpretations. But it appears that merely cumulative interpretations are not dispreferred in general. In one of Ussery's (2008) experiments, participants were given two paraphrases of a sentence like (81) (merely cumulative (a) and collective (b)), and asked to select their preferred paraphrase. Ussery found no significant difference between the two.

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[34] Recall Schwarzschild's example of the students talking to the teachers. A one-one preference might be involved in arriving at the cumulative interpretation that Schwarzschild says is preferred.

(81)   Two tailors made four suits.

        a. Altogether they made four suits. For example, the tailors work for
        different designers and each tailor made fewer than four suits. The total
        number of suits made added up to four.

        b. They made four suits together. For example, the tailors work for the
        same designer and they worked as a team to make each of the four suits.

        This is surprising, since in the previous section we saw evidence of a very

strong preference for collective interpretations. But notice that both of the

scenarios in (82) involve four events of suit-making. And both involve the same

number of individuals.

(82)   a. e1: Tailor 1 made Suit 1
           e2: Tailor 1 made Suit 2
           e3: Tailor 2 made Suit 3
           e4: Tailor 2 made Suit 4

        b. e1: Tailor 1+2 made Suit 1
           e2: Tailor 1+2 made Suit 2
           e3: Tailor 1+2 made Suit 3
           e4: Tailor 1+2 made Suit 4

Thus, the economy preferences we have talked about so far do not choose

between the two. This result makes sense if we see the collective interpretation as

an extreme version of cumulative, with groups rather than atoms. Either (82a) or

(82b) can be chosen, depending on what the cover is. (Schwarzschild (1996)

assumes that a definite plural DP makes both covers salient – one with

individuals in different cells (which we would need for the cumulative

interpretation), and one with all in one cell (which would give the collective

interpretation).)

        Ussery's experiment is unnatural in that participants were given only two

options: one (the collective) is hypothesized to be the most preferred, the other

(merely cumulative) is – based on Gil (1982) – hypothesized to be the least preferred. The scenarios disallow the branching interpretation, which is typically preferred over merely cumulative (Gil 1982). Nevertheless, the fact that the merely cumulative interpretation is not chosen significantly less frequently than the most preferred interpretation is interesting. It goes against all the claims (e.g. Beck 2001, Winter 2001, Dotlačil 2010) that (merely) cumulative interpretations are dispreferred and only chosen when necessary. But on an account where both arise from the same LF, and without a SMH that consistently disprefers merely cumulative interpretations, it is not too surprising. Both the collective and merely cumulative interpretations in (82) involve the same number of individuals and the same number of events, so they are equally economical.

Here's the picture we have arrived at: a single cumulative LF that gives rise to collective/cumulative/iterative (and subject distributive) readings. The processor prefers to instantiate the fewest individuals in the mental model. This means the possibly plural event in the semantic representation is by default instantiated as a single event in the mental representation. This shows up as a preference for collective (online and offline).

As for non-collective interpretations, the branching interpretation is preferred over a merely cumulative interpretation (Gil 1982). But Ussery (2008) suggests that merely cumulative interpretations are more readily available than would be predicted by SMH proponents (Beck, Winter, Dotlačil).

4.7.4 The question of phrasal cumulativity

So far, I have followed Kratzer (2005) in assuming that a plural subject automatically results in phrasal cumulativity. On this view, a sentence with a

plural subject has a single LF that allows collective/cumulative/iterative interpretations as well as subject distributive[35]. This view led me to explain the collective default (e.g. Frazier, Pacht & Rayner 1999) in terms of an economy preference for adding the fewest events to the discourse representation.

There is an alternative. It could be the case that phrasal cumulativity is optional in the presence of a plural DP. If so, if the processor obeys economy in building LFs, then we expect that a sentence like (83) will by default receive an LF without phrasal cumulativity, and that does not allow for a subject distributive interpretation.

(83)   Sam and Maria carried one suitcase

This makes the processor's preference for collective over subject distributive a result of economy at LF.

But it is not the case that we should abandon the idea that economy at the level of the mental model is needed. The default LF for (83) without phrasal cumulativity still allows for cumulative 'distributive' interpretations without variation (e.g. Sam carried the suitcase, then Maria carried it.). Economy explains why the preferred interpretation is collective.

4.7.5   Processing reciprocal sentences

We saw that, assuming lexical cumulativity, we no longer can explain the collective preference using economy at the level of LF. Instead, we can explain it

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[35] This is the default, since the version that allows object distributive requires movement and is dispreferred.

using economy in the mental model. The collective interpretation is the most economical because only one event is instantiated in the model.

What happens when the processor encounters a reciprocal predicate, as in example (84)? Economy predicts that a single event is added to the discourse representation[36]. It is reasonable to assume that the processor adds to the discourse representation a single event, with the kids as agent and theme of that event. The semantic representation requires that that event's subevents must add together, via cumulativity (and respecting the reciprocal's non-identity condition) to give the correct result.

(84)   The kids in that class photographed each other yesterday.

I am proposing that the processor treats a reciprocal sentence like any other sentence with a plural subject: by default it commits to a single event. In non-reciprocal sentences, that leads to the collective default/preference.

If the reciprocal were incompatible with the processor's collective default, the results of Frazier, Pacht & Rayner (1999) might predict processing difficulty in the post-verb region. Recall that they found a garden path effect when the processor encountered the distributive disambiguation *each* in the post-verb region, suggesting that it had already committed to the collective interpretation by that point. A complication here is that *each other* is both the 'disambiguation' to the reciprocal interpretation and the object of the verb. Frazier, Pacht & Rayner's results only tell us that at the point in the sentence after both the verb and object, the processor is committed to the collective interpretation. If the

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[36] I am assuming no special cover (e.g. where the kids are in pairs). Chapter 5 addresses partitioned interpretations.

processor does not make this commitment on the verb itself but only after the object, it is possible that *each other*, as the object of the verb, comes early enough to head off any garden path effect.

Experiment 2 (in Chapter 2) provides some relevant eye movement data. Although it was testing another hypothesis, it provides data on reciprocal vs. non-reciprocal sentences like (85). As discussed in Chapter 2 (§2.5.2), the experiment found no sign of processing difficulty for the reciprocal in the post-verb region. (There was however a marginal main effect of reciprocal on the sentence final region: reciprocal sentences had longer total times in this region[37].) We can at least say that Experiment 2 found no evidence of an immediate garden path effect in the post verb region.

(85) The editors | teased | {each other / the intern} about the spelling | errors

I assume that by default the processor adds a single event to the discourse representation. In this respect the reciprocal is treated like a collective. It is possible that in some – perhaps many – cases (especially where the antecedent numbers greater than two) the representation is left that underspecified. We know that the subevents of that event must add up by cumulativity to give the right result, and that the reciprocal's non-identity condition must be respected. But I don't know of any clear evidence that the processor must instantiate these subevents in the mental model.

By taking this position, my account runs into the issue of the contrast between reciprocals and reflexives. Both have co-reference between subject and

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[37] In Chapter 2 I speculate that this is a sentence wrap-up effect for reciprocals but it is not clear what is responsible for this effect.

object, but they differ on the identity/non-identity condition. Is identity/non-identity something that is immediately added to the mental representation? Something to think about is that according to Cable's (2014) analysis, reflexives in English, except for in certain circumstances, need to be interpreted with a D-operator (i.e. phrasal cumulativity) [38].

In terms of preferences related to more fully spelled out interpretations, the preference for uniformity is relevant. We saw this preference above, explaining Gil's result where branching interpretations have an advantage over merely cumulative ones. I suggested that this can be seen as an economy preference, speculating that it is more economical to in effect apply the same 'predicate' to each individual in the antecedent. This preference favours SR interpretations. As I just mentioned, there is little evidence that this is a necessary decision[39]. If we think of Gil's experiment, participants were given a sentence and a scenario and asked if it was true in that scenario. A higher rate of acceptability in the branching scenario than in the merely cumulative scenario does not necessarily mean that the language processor has fixed on a fleshed out branching interpretation of the sentence. It could instead mean that the branching scenario is a more attractive/economical way of satisfying the

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[38] Cable argues that the English reflexive is Focus-marked. There are two possible LFs: cumulative and distributive (i.e. with phrasal cumulativity). In a context that does not provide contrasting individuals, the cumulative LF is uninterpretable. The cumulative interpretation of a reflexive sentence – which can be satisfied by mixed scenarios i.e. reflexive or reciprocal – is only available in a context that provides contrasting individuals. For example, in the context of the question *Did the parents wash the kids?* the reflexive sentence *No, the kids washed themselves* is true in a mixed scenario where one kid washes herself and other kids wash/are washed by other kids.

[39] The strongest evidence that it is necessary is that statives seem to invite/require SR. But as we shall see in §4.8 below, evidence from exceptives suggests that stative reciprocals rarely receive fully spelled out SR interpretations.

cumulative/WR truth conditions because it satisfies the preference for uniformity.

Another relevant preference concerns substantivity. There is a large body of work related to substantivity in the psycholinguistics literature, mostly using plural anaphors as a probe of mental representations. This work finds that individuals that are ontologically homogenous (Koh & Clifton 2002), that share a location and goals (Carreiras 1997, Kaup & Kelter 2002), or that fill the same thematic roles (Koh & Clifton 2002) are more easily grouped into plural discourse entities. I see all this as evidence that plural discourse entities prefer for their individual parts to share as many characteristics as possible. Turning from individuals to events, Moltmann (1992:428) argues for a preference for plural events to be what she calls 'integrated wholes' (i.e. substantive pluralities):

> 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.

Much like a plural discourse entity prefers the individuals that constitute it to be of the same kind and share location/goals/thematic roles, a plural event prefers its subevents to be close together in time/space etc.

The preference for uniformity and the preference for 'event integrity' are expected to come into conflict with plausibility. In many cases, the SR interpretation favoured by uniformity is going to involve many subevents. If five kids photographed each other, uniformity favours the scenario where there are 20 photographing events. Event integrity requires all of those photographings to be close together in space/time. This is implausible.

But not all kinds of events will be implausible: if there are a small number of individuals, if the event does not take much time or involve movement/physical contact, or especially if it is stative, then we expect that preferences for event integrity and uniformity (i.e. the SR construal) will not lead to an implausible interpretation. This brings us back to the familiar stative/eventive contrast with respect to WR.

As we saw in Chapter 2, Kerem et al. (2009) provide evidence that there is a correlation between the strength of a predicate's preference for a single patient per agent, and the acceptability of the WR interpretation. E.g. *stab* strongly prefers a single patient, and has a higher rate of acceptance of WR; *see* does not have a strong preference for a single patient, and has a lower rate of acceptance of WR. According to Kerem et al. the SMH takes into account typicality: in their MTH system, a reciprocal sentence can truthfully describe a scenario if it contains the maximal number of relations consistent with typicality preferences. A problem for Kerem et al.'s account is that there is no correlation between typicality and the availability of WR for stative predicates. Kerem et al. have no account of this fact.

If we look at Kerem et al.'s typicality data in a different light, we can make sense of the lack of a correlation for statives. Kerem et al. do not draw attention to this, but one of the hidden assumptions here is that their typicality judgements for eventives involve the typicality or plausibility of the agent interacting with two patients simultaneously. In one of their studies determining typicality preferences, participants were given the sentence 'The boy is hitting', and in a forced choice task chose the scenario where the boy is hitting one patient over the one where he is hitting two patients. Kerem et al. take this as evidence that *hit*

has a preference for a single patient. But we could just as well take it as evidence that a single agent preferably does not take part in two hitting events simultaneously. If this is what is at issue, rather than the number of patients, then we have an answer to why typicality is irrelevant for statives. The question of how typical/plausible it is for multiple states of some kind to hold simultaneously is different, presumably because of the fact that states simply hold at a time rather than taking time.

On a sentence completion task, *hate* might have a high percentage of singular objects. But that does not provide any information about the plausibility of hating multiple things simultaneously. In contrast, I am arguing that the same measure does tell us something about the plausibility of simultaneous eventives. I think that for eventives, part of the calculation that goes into arriving at a typicality judgement involves the likelihood of an agent taking part in two events of that kind simultaneously or close in time. For statives, this part is irrelevant.

I have argued that a reciprocal sentence has a cumulative semantic representation equivalent to WR. The processor by default posits a single event in the mental representation (via economy). That single event must satisfy WR (any subevents must sum together via cumulativity to give the appropriate result, and the reciprocal's non-identity condition must be respected). If the mental model goes into more detail about the subevents of that single event, there is a preference for uniformity (which favours a branching/SR scenario over merely cumulative). In addition, there is a preference for events to have integrity (Moltmann 1992). The preferences for uniformity and event integrity can conflict with plausibility. When there is no conflict with plausibility (statives, eventives

without physical contact e.g. *see*) uniformity favours SR. When there is a conflict with plausibility, the preference for SR will be weaker.

4.7.6   Economy in mental models

I have argued that economy in mental models plays a part in both the fact that distributive interpretations with variation are dispreferred (Ussery 2008; Dotlačil 2010) and that collective interpretations are preferred for sentences with plural subjects (Frazier et al. 1999; Frazier & Clifton 2001; Brasoveanu & Dotlačil 2012). An issue for this kind of approach is whether we can find any empirical evidence regarding the contents of mental models.

In fact, as we will see in Chapter 5, there has been quite a lot of work on the conceptual representations associated with plural DPs. But an issue of particular interest to us in this chapter – the conceptual representation associated with events – is less well studied.

Huffman (2011) introduced an interesting new methodology for investigating the mental model. She uses an experimental task used by Berent, Pinker, Tzelgov, Bibi & Goldfarb (2005), where participants are shown either a single word or two words, and their task is to judge how many words they have been shown. Berent et al. found that when a single word appeared, participants were slower to make the 'one' judgement when that word was plural. That is, the number information associated with the plural interfered with the judgement task. Huffman (2011) extends the same methodology to words appearing in sentential contexts.

In one experiment, she looked at collective and distributive sentences like those in (86). Of interest was the contrast between the singular indefinites in (86a)

and (86b). On a distributive interpretation as in (86a), the sentence probably describes multiple boxes. On a collective interpretation as in (86b), there is one box. Huffman's experiment looked at whether the conceptual plural information associated with *box* in (86a) interfered with the task in the same way as the number information in Berent et al.'s study.

(86) a. Each of the men carried a **box** up the stairs.
      b. Together the men carried a **box** up the stairs.
      c. Each of the men carried some **boxes** up the stairs.
      d. Together the men carried some **boxes** up the stairs.

Sentences were presented incrementally in chunks of one or two words in response to the participant pressing a button. At each button press, either the next word or pair of words appeared. When a word or words appeared in blue, this was a cue for the participant to make a judgement about how many words they saw. Huffman found that as expected, the 'one' decision took longer when the word was plural marked (e.g. *boxes* in (86c,d)) than singular (e.g. *box* in (86a,b)). But of interest to the question of mental models, she also found an interaction between number marking and collective/distributive. It took longer for participants to make the 'one' decision about *box* in the distributive sentence (86a) vs. the collective sentence (86b). Huffman concludes that in the distributive sentence the singular *box* is associated with a plural conceptual representation, and this is what interferes with the judgement task.

Huffman also looked at whether having multiple events in the mental model might similarly interfere with the judgement task. This experiment involved intransitive verbs that are biased towards a distributive interpretation, like *sleep*.

(87)   The {cat/cats} **slept** on the rug.

The idea was that in a sentence like (87) with a singular subject, there is only one sleeping event. With a plural subject, there is one sleeping event per cat. If the mental model makes this distinction between a single event vs. multiple events, then participants should be slower to make the 'one' judgment on the verb when the subject is plural. However, Huffman found no such difference.

Huffman (2011:85,88) suggests that this may be interpreted as evidence that the processor leaves the number of sleeping events underspecified in sentences like (87). She speculates that the distributive bias of the predicate may not be a strong enough cue to the processor to instantiate multiple events, and that a distributive quantifier might be a stronger cue.

Her recent work (Patson & Warren, forthcoming) finds evidence that distributive quantifiers as in (88b), complex reference objects (i.e. conjoined DPs) as in (89b), and frequency adverbials as in (90b) all interfere with the judgement task on the verb. In each case, the 'one' judgement on the verb takes longer in the (b) version than the (a) version. Patson & Warren argue that the presence of these linguistic markers leads comprehenders to add multiple subevents to the mental model.

(88)   a. Together the hikers calmly **pitched** a small tent
        b. Each of the hikers calmly **pitched** a small tent

(89)   a. The dogs lazily **sat** in the sun
        b. The cat and the dog lazily **sat** in the sun

(90)   a. On Saturday, the soldier excitedly **returned** for a weekend
        b. Every Saturday, the soldier excitedly **returned** for a weekend

Huffman's (2011) null result with sentences like (87) contrasts with Frazier & Clifton's (2001) study which found that predicates biased towards a distributive interpretation (e.g. *resign*) were read slower than neutral ones. Above in §4.7.3, I suggest that Frazier & Clifton's result can be seen as evidence that the processor by default instantiates a single event in the mental model; predicates biased towards a distributive interpretation require revising the mental model. The results of Patson & Warren (forthcoming) suggest that the contrast between these two results may hinge on the difference in subject DPs; Huffman's study used definite plurals while Frazier & Clifton's study involved conjoined DPs (i.e. complex reference objects).

In conclusion , the methodology introduced by Huffman (2011) is a promising tool for investigating the mental model.

4.7.7   Conclusion

I have argued that a preference for a strong (doubly distributive/SR) construal of reciprocals does not mean that their semantic representation has such strong truth conditions. Rather, strong readings can be derived from weak semantic representations via preferences to do with natural groupings (in the case of neighbour/chain predicates) and economical ways of spelling out the underspecified LF (in the case of the uniformity preference, which favours branching/SR interpretations). My account is similar to that of Dotlačil (2010), who uses a version of the SMH to choose branching/SR interpretations over merely cumulative/WR ones. Dotlačil sees this as a preference for events to exemplify the strongest proposition (2010:73). On my view, it is possible to see the preference for uniformity as an economy preference: applying the same

'predicate' to each of the individuals in the subject/antecedent of the reciprocal is the most economical way of spelling out the subevents. Compared with a non-uniform scenario like a merely cumulative one, a uniform (branching/SR) scenario involves adding more events to the mental model, and in this respect a preference for uniformity is not obviously a type of economy preference. Yet a uniform scenario can be seen as more economical than a non-uniform one, in that it is simpler than a non-uniform one: there are no arbitrary differences between the individuals; each individual takes part in the same way.

The approach that I am arguing for sees strong/SR scenarios as having a certain attractiveness or simplicity that merely cumulative/WR ones lack. When the language processor is called upon to spell out the underspecified cumulative truth conditions in more detail, this kind of scenario is most economical. I predict that the processor need not fully instantiate all of the subevents that verify a reciprocal sentence. Preferences like that for uniformity, which chooses SR interpretations over WR ones, do not always come into play.

The next section looks at some evidence from exceptives. I argue that exceptives provide evidence in support of the idea that reciprocal sentences rarely are associated with fully spelled out interpretations equivalent to SR.

4.8 Reciprocals and exceptives

This section looks at evidence from free exception phrases[40]. On Moltmann's (1995) analysis, exceptives require the presence of universal quantification, either

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[40] As opposed to connected exception phrases: *Every boy except John came* (Moltmann 1995)

an actual universal or negative universal quantifier (91a), or at the level of
implications (91b).

(91)   a. Except for John, {every boy/all boys/no boy /*a lot of boys/*three
            boys/(?) most boys/(?)few boys} came.
         b. The place is deserted except for a cat.

On Moltmann's analysis, the free exception phrase in (92) is applying at the level
of implications. Because *came* is interpreted distributively, at this level there is in
effect a universal quantifier ranging over the boys, and thus the exception
phrases can felicitously modify the sentence.

(92)   The boys came except for John.

If we assume Moltmann's analysis of exceptives, felicity with an exceptive can be
seen as diagnostic of the presence of a universal. In the case of reciprocals, an SR
interpretation should make available the necessary universal.

4.8.1   Unmodified reciprocal sentences rarely co-occur with exceptives

It turns out that in naturally occurring text[41], it is rare for a reciprocal to co-occur
with an exceptive in the absence of an explicit universal or *all*. And removing the
universal or *all* tends to result in an infelicitous sentence, as shown in (93) - (95).

(93)   a. All of the students screwed each other except Screech[42]
         b. ?#The students screwed each other except Screech

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[41] My evidence is Google searches for the string 'each other except'. (I have not investigated cases
where the exceptive is not adjacent to *each other*.)

[42] http://www.sickchirpse.com/saved-by-the-bell-the-truth/ (accessed 16 May 2014)

(94) a. …a group of 39 Indiana friends and neighbors formed a train of 11 wagons and headed west… They were all related to each other except the J. A. Tiffany family, who were missionaries[43].
      b. ?#They were related to each other except the J. A. Tiffany family, who were missionaries.

(95) a. Everybody was talking to each other except the two of us[44].
      b. #{We/Our group of friends} were talking to each other except the two of us.

This is surprising since we assume that stative reciprocals usually, and eventive reciprocals at least sometimes, prefer SR interpretations. That should be enough to satisfy the exceptive.

Google searches do turn up a handful of cases with a definite plural antecedent without a universal or *all*. For the most part they involve lexically stative predicates as in (96) and (97).

(96) The two families really don't like each other, except for all us younger cousins because we don't know any better[45].

(97) Walter Jackson's skit, 'Space High School', is a story about a group of planets, portrayed as the Roman gods for which they're named, who were friends with each other except for Pluto, who was no longer part of their group.

It is difficult to find naturally occurring examples with an eventive predicate (in simple past) and without a universal quantifier or *all*[46]. Dalrymple et al.

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[43] http://www.kancoll.org/articles/martin/westliberty.htm (accessed 16 May 2014)

[44] http://uk.answers.yahoo.com/question/index?qid=20120306114414AAV5RR9 (Accessed 8 April 2013)

[45] A quote from the novel *The Perks of Being a Wallflower*. Found via: http://www.freewebs.com/shirtsleeves/quotes/perks.html (Accessed 8 April 2013)

[46] Here is an example that may be of this kind, but I think it is open to an analysis where *annihilating* is paraphrased as 'killing everyone', and that is the universal that the exception phrase operates on (like Moltmann's 'deserted' example (91b)):

(1998:165) provide the constructed example in (98). It has a lexically eventive

predicate, but note that the sentence is grammatically stative (habitual). Likewise,

the naturally occurring example in (99) is grammatically stative, with progressive

aspect.

(98)   House of Commons legislators refer to each other indirectly, except the
        most senior one addresses the most junior one directly[47].

(99)   A scuffle broke out between the Baltimore Ravens and San Francisco
        49ers during Superbowl XLVII… The players were pushing and shoving –
        each other. Except for Ravens cornerback Cary Williams, who gave one of
        the referees a pretty good shove[48].

Brisson (2003:175) does provide an example of this kind, however, and to my

ears her example, in (100), sounds felicitous[49].

(100)   The students recognized each other, except for Jenny.

It is not clear what the relevant difference is between (100) and (101).

(101)   ?#The kids {hit/saw} each other, except for Anna.

It is possibly related to the fact that *The students recognized each other* seems to

more strongly prefer an SR interpretation than *The kids hit each other* does (but

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In The Apocalypse Troll, *two entire Standard Sci-Fi Fleet battle groups, each crewed by
thousands of individuals of one race or another, end up annihilating each other except for a single
cyborg for the bad guys and a single human fighter pilot for the good guys.*

(http://tvtropes.org/pmwiki/pmwiki.php/Main/SoleSurvivor) (Accessed April 8 2013)

[47] This needs to be altered slightly to more closely parallel the exceptives we are looking at in this
section:

*House of Commons legislators refer to each other indirectly, except for the most senior one. He or she
addresses the most junior one directly.*

[48]

http://www.zap2it.com/blogs/raven_cary_williams_shoves_ref_in_super_bowl_should_he_ha
ve_been_ejected-2013-02 (Accessed 10 May 2014)

[49] Despite this grammaticality judgement, it is not clear to me what this sentence means exactly.

note that *The kids saw each other* seems to prefer SR). Given how hard it is to find

acceptable or naturally occurring examples of this kind, I see this as evidence

that eventive predicates in natural text almost never receive fully spelled out SR

interpretations.

4.8.2 Brisson: exceptives require distributivity

Brisson (2003) argues that exceptives require the presence of a quantificational

element, e.g. a DIST operator. One of the pieces of evidence she uses to justify

this claim concerns Taub's generalization[50]. She notes that Taub's generalization

holds for exceptives: while collective activities and accomplishments can co-

occur with exceptives, collective states and achievements cannot.

(102)   a. #The girls are a big group, except for Kim and Hannah.
        b. #The students elected Mike, except for the sophomores.
        c. The campers built rafts every summer, except for the youngest ones.
        d. The students built a raft, except for Maggie and Josh.

Brisson (1998, 2003) argues that activities and accomplishments have two sites

for a DIST operator. The higher one results in an ordinary distributive

interpretation, while the lower one is compatible with a collective interpretation:

there is a single collective event, but the distribution results in each individual

having their own subevent within that event. Because states and achievements

do not have the lower site for the DIST operator, there is no collective

interpretation compatible with a DIST operator.

Brisson (1998) originally made this argument about *all*, which can occur

with collective activities and accomplishments (*The girls all carried the piano*

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[50] Taub (1989) observed that *all* is compatible with collective activities and accomplishments but not collective states and achievements.

upstairs) but not collective states and achievements (#*The girls are all a big group*). (This is Taub's generalization.) According to Brisson, *all* requires the presence of a quantificational element, namely DIST. Because collective states and achievements cannot co-occur with DIST, they cannot co-occur with *all*. Since exceptives also obey Taub's generalization, Brisson (2003) suggests that they too require the presence of DIST. Both *all* and exceptives operate on the domain of quantification.

On Brisson's (2003) view, reciprocals always contain a quantificational element equivalent to DIST since they always involve distribution over the parts of the antecedent[51]. (In this respect they contain 'hidden distributivity'.) This predicts that reciprocal sentences will always be compatible with exceptives (2003:176). But as we saw in §4.8.1, most naturally occurring examples of reciprocal sentences with exceptives include *all*, and are degraded when *all* is removed. It seems that the reciprocal itself is not enough to license the exceptive.

If exceptives require the presence of DIST, a possible account of the reciprocal facts is that first, any 'hidden distributivity' within the reciprocal is not sufficient for the exceptive, and second that by default there is no DIST operator present in sentences like (103a,b). (On an account where distributive interpretations come about via phrasal cumulativity: these sentences by default do not involve phrasal cumulativity.)

(103)   a. The kids photographed each other.
        b. ??The kids photographed each other except Amy.
        c. The kids all photographed each other except Amy.

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[51] Brisson favours an account like Beck's where reciprocal sentences contain a DIST operator (2003:176).

When *all* is present as in (103c), it forces the presence of the necessary DIST element. It seems that the reciprocal itself cannot do this.

4.8.3   Conclusions about exceptives

This section looked at evidence from exceptives relevant to the interpretation of reciprocal sentences. On the view (e.g. Moltmann 1995) that exceptives require the presence of a universal or *all* (either explicitly or at the level of implications) the fact that reciprocal sentences modified by exceptives almost always seem to require the presence of a universal/*all* supports the idea that such sentences (without a universal/*all*) are rarely associated with fully spelled out interpretations equivalent to SR.

On Brisson's (2003) view, exceptives require the presence of a quantificational element, namely DIST, and since reciprocals inherently involve distribution, they should license exceptives. We saw that naturally occurring reciprocal sentences with exceptives almost always also have *all*, and are degraded when *all* is removed. I conclude that any 'hidden distributivity' within the reciprocal is not enough to satisfy the exceptive. Rather, what is required is a DIST operator (or phrasal cumulativity). It may be that the evidence from reciprocals and exceptives can be accounted for if phrasal cumulativity is optional, and is not present in the default LF.

In conclusion, the exceptive facts seem to fit the account I have presented here: that reciprocal sentences are associated with WR/cumulative semantic representations, and that fully spelled out SR interpretations are rarer than SMH account would have us believe.

4.9   Conclusion

This chapter has argued that cumulative semantic representations, despite having weak truth conditions, can nevertheless favour strong interpretations. The chapter argues that extragrammatical preferences for natural groupings, or for uniformity, result in interpretations stronger than that required by the semantics.

A requirement for pluralities to be substantive, or principles of natural grouping, can account for the stronger-than-WR interpretations of neighbour/chain examples.

Experiment 3 showed that reciprocals and other plurals show a tendency for stative predicates to resist cumulative/WR interpretations. I suggested that Kratzer's constraint for quantification over states may explain why statives resist weak readings, and why reciprocals show this tendency more strongly than other plural sentences.

The chapter looked at plural sentences from the perspective of sentence processing. It argued that economy preferences favour mental/discourse representations of reciprocal (and plural) sentences that posit a single event. For plural sentences, that equates to a preference for collective interpretations. For reciprocals, that single event must have subevents that via cumulativity satisfy the WR truth conditions. But there is little proof that the processor must fully instantiate those subevents in all cases. When the processor is called upon to fully instantiate those subevents, certain scenario types (i.e. SR) are attractive because they are economical – not in terms of the number of events posited, but

rather in the way that each individual takes part in the event in the same way (I call this the preference for uniformity).

CHAPTER 5

PARTITIONING AND THE SINGLE EVENT PREFERENCE

5.1 Introduction

The previous chapter argued that, due to the influence of extragrammatical preferences, a cumulative semantic representation equivalent to WR may give rise to stronger interpretations than required by the semantics. Two types of preferences were discussed: a preference for pluralities to be substantive or based on natural grouping principles, and a preference for uniformity in the mental model. These preferences were argued to result in interpretations stronger than WR in the case of neighbour/chain predicates and statives generally. Chapter 4 argued that evidence regarding the online processing of plural sentences supports the idea that economy principles favour adding the fewest individuals and events to the mental model. It was argued that reciprocal sentences, like other sentences with plural subjects, are by default represented in the mental model by a single event.

The chapter addresses two main topics. The first one is related to the idea that a reciprocal sentence by default introduces a single event to the mental model. Fiengo & Lasnik (1973) observe that reciprocal sentences prefer an interpretation where they describe 'one general event'; the subevents are preferably simultaneous or close in time. In fact, in some cases it seems that this is the only felicitous interpretation: it does not seem possible for a sentence like *Amy and Ben stared at each other* to describe a scenario where Amy stared at Ben for a while, and then later Ben stared at Amy. From the perspective of the

cumulative semantics, this is somewhat unexpected. If *A saw B*, and *C saw D*, then via cumulativity we can conclude that it is true that *A and B saw C and D*. But the inference in (1) does not go through.

(1)   Amy stared at Ben (from 1 to 2 pm).
        Ben stared at Amy (from 3 to 4 pm).
        _____

        Amy and Ben stared at each other.

As in Chapter 4, economy principles at the level of the mental model, and a preference for pluralities to be substantive, are argued to be responsible for this preference.

The second topic addressed in this chapter concerns the possibility of partitioned interpretations. Fiengo & Lasnik (1973) observe that stative reciprocal sentences disallow partitioned interpretations. As discussed in Chapter 4, a sentence like *The kids love each other* receives an SR interpretation, where each kid loves every other kid. But Fiengo & Lasnik's observation concerns partitioned SR interpretations, where SR holds within subsets. Such interpretations are rejected for stative reciprocal sentences. If we assume a cumulative semantics, this is surprising. If *A and B ate pizza*, and *B and C ate pizza*, then by cumulativity it is true that *A, B, C and D ate pizza*. Likewise, the cumulative account would predict that the inference in (2) should be valid.

(2)   Kid 1 and Kid 2 love each other.
        Kid 3 and Kid 4 love each other
        _____

        The kids love each other.

211

I argue that this restriction on stative reciprocals has the same source as the restriction on WR interpretations seen in Chapter 4: statives have special requirements regarding substantivity.

Sabato & Winter (2010) propose that the reciprocal itself never licenses partitioned interpretations. In their view, partitioned interpretations of reciprocal sentences only ever arise through implicit quantification of the antecedent. This chapter defends the idea that partitioned interpretations should always be available, given cumulativity.

5.2   Preference for a single event

A reciprocal sentence like *Those two cars crashed into each other* can describe a number of different scenarios. It could be that car #1 and car #2 collided (which seems to be the preferred interpretation), or it could be that car #1 crashed into car #2, and then some time later, car #2 crashed into car #1. In both cases there are two instances of crashing; the difference is that in the case of the collision, the two crashes happen simultaneously.

Section 5.2.1 concerns the intuition that such sentences prefer a construal where the two crashing events are subparts of a single larger event (i.e. they are simultaneous, or at least, close together in time). This observation is due to Fiengo & Lasnik (1973). Section 5.2.2 looks at proposals by Fiengo & Lasnik (1973) and Moltmann (1992) to distinguish between reciprocal sentences and their near paraphrases with *each-the-other* in this regard. Section 5.2.3 discusses the findings of Haas (2008, 2010), who provides relevant evidence from a corpus study. Haas favours a functionalist approach, which sees the more marked form (*each-the-other*) preferably expressing the multiple event interpretation. In a

similar vein, §5.2.4 discusses a possible account in terms of manner implicatures. Section 5.2.5 looks at the influence of predicate type on the strength of the preference.

5.2.1 The intuition

Fiengo & Lasnik (1973:450-1) observe that reciprocal sentences typically require that the events described occur simultaneously or 'in the same general time span'. They point out that (3) is infelicitous.

(3)   The men stared at each other; #John stared at Bill for 3 hours and then Bill stared at John for 3 hours.

Fiengo & Lasnik note a contrast between sentences with the reciprocal *each other*, and their seeming paraphrases with *each* and *the other*. Example (4) (following Fiengo & Lasnik, we'll call this an *each-the-other* sentence) can felicitously describe a scenario where the two events are not simultaneous.

(4)   Each of the men stared at the other; John stared at Bill for 3 hours and then Bill stared at John for 3 hours.

Fiengo & Lasnik make the generalization that 'the events characterized by reciprocal sentences are regarded as one general event' (1973:451). They argue that this is not a special characteristic of reciprocal sentences, but rather a fact about sentences with plural subjects in general. For example, they claim that (5a) preferably describes a single climb by the group of men. (This observation seems to be related to the collective default discussed in Chapter 4.) They note that the degree of this preference depends on the particular predicate involved, claiming that the multiple-events interpretation is not difficult for example (5b) (1973:451).

(5)   a. The men climbed Mt. Everest.
        b. The women left.

They point out that the choice of predicate makes a difference for reciprocals, too. Unlike (3) which requires simultaneity, (6) need not describe events that are simultaneous or close in time (1973:451).

(6)   The candidates criticized each other.

On Fiengo & Lasnik's analysis, *each-the-other* sentences like (4) are not affected by the preference for sentences with plural subjects to describe one event because at Deep Structure they have a singular subject (1973:452).

5.2.2   Accounting for the single event preference

Like Fiengo & Lasnik, Moltmann (1992) argues that the preference for the single event construal of reciprocal sentences is best explained in terms of a more general preference. Moltmann sees it as just another reflex of a preference for substantive pluralities (which she calls 'integrated wholes'). In Moltmann's system, simple sentences with plurals (including reciprocal sentences) are associated with a single event argument[1]. That event argument may be a group event, and while in principle the subevents of a group event can be separated in time and space, Moltmann assumes a preference for the event to be an integrated whole:

[1] The contrast here is with sentence with quantifiers, which do not have a single event argument.

> 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. (1992:428)

In Moltmann's account, the preference for a single event interpretation of reciprocal sentences like (7a) or non-reciprocal plural sentences like (7b) comes about because the event argument is preferably taken to have 'a certain degree of integrity' – for instance, any subevents of the event argument are close in space and time.

(7) a. The men stared at each other.
     b. The men climbed Mt. Everest.
     c. The men each stared at the other.

On Moltmann's analysis, the representation of an *each-the-other* sentence like (7c) – because it is not a simple plural sentence, but rather involves the quantifier *each* – does not involve a single event argument, and hence the preference for the event argument to be an integrated whole is irrelevant.

As discussed in Chapter 4, there is solid evidence that the processor by default fixes on a collective interpretation of sentences with plural subjects. There we saw that, given a cumulative semantic representation, a way of explaining this default was in terms of an economy preference at the level of mental representation: the processor by default posits a single event. I made use of Moltmann's idea that events should have integrity: if that single event has subevents, those subevents should be close in space or time, etc.

5.2.3 Haas

Haas (2008, 2010) finds empirical support for Fiengo & Lasnik's intuition that the reciprocal prefers to describe a single event. Haas (2010:123) emphasizes that the single event / multiple event contrast is not always reducible to a contrast between simultaneity and non-simultaneity. His corpus study focused on a small set of predicates that are biased towards a reciprocal interpretation with distinct events, but this bias did not take the form of a preference for non-simultaneity. The set of biased predicates included *accuse*, *blame* and *suspect*. Haas (2010:125-126) sees them as biased towards a multiple event interpretation in this way: 'If person A suspects person B of property X and B likewise suspects A of X, there is unlikely to be mutual agreement'. That is, if I suspect you of breaking the window and you suspect me of it, we cannot have a joint belief: they are necessarily distinct suspicions (and in this sense distinct events). Haas' corpus study compared the biased predicates with a set of 'neutral' predicates (*understand*, *love*, *help*, *trust*)[2]. He looked at the frequency with which they co-occurred with *each other* and *each-the-other*. He found that the neutral predicates rarely co-occurred with *each-the-other*: e.g. the corpus contained 225 instances of *trust* co-occurring with *each other*, compared with only 8 where it co-occurred with *each-the-other*. That is, 3.4% of all reciprocal scenarios of trusting were described using *each-the-other* (and this was the highest frequency among the neutral predicates). In contrast, the biased predicates showed significantly higher rates of *each-the-other* co-occurrence, ranging from 21% to 100% of all reciprocal scenarios.

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[2] This study was conducted on The Corpus of Contemporary American English.

Haas summarizes his findings thus: 'the less easily a reciprocal situation can be conceptualized as a single, collective event for a given verb, the more frequently this verb is combined with the analytic[3] strategy' (2008:4).

Haas (2010) is a wide-ranging study of the concept of reciprocity, both in present day English and diachronically. Haas views the expression of the concept of reciprocity as a system in which various constructions (not only *each other* and *each-the-other*, but also intransitive uses of symmetric (*meet*) or prototypically reciprocal (*kiss*) verbs) are in competition. Haas (2010:118) notes that the single event interpretation is associated with the 'light' form, and the multiple event interpretation with the 'heavy' form (on this he cites Kemmer 1993 and Safir 2004). But what counts as 'light' and 'heavy' depends on which constructions are in competition. The well known contrast in (8), where (8a) describes a single event but (8b) may describe distinct events, is explained if the intransitive is the light form, and the reciprocal the heavy form.

(8)   a. Alex and Brett kissed.
        b. Alex and Brett kissed each other.

But when there is no intransitive construction, as in (9), the reciprocal counts as the light form, and *each-the-other* is the heavy form. Thus (9b) prefers to describe a single event, while (9c) may describe distinct events.

(9)   a. *Alex and Brett saw.
        b. Alex and Brett saw each other.
        c. Alex and Brett each saw the other.

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[3] i.e. *each-the-other*

This functionalist approach does not distinguish between possible and preferred interpretations. Notice that for the light form in (8a), a distinct events interpretation is impossible (it must describe a mutual kiss)[4]. In contrast, for the light form in (9b), the distinct events interpretation is merely dispreferred.

5.2.4   Manner implicatures

In Haas' approach, the single event interpretation is associated with the light (less marked) form *each other*, and the multiple event interpretation with the heavy (more marked) form *each-the-other*. We might account for the link between markedness and the number of events using manner implicatures.

Consider Levinson's (2000) M-principle in (10) (also see Horn 1989).

(10)   <u>The M-Principle</u>:
Speaker's maxim: Indicate an abnormal, nonstereotypical situation by using marked expressions that contrast with those you would use to describe the corresponding normal, stereotypical situation.

Recipient's corollary: What is said in an abnormal way indicates an abnormal situation, or marked messages indicate marked situations

We can reasonably assume that *each other* is less marked than *each-the-other*. Explaining the single event preference for *each other* would then require it to be the case that having two events of the same kind (and with the same participants) occur together is more typical than having them occur separately. We can't take this for granted, but it seems plausible. Consider Fiengo & Lasnik's example of two cars bumping into each other. The scenario where this describes a single collision seems more typical than one where car A bumps into car B, and then some time later car B bumps into car A. There is something implausible

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[4] See Rubinstein (2009).

about the universe arranging things such that those same cars come back in contact again, and take part in the same kind of event (with their roles reversed). But it is unclear that this holds in general, especially if we are not talking about strangers, but people that know and come into regular contact with each other, and about non-accidental events. (e.g. People return favours – if someone invites you to dinner, you probably will invite them in return some time later. This is more typical than the two of you exchanging simultaneous invitations.)

A simple version of the manner implicatures account would predict that the unmarked form (*each other*) suits the more typical scenario (one general event), while the marked form (*each-the-other*) suits the less typical scenario (two distinct events). The opposite pairings (one event + *each-the-other*, two events + *each other*) should be less acceptable.

5.2.5   The effect of predicate type

As Fiengo & Lasnik point out, the strength of the preference for a single general event interpretation depends on the predicate. *Stare at* strongly prefers the two events to be simultaneous, while *criticize* allows them to be far apart in time.

(11)   The men {stared at/criticized} each other.

This seems reminiscent of the stative/eventive contrast in the availability of WR, and it is true that statives strongly prefer the simultaneous interpretation:

(12)   They loved each other; #she loved him when they were in high school
       and he loved her years later.

But there does not appear to be a strict correlation between a preference for SR and a preference for simultaneity. *See* tends to prefer SR in (13a), but allows non-simultaneity in (13b).

(13)   a. The three kids saw each other.
        b. The men saw each other; Bill saw Ted at the library and then Ted saw Bill at the movies.

Note that it is possible for the reciprocal clause in (12) to describe two non-simultaneous states, but it requires the presence of an adverbial as in (14). Thus it seems that simultaneity is defeasible.

(14)   They loved each other, but at different times.

Interestingly, the same strategy does not work as well for *see* in (15). However, (16) provides some naturally occurring examples of this kind[5].

(15)   a. ??They saw each other, but at different times.
        b. ?They saw each other, but not at the same time.
        c. ?They saw each other, but not simultaneously.

(16)   a. I love how they both look at each other but at different times[6]
        b. Unbeknownst to each other, they spot each other but at different times never meeting each other's eye[7].

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[5] I could find no naturally examples of this kind with *see*, only *spot* and *look at*.

[6] This is describing a pair of sequential photos: in one, Spock looks at Kirk, and in the other Kirk looks at Spock. http://www.pinterest.com/pin/339388521890228027/ [Accessed June 22 2014]

[7] http://www.examiner.com/review/mo-olelo-s-kita-y-fernanda-is-a-journey-worth-taking [Accessed June 22 2014]

5.3 Experiment 4: Single event preference

This experiment was designed to test the hypothesis (as per Fiengo & Lasnik's (1973) evidence from intuitions) that simple reciprocal sentences with *each other* have a stronger preference for the single event construal than do *each-the-other* sentences.

5.3.1 Method

Materials and design   A set of 24 items was constructed. Each item had two parts: a context and a description. There were two forms of context: one occasion scenarios as in (17a), and two occasion scenarios as in (17b). The context was followed by a description of the situation, in one of two sentence types: *each other* as in (18a) or *each-the-other* as in (18b). It was a 2x2 design (Number of occasions x Sentence type).

(17)   a. Richardson sued Summers, and Summers sued Richardson. They are both songwriters. It was a dispute about which of them wrote the hit song.
         b. Richardson sued Summers about 10 years ago, and then recently Summers sued Richardson over another matter. They are both songwriters.

(18)   a. Those songwriters sued each other.
         b. Those songwriters each sued the other.

All predicates were eventive. In order to test a hypothesis about manner implicatures (to be discussed in §5.3.3.3 below), the items included two types of predicates. Half of the items involved event-types that according to my intuitions occur simultaneously and reciprocally relatively often. For the most part, these were predicates describing physical impact (*bump, crash into*) or verbal confrontations (*yell at*). The other half of the items involved events that were

judged to occur simultaneously and reciprocally more rarely (*bite, help, feed*). The full set of items, including this classification into two groups, appears in the Appendix.

The 24 experimental items were included in a questionnaire along with 22 unrelated items. There were 4 counterbalanced forms of the questionnaire, each with 6 experimental items in each of the 4 conditions. The same pseudo-randomization was applied to each of the 4 questionnaire forms.

Participants   Forty-six University of Massachusetts undergraduates in introductory Linguistics and Psychology courses took part in the experiment for course credit.

Procedure   Participants were randomly assigned to receive one of the four versions of the written questionnaire. They were instructed to rate the description part of the item in terms of 'how good it sounds as a description' of the context part of the item. Participants rated the description on a scale from 1 – 7 (where 1 was 'terrible' and 7 was 'perfect').

5.3.2   Results

Two types of data were excluded from the analysis: the data of participants who were not native speakers of English, and those who answered incorrectly on at least one of two comprehension questions included in the questionnaire. In total, six participants were excluded, leaving the data of 40 participants. The mean ratings appear in Table 10.

		Sentence type	
		each other	*each-the-other*
Number of	One	5.76 (1.15)	5.47 (1.34)
occasions	Two	5.10 (1.26)	5.16 (1.32)

Table 10: Participant means (SDs), Experiment 4.

Two-way repeated measures ANOVAs revealed an interaction between sentence type and number of occasions that was marginally significant by participants and fully significant by items ($F_1(1,39)=3.7$, $p=.06$; $F_2(1,23)=8.8$, $p=.007$). The interaction is illustrated in Figure 27. In addition, there was a main effect of number of occasions, with the descriptions rated as more acceptable in the one occasion condition than in the two occasion condition ($F_1(1,39)=15.8$, $p<.001$; $F_2(1,23)=9.6$, $p=.005$). There was also a main effect of sentence type that was marginal by items ($F_1(1,39)=1.6$, $p=.2$; $F_2(1,23)=3.5$, $p=.075$).
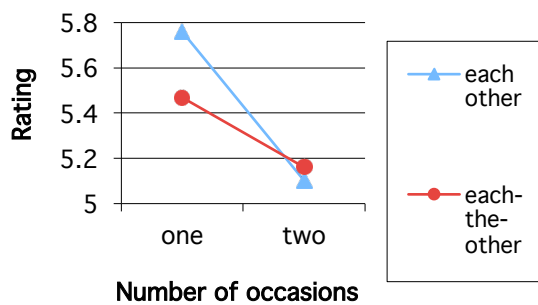
Figure 27: Experiment 4 interaction.

The difference between *each other* and *each-the-other* was predicted to appear as an interaction, with the two occasion context having more of a negative effect on *each other* than on *each-the-other*. The results of simple effects tests were consistent with this prediction. Ratings were higher in the one

occasion condition than the two occasion condition for both *each other* ($t_1(1,39)=3.9$, $p<.001$; $t_2(1,23)=4.3$, $p<.001$) and *each-the-other* ($t_1(1,39)=2.2$, $p=.03$; $t_2(1,23)=1.7$, $p=.1$). But while *each other* was rated significantly higher than *each-the-other* in the one occasion condition ($t_1(1,39)=2.5$, $p=.015$; $t_2(1,23)=4.8$, $p<.001$) there was no significant difference in the two occasion condition (p's>.5).

As mentioned above, half of the items (the 'bump' class) were judged to occur simultaneously and reciprocally more often than the other half of the items (the 'bite' class). Table 11 presents the means by item class.

		Sentence type			
		each other		*each-the-other*	
		'bump' class	'bite' class	'bump' class	'bite' class
Number of	One	5.69	5.83	5.47	5.47
occasions	Two	4.9	5.31	4.96	5.37

Table 11: Participant means, Experiment 4, 'bump' class vs. 'bite' class.

An ANOVA with number of occasions and sentence type as within-items factors, and item class as a between-items factor found no significant interactions between item type and any other factor (p's>.2). It may be that the experiment did not have enough power to reveal such an interaction. Numerically there appears to be an interaction between item class and number of occasions, with a larger difference between the 'bump' class and the 'bite' class in the two occasion condition than in the one occasion condition.

5.3.3 Discussion

5.3.3.1 *Reciprocals have a stronger preference for one occasion*

Experiment 4 provides empirical support for Fiengo & Lasnik's (1973) evidence from intuitions: compared with *each-the-other* sentences, reciprocal sentences with *each other* have a stronger preference for the interpretation where the events occur on a single occasion.

5.3.3.2 *An overall preference for describing one occasion*

In Experiment 4, both sentence types were rated more highly when they described one occasion scenarios, compared with two occasion scenarios.

Given certain assumptions about the experiment, this result can be seen as evidence that the default construal of both kinds of sentence involves a single occasion. I think it is reasonable to assume that, at least to some extent, participants came up with a rating by reading the description sentence, fixing on their default construal, and comparing that construal with the scenario spelled out in the context. On this view, the rating task tells us about the preferred construal of the description sentence[8].

The overall preference for describing a single occasion scenario is not predicted by previous accounts such as Fiengo & Lasnik (1973) or Moltmann (1992). Both of those accounts sought to distinguish between, on the one hand,

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[8] Let's consider an alternative view: participants might be basing their ratings on how many details of the context are captured or left out by the description. The experiment exhibits a potential confound in this regard, because the one occasion vs. two occasion manipulation simultaneously involves manipulating the amount of information in the context. (The two occasion scenario conveys more information, in that there are two times/locations described.) While this would correctly predict the penalty associated with the two occasion context, it fails to predict the interaction between sentence type and number of occasions.

simple reciprocal and plural sentences which have such a preference, and on the other, sentences involving quantifiers (such as *each-the-other* sentences) which do not. But the experiment found evidence that while reciprocal sentences may show a stronger preference for the single event construal, *each-the-other* sentences show the same preference, albeit weaker.

If both types of sentence have a preference for the single event construal, then the question is: why should the preference be stronger in the case of reciprocals?

While previous researchers have focused on the strength of this preference for *each other*, an alternative is that it is the relative weakness of the preference in the case of *each-the-other* that calls for further explanation. Tunstall (1998) gives us reason to think that sentences with the quantifier *each* will have a preference for describing events with distinct subevents. Tunstall proposes that the Differentiation Condition in (19) is part of the lexical meaning of *each*.

(19)   The Differentiation Condition:
         A sentence containing a quantified phrase headed by *each* can only be true
         of event structures which are totally distributive. Each individual object in
         the restrictor set of the quantified phrase must be associated with its own
         subevent, in which the predicate applies to that object, and which can be
         differentiated in some way from the other subevents.

If *each-the-other* sentences are subject to the demands of the Differentiation Condition, that could explain their weaker preference for a single occasion[9]. They would be subject to competing preferences: a general preference for describing a

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[9] Haas (2010:150, endnote 6) has a similar view. He agrees with Fiengo & Lasnik (1973) that there is a general preference for sentences with plural subjects to describe a single event. In the case of *each-the-other* sentences the single event preference is 'overridden by the overt indication of distributivity that the quantifier *each* provides for'.

single occasion, and the Differentiation Condition which requires distinct

subevents. The single occasion condition does not provide distinct subevents[10].

5.3.3.3 *Little support for a manner implicatures hypothesis*

Experiment 4 found no support for the predictions of a simple manner

implicatures hypothesis (as in Table 12) that assumes that *each other* is unmarked,

each-the-other is marked, and that it is more typical for two events of the same

kind with the same participants to occur on a single occasion rather than separate

occasions.

	unmarked (*each other*)	marked (*each-the-other*)
typical (one occasion)	good	bad
less typical (two occasion)	bad	good

Table 12: Predictions of a simple manner implicature hypothesis

		Sentence type	
		each other	*each-the-other*
Number of	One	5.76 (1.15)	5.47 (1.34)
occasions	Two	5.10 (1.26)	5.16 (1.32)

Table 13: Participant means, Experiment 4

Crucially, the experiment found that in the two occasion condition, there was no

significant difference between *each other* and *each-the-other*. If the two occasion

scenario is less typical, then it should prefer the marked form *each-the-other*.

      Though the results do not pattern as in Table 12, it may still be possible to

explain them using manner implicatures. Let's take the ratings for the one

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[10] As for *each other*, I take the position that while historically the reciprocal derives from the combination of the quantifier *each* and *other*, the fact that it has been grammaticalised means that the Differentiation Condition does not apply in this case.

occasion condition as a baseline. *Each other* receives higher ratings, and we might

explain this using the fact that *each other* is the unmarked form, whereas *each-the-*

other is marked. Then in the two occasion condition, instead of the expected

penalty for the marked form *each-the-other*, we see that the two forms receive

similar ratings. The penalty disappears because *each-the-other* receives a boost for

manner implicature reasons. The difference between this story and the one that

leads to the predictions in Table 12 is that this story assumes that the marked

form is always penalized just for being marked, regardless of the number of

occasions being described.

As discussed above in §5.2.4, it is far from clear that a two occasion

scenario is always less typical than a one occasion scenario. It seems reasonable

to assume that typicality is going to depend on a number of factors including the

particular predicate involved. For instance, while Fiengo & Lasnik's example of

cars bumping into each other suggests that the one occasion scenario is more

typical, I don't have the intuition that the one- and two-occasion scenarios in (20)

differ in typicality[11].

(20)   a. In June, Leo recommended Jenny for the employee-of-the-month
          award, and Jenny recommended Leo.
       b. In June, Leo recommended Jenny for the employee-of-the-month
          award, and in July, Jenny recommended Leo.

Experiment 4 looked for an effect of typicality differences of this kind. Half of the

items used predicates (like *bump into*) where the one occasion scenario was

judged to be high in typicality (the 'bump' class). The other half were like

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[11] This is a 'bite' class item from Experiment 4.

recommend, where the one occasion scenario was not judged to be typical (the 'bite' class).

If the typicality preferences associated with the predicate are part of the manner implicature calculations, then the 'bump' class should work as described in the simple manner implicature hypothesis above: the one occasion scenario is typical and should prefer the unmarked *each other*, and the two occasion scenario is atypical and should prefer the marked form *each-the-other*. But for the 'bite' class, if the scenarios do not differ in typicality, then the manner implicature cannot work the same way. We should see an interaction only for the 'bump' class. That is, there would be a three-way interaction between sentence type, number of occasions and verb class. But there was no sign of such an interaction. Rather, there was a numerical (non-significant) interaction between verb class and number of occasions. The numerical interaction was such that in the two occasion condition, the 'bite' class received higher ratings than the 'bump' class. If this interaction were significant, it could be explained in terms of a penalty for deviating from the typical one occasion interpretation in the case of the 'bump' class. Crucially, an interaction of this kind would provide no evidence for the manner implicature account outlined above.

If typicality preferences that vary by predicate go into the manner implicature calculations, the numerical interaction argues against the revised account above. Recall that the explanation for the lack of a significant difference between *each other* and *each-the-other* in the two occasion condition was that the marked form *each-the-other* received a boost for manner implicature reasons (thus obscuring the baseline penalty for being the marked form). Now, the numerical interaction between verb class and number of occasions suggests that the 'bump'

229

class has a stronger preference for the stereotypical single occasion scenario than the 'bite' class. This means that in the 'bite' class, without such a stereotype, we would not expect the manner implicature boost – we should see the penalty for using the marked form *each-the-other*, unobscured, yet this is not the case. As shown in Table 14, numerically *each other* and *each-the-other* receive similar ratings in the two occasion condition for the 'bite' class, just as they do for the 'bump' class.

		Sentence type			
		each other		*each-the-other*	
		'bump' class	'bite' class	'bump' class	'bite' class
Number of	One	5.69	5.83	5.47	5.47
occasions	Two	4.9	5.31	4.96	5.37

Table 14: Participant means, Experiment 4, 'bump' class vs. 'bite' class

5.3.4 Conclusion

Experiment 4 found support for Fiengo & Lasnik's evidence from intuitions that reciprocal sentences have a preference for describing 'one general event'. But it found that *each-the-other* sentences likewise show this preference, albeit weaker. The next section looks at how best to capture this preference.

5.4 No Extra Times (NET)

In Chapter 4, I argued that in a lexical cumulativity account, the collective default can be explained using an economy principle. The processor by default adds a single event to the discourse representation. There, I used Moltmann's idea that events should have integrity (for instance, subevents of a single event should be close in time) to explain why a preference for uniformity (which favours SR)

comes into conflict for certain types of events (those that involve physical contact, take time) but not others (statives, *see*).

In this chapter, we saw that Moltmann explains the difference between *each other* and *each-the-other* using the preference for event integrity. An *each other* sentence has a single event argument, whose subevents should have integrity (e.g. be close in time). An *each-the-other* sentence, with quantifier *each*, does not have a single event argument. Hence event integrity is irrelevant for *each-the-other* sentences.

Experiment 4 suggested that there is a general preference for the single occasion condition for both *each other* and *each-the-other*. This is unexplained on Moltmann's account. It is also unexplained by the account put forward in Chapter 4 – we cannot derive the preference for a single occasion from the economy preference for adding a single event to the mental representation, because *each* (in the *each-the-other* sentence) requires multiple events to be added. In which case, if there are multiple events in the discourse representation, we cannot use integrity/substantivity to make them prefer to be close in time. And in fact, *each* is associated with a preference for the events to be distinct (Tunstall 1998).

We can account for the results of Experiment 4 with another reflex of the preference for conceptual economy, which I call No Extra Times:

(21)   No Extra Times (NET):
         A sentence describes a single occasion (unless there is evidence to the
         contrary).

As it is stated in (21), NET is a pre-theoretical statement of the intuition that conceptual economy should apply not only to discourse referents such as

individuals and events, but also occasions/reference times/situations. As we shall see, the preference that NET is trying to capture is somewhat overdetermined.

In the case of the reciprocal, the preference for a single occasion can be explained if a single event is added to the representation (as Chapter 4 suggested) and its subevents are taken to be close in time because of the preference for event integrity (Moltmann 1992). The evidence that suggests a preference like NET is necessary is when there are necessarily multiple distinct events, as with *each*. In the case of a sentence with *each*, we need NET to explain why a sentence like *Those workers each recommended the other* prefers for the individual events of recommending to occur close in time. The discourse representation contains multiple events (one for each worker) but a single (unspecified) reference time (or occasion). The events take place within that reference time. In Experiment 4, the two occasion scenario was dispreferred – this is because it spelled out two distinct reference times.

If we assume that economy favours adding the fewest events to the discourse representation, then NET is not needed to account for preferences for episodic interpretations over habitual ones, or non-iterative interpretations over iterative ones. Consider a sentence like (22).

(22)   Amy drove to work.

An episodic interpretation and a habitual one both can be seen to have a single reference time. The episodic interpretation has the event of driving take place within a salient reference time (e.g. yesterday). The habitual interpretation has a state of habitually driving to work overlapping a salient reference time (e.g last

year). But the habitual interpretation can be seen to involve a plurality of events of driving to work, whereas the episodic interpretation probably involves a single event. Thus it seems we can derive a preference for episodic over habitual interpretations via economy in event representation[12]. Likewise for non-iterative interpretations over iterative ones: example (23) allows both kinds of interpretation, but the default should be that Ben lifted the box once, rather than over and over again. Again, both of these interpretations would have a single reference time or occasion, and a better way to distinguish them is using economy: a single event of lifting is preferred over a plurality of liftings.

(23)   Ben lifted a box.

Harris, Clifton & Frazier (2013) apply the predictions of NET to the question of how the processor arrives at an interpretation of sentences involving variable quantificational domains. They focus on *mostly*, which can quantify over individuals/parts as in (24a), or over times as in (24b). They provide evidence that *mostly* does not appear to be lexically biased towards one or other of these.

(24)   a. This apple is mostly green.
         b. Today I was mostly at home.

In a sentence like (25a), the two interpretations differ in the number of occasions required. Quantification over individuals/parts is consistent with the sentence describing a single occasion. Quantification over times of course requires multiple times. NET thus favours quantification over individuals/parts in this

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[12] There will be other ways to do this, e.g. episodic interpretations of simple past tense sentences are probably much more frequent than habitual ones.

case. Harris et al. present the results of an eye movement study that found that sentences open to the quantification over individuals/parts interpretation like (25a,c) were easier than those where quantification over times was the only pragmatically plausible interpretation, as in (25b).

(25)　a. The army was mostly in the capital.
　　　b. The inspector was mostly in the capital.
　　　c. The attack was mostly in the capital.

We can use conceptual economy to favour adding the fewest entities (individuals, events or times) to the mental model. Although in some cases, the effect of NET could be derived without reference to times (or occasions), I have suggested that it is necessary for conceptual economy to refer to times or occasions based on examples with *each*. But ultimately, in many cases there are several ways of using a preference for economy to get to the same result. Take sentence (26), which on first reading sounds slightly contradictory.

(26)　(?)The Tigers and the Eagles defeated each other.

Here are two possible explanations. First, NET favours a default interpretation where the sentence describes a single occasion. We naturally think of a single match, but two teams cannot defeat each other in one match, hence the air of contradiction. The other possibility is that the processor adds a single (reciprocal) event to the discourse representation. To satisfy event integrity, the subparts of that event should be close in time. But this leads to trying to have two defeats be part of the same event. There need to be multiple matches, which work best as separate events.

Or take sentence (27). It describes multiple events of suitcase carrying that most likely occurred at the same place / time. Is this because of NET (the processor posits a single time / occasion)? Or could it be derived from a preference for the plurality of women to have 'integrity' in Moltmann's sense. (If we have grouped the women together in this plurality, then one way for this grouping to have integrity is if they are close in space / time[13].)

(27)   The women each carried a suitcase.

In conclusion, the results of Experiment 4 suggest that there is an overall preference for a sentence to describe a single occasion. I call this preference NET, and suggest that it is a kind of economy preference. This section has looked at how, given other economy principles and a preference for substantivity, this preference is somewhat overdetermined.

5.5   Limits on partitioning for reciprocals

This section addresses two proposals that limit the availability of partitioned interpretations for reciprocal sentences. Cumulativity predicts that partitioned interpretations should always be available, so these proposals by Fiengo & Lasnik (1973) and Sabato & Winter (2010) challenge the notion that the cumulative / WR semantics is sufficient to account for the interpretation of reciprocal sentences. Section 5.5.1 looks at Fiengo & Lasnik's observations about stative reciprocals and partitioning. Section 5.5.2 looks at Sabato & Winter's claim

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[13] It should be noted that later in this chapter, in §5.7.2, I suggest that definite plurals like *the women* do not show this preference for integrity as strongly as conjoined DPs like *Anne and Beth* do.

that reciprocals always require connectedness. Section 5.5.3 summarizes the issues for the cumulative/WR semantics.

5.5.1 Stative reciprocals disallow partitioning

Fiengo & Lasnik (1973) were the first to point out that stative reciprocals resist partitioned interpretations. They note (1973:453) that eventive predicates allow a partitioned SR (part-SR) reading – that is, where there is a partition such that within each subset SR holds. For instance, sentence (28) (with the eventive predicate *hit*) might describe a situation where there are two pairs of men in the room: A and B are hitting each other, and C and D are hitting each other, as in (29).

(28)   The men in the room are hitting each other.

(29)   A ↔ B
        C ↔ D

They point out that, in contrast, sentences with stative predicates do not permit the partitioned SR reading. A sentence like (30) requires that every man in the room know every other man[14]. That is, it is not possible for (30) to describe the kind of situation depicted in (29).

(30)   The men in the room know each other.

Fiengo & Lasnik claim that the generalization here is that stative predicates do not allow the antecedent of the reciprocal to be partitioned. They do note a class of exceptions: when the antecedent involves a 'natural pairwise

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[14] This is with the appropriate caveats about exceptions – it holds as long as we are dealing with a small number of men.

236

relationship', statives permit partitioning (e.g. *The husbands and wives in the room are similar to each other*) (1973:454)[15]. Apart from this, their generalization is that eventive predicates do, and stative predicates do not, permit the partitioned SR reading[16].

5.5.2 Reciprocals and connectedness

Sabato & Winter (2010) make a more general argument about partitioned interpretations of reciprocal sentences, namely that the reciprocal itself cannot give rise to a partitioned interpretation. They argue that reciprocal interpretations always obey connectivity:

(31) *Connectivity*: Let *A* be a set and let *R* be a binary relation. If the one-place predicate *R each other* holds of *A*, then the graph induced by *R* on *A* is *connected* (=not partitioned).

Specifically, they argue that partitioned interpretations (such as part-SR) only arise by virtue of the anaphoric properties of the antecedent. They contrast (32a) and (32b), noting that only (32a) seems a possible description of the situation in (33).

(32) a. The planks are stacked atop each other.
      b. Planks 1, 2, 3, and 4 are stacked atop each other.

(33) Plank 1   Plank 3
      Plank 2   Plank 4

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[15] Although Fiengo & Lasnik's observations are all about pairs , the same point holds for groupings of other sizes. (*The triplets in the room are similar to each other*.)

[16] Matsuo (2000) provides experimental evidence of the contrast in the case of English speaking children (mean age 4;4) and an adult control group.

On their view, the partitioned interpretation comes about when the definite combines with implicit quantification, resulting in distribution to subsets. ('In each group of planks g, the planks in g are stacked on top of each other.') The conjunction of proper names as in (32b) does not allow for the subject to be dependent on an implicit quantifier[17]. Their argument is that if the reciprocal itself were able to license the partitioned interpretation required by the situation in (33), then there would not be a contrast in acceptability between (32a) and (b). Therefore the reciprocal itself does not allow partitioning.

Another of Sabato & Winter's examples is in (34). They observe that while example (34a) can describe the scenario in (35), example (34b) is an infelicitous description (2008:4). Again, they point to the fact that conjoined names disallow the implicit quantification required for this interpretation.

(34)   a. The singers are looking into each other's eyes in this photo.
       b. #John, Paul, George and Ringo are looking into each
          other's eyes in this photo.

(35)   John ↔ Paul
       George ↔ Ringo

5.5.3   The problem for the cumulative/WR semantics

The issue for the cumulative/WR analysis is that cumulativity predicts that these are valid inferences:

(36)   Man 1 and Man 2 like each other.
       Man 3 and Man 4 like each other.
       _____
       The men like each other.

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[17] Winter (2000)

238

(37)   Plank 1 and Plank 2 are stacked on top of each other.
        Plank 3 and Plank 4 are stacked on top of each other.
        _____
        Planks 1, 2, 3 and 4 are stacked on top of each other.

Schwarzschild (1996:126-7) discusses a similar issue. He points out that

the following inference is dubious:

(38)   The cows talked to each other.
        The pigs talked to each other.
        _____
        The cows and the pigs talked to each other.

Schwarzschild notes that *The cows and the pigs talked to each other* preferably

describes the relation holding between the two groups (i.e. the cows talked to the

pigs and the pigs talked to the cows). These are the salient pluralities in the

context: the cover contains a bovine cell and a porcine cell. On Schwarzschild's

analysis, the reciprocal is a free variable over functions. The function can be

provided by or salient in the context. He proposes that the domain and range of

the function should make use of the preexisting partition. But for the cumulative

inference in (38) to work, *The cows and the pigs talked to each other* would have to

have the reciprocal predicate interpreted distributively. This would require two

covers: one with a bovine cell and a porcine cell, and the other with

subpluralities of cows and subpluralities of pigs. If there is a preference for the

reciprocal to use the same partition as the cover variable, this is dispreferred.

As we saw in Chapter 4, there are limits on cumulativity. In §4.2.1 we saw

another of Schwarzschild's examples (*The prisoners on the two sides of the room*

could see each other). I follow Schwarzschild in assuming that there is a preference

for the interpretation of the reciprocal to make use of existing salient pluralities.

In terms of the cumulative semantics, we cannot freely sum any collection of subevents that happens to give the correct result – our choice is constrained by which subpluralities are salient. But neither Fiengo & Lasnik's observation about statives (§5.5.1), nor Sabato & Winter's about sentences with conjoined names (§5.5.2) can be explained simply by restricting ourselves to summing eventualities participated in by salient pluralities. Fiengo & Lasnik's observation concerns a contrast between statives and eventives in a given context. And Sabato & Winter's observation concerns a contrast between definite plural and conjoined name antecedents in a given context.

Section 5.6 accounts for the stative/eventive contrast using Kratzer's constraint for quantification over states. Section 5.7 looks at the definite plural/conjoined name contrast in terms of pragmatic effects and evidence from processing. Section 5.8 introduces some new data on the effect of contrast in licensing previously unavailable partitioned interpretations, and argues that the effect of contrast is unexplained by previous accounts that limit partitioning for reciprocals.

5.6   Stative/eventive and partitioning

Let's begin with Fiengo & Lasnik's observation that one kind of stative reciprocal sentence does allow the partitioned-SR interpretation: those where the antecedent involves a 'natural pairwise relationship' as in (39). If A, B, C and D are the twins, (39) is true in the scenario in (40) if A and B are twin siblings and C and D are twin siblings. Each person is only similar to their twin.

(39)   The twins are similar to each other.

(40) A ↔ B
      C ↔ D

This can be accounted for using Kratzer's (2001:63) constraint in (41). The twin

siblings are substantive pluralities, and (41) allows quantification over the states

they participate in.

(41) <u>Constraint for quantification over states:</u>
      Quantification over states is restricted to sums of states whose participants
      are substantive pluralities

This suggests that the problem with Fiengo & Lasnik's example (42a) – the

reason it cannot describe a scenario like (40) – is that even if the men are grouped

in pairs, those pairs do not constitute substantive pluralities.

(42) a. The men in the room know each other.
      b. The men know each other.

It seems to me that example (42a) exaggerates the strength of this intuition. I

think it might be possible to accept (42b) as describing a part-SR scenario where

there are pairs of men and each knows only his partner. Why should this be? For

the part-SR interpretation, the sentences in (42) need to be understood as

describing multiple subpluralities. Those subpluralities should be substantive.

But the additional difficulty faced by (42a) is that the presence of *in the room*

suggests that the salient plurality should be (all) the men in the room. That is, it

is more difficult to accommodate the necessary subdivision (into pairs) when this

information is provided.

It seems that for a stative like *know* or *like*, merely being grouped in pairs

or standing together is not typically enough for the participants to be considered

substantive. But more elaborate contexts can make subpluralities substantive enough to allow the part-SR interpretation, as (43) shows.

(43)   (The shipping company is transporting a bunch of dogs. They've been split up, two to a crate.)
       Luckily the dogs like each other so it's okay.

Do we have to say anything special about stative reciprocals? If this is because of the constraint for quantification over states, it should hold for other plural sentences too. We have already seen evidence on this point: Experiment 3 in Chapter 4 showed that co-distributive interpretations were more acceptable with eventive predicates (44a) than stative predicates (44b).

(44)   a. The journalists quoted the actors.
       b. The journalists hated the actors.

Thus, Fiengo & Lasnik's stative/eventive contrast has the same source as the stative/eventive contrast we saw in Chapter 4. Statives have special requirements regarding substantivity.

5.7   Conjoined names and partitioning

Sabato & Winter (2010) base their argument that reciprocals require connectivity (and don't themselves license partitioned interpretations) on examples like (45), repeated from above. They point to the fact that (45a) is a felicitous description of the scenario in (46) but (45b) is not, as evidence that the partitioned interpretation only comes about via implicit quantification which is possible with the definite plural in (45a) but not in (45b) with conjoined names.

(45)   a. The planks are stacked atop each other.
       b. Planks 1, 2, 3, and 4 are stacked atop each other.

(46)   Plank 1   Plank 3
       Plank 2   Plank 4

The cumulative/WR account has no explanation of the contrast in (45). Both are predicted to be acceptable. Instead, this section will investigate pragmatic (§5.7.1) and processing (§5.7.2) effects that might be associated with conjoined names. Rather than seeing the conjoined names case as showing us the reciprocal's true character when it comes to partitioning (as Sabato & Winter (2010) assume), I argue that a conjoined name antecedent should be expected to have effects of its own that can explain the preference for non-partitioned interpretations.

5.7.1   Conjoined names and pragmatics

It has been observed that conjoined names resist nonmaximal interpretations (Brisson 1998:50-51). Consider Brisson's examples in (47). If we assume that the subjects of the sentences in (47) are coreferent, a difference between them is that it is much easier for (47a) to describe a situation where one of the girls happened to not eat a sandwich. This seems to be a Gricean effect – as Brisson puts it, 'if we went to all the trouble of mentioning Alice, Betty, Carmen and Diane by name, it is hard to exclude them'.

(47)   a. The girls ate a sandwich.
       b. Alice, Betty, Carmen and Diane ate a sandwich.

In Brisson's system, listing the names like this favours a cover that does not exclude any of the individuals. If it is distributive, each girl occupies a singleton set of the cover. If it is collective, {a,b,c,d} is a cell. Brisson's suggested

243

Gricean explanation is that if you had in mind a cover that excluded one of the individuals, it would be more cooperative to not name them.

Dalrymple et al. (1998:168) claim that there is a difference between the sentences in (48), such that (48b) allows less imprecision (i.e. it disallows nonmaximality): 'the reciprocal is interpreted more strictly when its antecedent group is referred to by listing the members'. They claim that both sentences have the semantics of SR, but only (48a) can be interpreted imprecisely[18].

(48)   a. The men were hitting each other.
       b. John, Paul, George, Ringo and Stu were hitting each other

These observations by Brisson and Dalrymple et al. do not help with Sabato & Winter's planks example. The planks example does not involve nonmaximality; rather the issue is that conjoined names seem to rule out a partitioned interpretation.

I think that it is likely that conjoined names are associated with a number of pragmatic effects. Not only does listing names discourage nonmaximality, but we might also expect that enumerating the individuals in this way leads the hearer to expect that the individuals are going to form a single substantive plurality. The next section will look at evidence from psycholinguistics that conjoined DPs are associated with conceptual representations distinct from those associated with simple definite plurals.

We should expect that any such pragmatic effects should be able to be overridden, and example (49), from Schwarzschild (1996:54) shows that this is

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[18] I disagree; I don't think example (b) requires there to be hitting going on between each pair. But I agree that there is a contrast between (a) and (b) with respect to the point made by Brisson: only (a) allows for some man not to take part.

the case[19] – the partitioned construal is available despite the fact that the

antecedent consists of conjoined names[20].

(49)   Despite their current membership in a common market, only 50 years ago,
         Germany, England, France and Italy were battling each other in one of the
         worst wars in history.

5.7.2   Psycholinguistics and plural DPs

There has been a considerable amount of research on the processing of plurals

and anaphora (e.g. Albrecht & Clifton 1998; Kaup et al. 2002; Moxey et al. 2004).

In particular, much of this work has argued that studying anaphora resolution

gives us an insight into the conceptual representation associated with the

referents of plural DPs.

Consider the 'split antecedent' discourse in (50). The first sentence

introduces two individuals, and the second sentence has pronominal reference

back to either one or both of them. Work in this area has found evidence of a

'conjunction cost' associated with using a singular pronoun in discourses like

(50). It is argued that the conjoined subject is associated with a particular

conceptual representation: it is a Complex Reference Object (CRO) (Sanford &

Moxey 1995; Moxey et al. 2004). Referring back to one of the atomic individuals

with a singular pronoun incurs a cost either because of difficulty associated with

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[19] Notice that this sentence is much more complicated than Sabato & Winter's planks example
(45), with the contrast between the present and the past. This is possibly related to the contrast
examples to be discussed in §5.8.

[20] This example is fine on Sabato & Winter's account because it describes a connected scenario. Its
relevance to my account is that whatever pragmatic effects may be associated with conjoined
names, they are (as is to be expected) able to be overridden.

decomposing the CRO, or possibly because the CRO is in discourse focus and the individual parts are not (Moxey et al. 2004).

(50)   Amy and Ben went out. {They / She} had a nice day.

Moxey et al. claim that the individuals parts of a CRO generally share a role[21] in the discourse; grouping individuals in a CRO 'decreases the degree to which the individuals are distinguished from one another in the mental representation of the discourse, and increases the likelihood of readers inferring that the …individuals will be involved in a common activity' (2004:351).

In a discourse like (50), the fact that Amy and Ben are introduced by a conjoined DP and share a thematic role is argued to be the basis for constructing a CRO. Work in this area has looked at other factors such as ontological homogeneity (Koh & Clifton 2002), shared location and goals (Carreiras 1997; Kaup & Kelter 2002) and symmetry (Koh & Clifton 2002).

Patson & Ferreira (2009), Patson & Warren (2011) and Huffman (2011) show that CROs – but not undifferentiated plural objects (e.g. the mental representations associated with plural DPs like *the lovers*, *the two lovers*) – block the garden path effect in sentences like (51b)[22].

(51)   a. After Jose and the bride signaled the party began in earnest.
   b. After Jose and the bride kissed the party began in earnest.

As shown in Figure 28, the idea is that a CRO has 'pointers' to the individuals. This means that when the processor hits a verb like *kissed*, with ambiguous

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[21] This is possibly but not necessarily a thematic role.

[22] From Ferreira & McClure (1997)

246

argument structure (either intransitive (i.e. reciprocal) or transitive), the

individuals in the CRO are immediately available to satisfy the thematic roles of

the reciprocal argument structure. In contrast, an undifferentiated plural object

has no pointers, so cannot immediately satisfy those thematic roles, which leads

to the garden-path effect of taking the following DP as object. As we have seen,

conjunction is one way of introducing a CRO; as Patson & Warren (2011) show,

differentiating the individuals (*two cats, one of whom was white*) is another way.
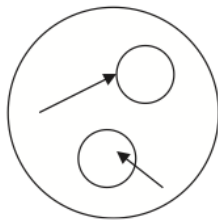
Figure 28: Complex reference object (Patson & Warren 2011)
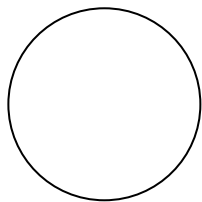
Figure 29: Undifferentiated plural object

Work in this area provides evidence that different kinds of DP[23] are

associated with different conceptual representations, and/or different numbers

of available referents. CROs differ from undifferentiated plural objects in that the

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[23] My focus here is on the question of conjoined DPs vs. definite plurals, but Patson and colleagues show that non-structural differences are also relevant (e.g. differentiating the individuals can create a CRO; they also show (Patson & Warren 2011) that the garden-path effect is blocked in sentences where the subject is an anaphor, if that anaphor refers back to differentiated individuals) .

individuals within the CRO are available referents, while those referred to by an undifferentiated plural are not (as shown by Patson and colleagues). But CROs also have the entire group as a possible referent (even a preferred referent, as in split-antecedent cases). It seems that CROs have a dual nature: compared with undifferentiated plural objects, CROs are argued to 'highlight distributivity within a group' (Patson & Warren 2014:419) but at the same time there is a lot of evidence that CROs are constructed based on similarity between the members of the group (Carreiras 1997; Kaup & Kelter 2002; Koh & Clifton 2002). These two opposing tendencies are not in conflict; they can be seen as a result of the complex structure of a CRO: simultaneously a group, and a set of individuals.

Now that we have seen some of the evidence that psycholinguists have amassed regarding the conceptual representation of plural DPs, we can look at the relevance of this work to Sabato & Winter's examples in (52). Recall their observation that the definite plural (52a) is a felicitous description of the scenario in (53), while (52b) is not.

(52)   a. The planks are stacked atop each other.
        b. Planks 1, 2, 3, and 4 are stacked atop each other.

(53)   Plank 1   Plank 3
        Plank 2   Plank 4

The observation is that the CRO (the conjoined names) prefers to describe a scenario where there is a single stack of planks. The undifferentiated plural object (*the planks*) does not have as strong a preference in this regard. Why should this be? If the conjoined names are associated with a CRO in the mental model, and CROs characteristically involve a high degree of similarity between their members, then this might lead to a preference for the individuals to all take

part in the same event. In this case, an event corresponds to a stack; the problem with (53) is that the individuals within the CRO are taking part in two distinct events. In contrast, if *the planks* is represented as an undifferentiated plural object then the individual planks are not represented, and there is thus no expectation that the individual planks should have a high degree of similarity.

As a side note, the fact that Patson & colleagues' experiments used reciprocal verbs (like *kissed*) to investigate the conceptual representation associated with plural DPs raises the question of whether/how this relates to reciprocal sentences (with *each other*). Does this work make predictions about how the form of the antecedent might affect the available interpretations of unambiguously reciprocal sentences? First, it should be pointed out that from their experiments, we cannot conclude anything in particular about reciprocal verbs like *kiss* (for instance, it is tempting but incorrect to conclude that the experiments show that reciprocal verbs have particular requirements regarding the conceptual representation of their subjects). The garden-path effect (or its blocking) has to do with whether, during online processing, the subject is associated with a representation that allows immediate satisfaction of the thematic role needs of a verb with ambiguous argument structure (i.e. *kissed* can be transitive or intransitive/reciprocal). A CRO allows immediate satisfaction of the intransitive/reciprocal thematic role needs, and blocks the garden path effect; an undifferentiated plural object does not.

In a reciprocal sentence with *each other*, both CROs and undifferentiated plural objects are suitable antecedents. But CROs probably make certain interpretations more likely. As I outlined above, there may be a preference for the individuals within the CRO to take part in the same event.

249

5.8 The effect of contrast

The previous section suggested that conjoined names should be expected to have certain pragmatic effects, and that Sabato & Winter's (2010) examples should be explained in this way. This section presents an argument against Sabato & Winter's claim that reciprocal sentences with conjoined name antecedents require connected interpretations.

5.8.1 Conjoined names, partitioning and contrast

Consider the examples in (54), which add to Sabato & Winter's examples some participants taking part in a contrasting activity. These sentences felicitously describe the scenarios in Figure 30 and Figure 31.

(54)   a. Planks 1, 2, 3 and 4 are stacked on top of each other, while Planks 5, 6, 7 and 8 are leaning against each other.
        b. In this photo, John, Paul, George and Ringo are looking into each other's eyes, while Mick and Keith have their backs to each other.

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1 ------------        3 ------------                /\        /\
2 ------------        4 ------------          5/      \6   7       8
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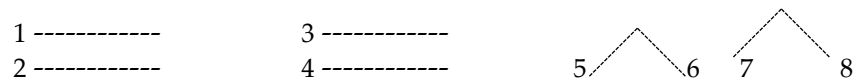
Figure 30: Planks stacked on top of and leaning against each other

$$J \Leftrightarrow P$$
$$G \Leftrightarrow R \qquad M\ K$$

Figure 31: A photo of the Beatles and some Rolling Stones

On Sabato & Winter's (2010) account, this is quite unexpected. The added linguistic material has not changed the anaphoric possibilities of the antecedent. I see this as evidence against Sabato & Winter's claim that reciprocal sentences require connectivity.

5.8.2 Statives, partitioning and contrast

Recall Fiengo & Lasnik's observation that (55) is an infelicitous description of scenario (56).

(55)   The men in the room like each other.

(56)   A ↔ B
        C ↔ D

But it seems that sentence (57) can felicitously describe the scenario in (58), where there is a contrast between the pairs of men inside and those outside[24].

(57)   The men in the room like each other, but the ones outside hate each other.

(58) | A ↔ B | E ↔ F
        | C ↔ D | G ↔ H

The change in acceptability associated with adding the contrasting set of men outside is not easily explained on a view such as Fiengo & Lasnik's, where partitioning is simply disallowed for stative predicates. Why should adding a contrasting set of men have the effect of allowing partitioning? We might reasonably expect that it would make it easier to partition the men into the two groups of those inside and those outside. But something different is going on here – the partitioning we are concerned with in scenario (58) is into the subsets (i.e. pairs) of men in each place.

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[24] It works similarly with *The men (=A+B+C+D) like each other and the women (=E+F+G+H) hate each other.*

5.8.3 Explaining the effect of contrast

As I have pointed out, the effect of contrast is unexpected on both Sabato & Winter's account and Fiengo & Lasnik's. On my account, *The men in the room like each other* does not allow the part-SR interpretation because of the constraint for quantification over states. Any subevents must have participants who form a substantive plurality. In this case that is all the men in the room, so each subevent must contain all of them. This equals the non-partitioned SR interpretation.

Now, when it comes to the example with the added contrast set of men outside, I will not argue that the addition of the contrast set makes the pairs of men into substantive pluralities. As was just mentioned, while we might expect the men inside and the men outside to form substantive pluralities, there is no reason to expect that the subsets (pairs) within each of these pluralities would likewise be made substantive by the addition of the contrast set. Instead, I think that the acceptability of this sentence in this scenario actually has nothing to do with partitioning into pairs based on substantive pluralities. I don't think that the hearer need come up with a construal that involves partitioning into pairs at all, in order to accept this sentence in this scenario. Rather, the contrast set encourages a construal that goes no further than the pluralities of men inside, and men outside. The sentence is about the men inside doing one thing, and the men outside doing a different thing. On this view, the presence of contrast can have the effect of encouraging a particularly underspecified construal.

The problem with this approach – where the presence of the contrast makes the substantivity (or not) of the pairs of men irrelevant – is that it suggests

252

that another construal ruled out by the requirement for substantivity should be allowed: WR. If it is the case that the construal is as underspecified as I suggest, we would wrongly predict that sentence (59) is true in scenario (60). Thus it seems that not all requirements are ignored in the presence of contrast.

(59)　The men in the room like each other, but the ones outside hate each other.

(60)
\<A,B\>	\<D,E\>
\<B,C\>	\<E,F\>
\<C,A\>	\<F,G\>

I think it is reasonable to assume that a stative reciprocal is worse in a WR scenario than in a part-SR scenario, (61). After all, if we can come up with some way of having the pairs in the part-SR scenario be substantive, the scenario can satisfy the constraint for quantification over states. In contrast, the WR scenario involves three overlapping states (as argued in Chapter 4, this makes it difficult to see them as three separate situations). It only consists of three states, none of which has participants which are a substantive plurality. According to my intuitions, the sentence *The men like each other* is completely infelicitous in the WR scenario in (61), but merely questionable in the part-SR scenario.

(61)　WR scenario:　　A likes B, B likes C, C likes A
　　　Part-SR scenario:　A+B like each other, C+D like each other

If there is this difference in how far the two scenarios are from satisfying the substantivity requirements, then perhaps we have an explanation for why the scenario in (60) is not rendered acceptable by the presence of contrast. The

contrast allows a certain relaxation of the substantivity requirements, but WR is too far from being felicitous to be allowed.

As for Sabato & Winter's conjoined name examples (*The planks/Planks 1, 2, 3 and 4 are stacked atop each other*), recall that on my account the problem with their original examples is that there are certain pragmatic effects associated with conjoined names. In particular, and related to the work on complex reference objects we saw in §5.7.2, I suggested that we might expect the version with conjoined names to prefer to describe a scenario where the four planks have a high degree of similarity (for instance, where they take part in the same event). In this case, a stack is equivalent to an event. Now, consider the effect of adding the contrasting set of planks:

(62)   Planks 1, 2, 3 and 4 are stacked on top of each other, while Planks 5, 6, 7 and 8 are leaning against each other.

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1 ------------          3 ------------              /\        /\
2 ------------          4 ------------         5 /    \ 6   7 /    \ 8
```
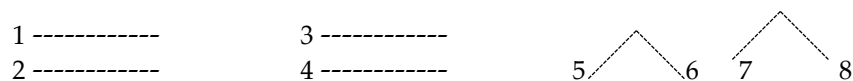
Figure 32: Planks stacked on top of and leaning against each other

Now we are talking about 8 planks. They are split into two substantive pluralities: the stacked, and the leaning. If conjoined names prefer interpretations where the conjuncts form a substantive plurality (or exhibit a high degree of similarity, e.g. by all taking part in the same event), this scenario satisfies that requirement. This is because now the scenario can be construed as involving two events: one consists of all the stacked planks; the other consists of all the leaning planks. Previously (in the original example from Sabato & Winter), each stack was construed as a separate event. The effect of introducing the contrasting set of

leaning planks is to enable this scenario to be viewed as two larger events: the stacking event (which includes both stacks) and the leaning event (which includes both leaning configurations). Thus, the CROs associated with the conjoined name antecedents in (62) can have their preference for having the individual conjuncts take part in the same event satisfied in the scenario in Figure 32.

5.9 Conclusion

The first part of the chapter focused on the preference for a reciprocal sentence to describe 'one general event'. It was argued that this reflects a general preference for economy: not only reciprocals and plural sentences (as predicted by Fiengo & Lasnik (1973) and Moltmann (1992), as well as the collective preference we saw in Chapter 4) but also sentences with quantification (e.g. *each*) prefer to describe one occasion.

The second part of the chapter looked at proposals to limit partitioned interpretations for reciprocal sentences. We saw that restrictions on partitioned interpretations for stative reciprocal sentences arise from the same source as the restrictions on WR discussed in Chapter 4: statives have special requirements regarding substantivity, as captured by Kratzer's constraint for quantification over states. As for Sabato & Winter's (2010) claim that apparent partitioned interpretations of reciprocal sentences are all attributable to the anaphoric properties of particular antecedents, I argue that conjoined name antecedents do not provide a neutral way of ascertaining the reciprocal's true capabilities regarding partitioning (as Sabato & Winter assume). I show that adding a contrasting set of individuals/events makes available a previously dispreferred

255

partitioned interpretation, and argue that the current account (which allows for the possibility of partitioned interpretations) can explain the effect of contrast better than previous accounts (which rule them out).

Overall this chapter, and this dissertation, have argued that the cumulative/WR semantics gives rise to the appropriate reciprocal interpretations, as long as it is supplemented by certain extragrammatical preferences.

CHAPTER 6

CONCLUSION

This dissertation has argued that the various interpretations of reciprocal sentences all arise from a single semantic representation equivalent to WR. In contrast to most contemporary accounts of the semantics of reciprocals, it does not see a place for the Strongest Meaning Hypothesis (SMH).

The dissertation began with an investigation of SMH-type approaches. Chapter 2 presented the results of two eye movement studies which failed to find evidence that the processor by default commits to a strong interpretation of reciprocal sentences during online sentence processing. These null results fit with previous studies that suggest that language users do not commit to the strong readings predicted by the SMH.

The rest of the dissertation assumes that all reciprocal interpretations arise from a cumulative semantic representation equivalent to WR. The need for an SMH is obviated by the influence of various economy principles and substantivity requirements.

There are two main problems for the WR account: interpretations weaker than WR, and interpretations that are necessarily stronger than WR. Chapter 3 addressed the issue of interpretations weaker than WR (chain interpretations). It was argued that approaches that assign chain reciprocals truth conditions weaker than WR (e.g. Dalrymple et al. 1998, Sabato & Winter 2012) fail to account for the variability in acceptability judgements of sentences with antecedents denoting two individuals. In contrast, such variability is a natural

consequence of an approach where chain interpretations arise via pragmatic weakening from the WR semantics.

Chapter 4 defended the WR semantics against the opposite problem: cases where reciprocal sentences are necessarily interpreted more strongly than WR. It argued that despite the weak truth conditions of the cumulative semantic representation, extragrammatical preferences for natural groupings and uniformity result in stronger interpretations than required by the semantics. Experiment 3 showed that reciprocals and other plural sentences show a tendency for stative predicates to resist cumulative/WR interpretations. I argued that Kratzer's constraint for quantification over states could explain why statives resist WR readings, and why reciprocals show this tendency more strongly than other plural sentences.

Chapter 4 looked at cumulative semantic representations of reciprocal and other plural sentences from the perspective of sentence processing. It argued that economy preferences at the level of the mental representation of discourse favour positing that a plural sentence is associated with a single event. For plural sentences, that equates to a preference for collective interpretations. For reciprocals, that single event must have subevents that via cumulativity satisfy the WR truth conditions (as well as the reciprocal's non-identity condition). But there is little proof that the processor must fully instantiate those subevents in all cases. When the processor is called upon to fully instantiate those subevents, certain scenario types (i.e. SR) are attractive because they are economical – not in terms of the number of events posited, but rather in the way that each individual takes part in the event in the same way (I call this a preference for uniformity).

Chapter 5 focused on two challenges to the cumulative account: the preference for a single occasion, and limits on partitioning. As we saw earlier in the dissertation, by their very nature cumulative semantic representations are always in danger of overpredicting available interpretations. Chapter 4 proposed that economy preferences and substantivity requirements act to limit the available interpretations, and Chapter 5 argued likewise. The preference for a reciprocal sentence to describe 'one general event' was argued to reflect a general preference for economy in representation. Restrictions on partitioned interpretations for stative predicates were argued to arise from the same source, potentially, as the restrictions on WR discussed in Chapter 4: statives have special requirements regarding substantivity, as captured by Kratzer's constraint for quantification over statives. The chapter addressed Sabato & Winter's (2010) proposal that reciprocal sentences require connected interpretations, and only receive apparent partitioned interpretations via the anaphoric possibilities of the antecedent. This proposal is a strong attack on cumulativity. I argued that Sabato & Winter's examples have another explanation (pragmatic effects associated with conjoined names), and showed that examples predicted by Sabato & Winter not to allow partitioned interpretations actually become acceptable when a contrasting set of individuals/events is introduced.

This dissertation has argued that reciprocal sentences are a kind of plural sentence. Apart from the non-identity condition, we should not expect to have to say anything special about reciprocals – the cumulative semantics that gives rise to interpretations of other plural sentences is enough.

The dissertation has argued that the cumulative semantics radically underspecifies, and that in order to arrive at an interpretation, the language

259

processor makes use of economy principles at the level of the mental model. The processor also must make decisions about the substantiveness of various pluralities. There is no need for a SMH to select among possible reciprocal meanings. The cumulative/WR semantics, supplemented by extragrammatical preferences, gives rise to the appropriate interpretations.

This dissertation has used psycholinguistic evidence and processing considerations in order to ask questions about where the grammar ends and non-grammatical influences on interpretation begin. It has presented an argument that the task of assigning interpretations to reciprocal sentences does not require a principle like the SMH. It argued that effects claimed to be due to the SMH could instead arise from a set of extragrammatical preferences.

APPENDIX

EXPERIMENTAL MATERIALS

Experiment 1A: SR default questionnaire pilot

1. I saw a group of kids playing. The kids hit each other on the arm. Each kid hit {every other kid / one of the other kids.}
2. The team was training at the gym. The players helped each other with the various machines. Each player helped {every other player / one of the other players.}
3. Yesterday, nominations closed for the employee award. The clerks nominated each other secretly. Each clerk nominated {every other clerk / one of the other clerks.}
4. There were a bunch of journalists at the conference. The journalists quoted each other approvingly. Each journalist quoted {every other journalist / one of the other journalists.}
5. A few people took part in the 'Interview experiment'. The participants interviewed each other while being recorded. Each participant interviewed {every other participant / one of the other participants.}
6. The biologist watched the family of gorillas. The gorillas fed each other fruit. Each gorilla fed {every other gorilla / one of the other gorillas.}

Experiment 1: SR default eye movement study

1.   a. I saw a group of kids playing. Each kid hit every other kid. The kids hit each other on the arm.
    b. I saw a group of kids playing. The kids hit each other on the arm. Each kid hit every other kid.
    c. I saw a group of kids playing. Each kid hit one of the other kids. The kids hit each other on the arm.
    d. I saw a group of kids playing. The kids hit each other on the arm. Each kid hit one of the other kids

2. The team was training at the gym.
    a/c. Each player helped {every other player/one of the other players}. The players helped each other with the various machines.
    b/d. The players helped each other with the various machines. Each player helped {every other player/one of the other players}.
3. All the clerks were filling in forms.
    a/c. Each clerk nominated {every other clerk/one of the other clerks}. The clerks nominated each other secretly.
    b/d. The clerks nominated each other secretly. Each clerk nominated {every other clerk/one of the other clerks}.
4. Those four workers were talking to the boss.
    a/c. Each worker praised {every other worker/one of the other workers}. The workers praised each other loudly.

b/d. The workers praised each other loudly. Each worker praised {every other worker/one of the other workers}.

5. There were a bunch of journalists at the meeting.
    a/c. Each journalist quoted {every other journalist/one of the other journalists}. The journalists quoted each other approvingly.
    b/d. The journalists quoted each other approvingly. Each journalist quoted {every other journalist/one of the other journalists}.

6. All the participants were in the room.
    a/c. Each participant interviewed {every other participant/one of the other participants}. The participants interviewed each other briefly.
    b/d. The participants interviewed each other briefly. Each participant interviewed {every other participant/one of the other participants}.

7. The biologist watched the family of gorillas.
    a/c. Each gorilla fed {every other gorilla/one of the other gorillas}. The gorillas fed each other fruit.
    b/d. The gorillas fed each other fruit. Each gorilla fed {every other gorilla/one of the other gorillas}.

8. Nina saw five little girls on the sofa.
    a/c. Each girl tickled {every other girl/one of the other girls}. The girls tickled each other happily.
    b/d. The girls tickled each other happily. Each girl tickled {every other girl/one of the other girls}.

9. The pack of dogs played in the park.
    a/c. Each dog bit {every other dog/one of the other dogs}. The dogs bit each other playfully.
    b/d. The dogs bit each other playfully. Each dog bit {every other dog/one of the other dogs}.

10. The six contestants waited for the results.
    a/c. Each contestant hugged {every other contestant/one of the other contestants}. The contestants hugged each other nervously.
    b/d. The contestants hugged each other nervously. Each contestant hugged {every other contestant/one of the other contestants}.

11. The panel of judges met yesterday.
    a/c. Each judge questioned {every other judge/one of the other judges}. The judges questioned each other harshly.
    b/d. The judges questioned each other harshly. Each judge questioned {every other judge/one of the other judges}.

12. I watched the litter of kittens.
    a/c. Each kitten cleaned {every other kitten/one of the other kittens}. The kittens cleaned each other thoroughly.
    b/d. The kittens cleaned each other thoroughly. Each kitten cleaned {every other kitten/one of the other kittens}.

13. All the suspects were at the station.
    a/c. Each suspect identified {every other suspect/one of the other suspects}. The suspects identified each other by sight.
    b/d. The suspects identified each other by sight. Each suspect identified {every other suspect/one of the other suspects}.

14. All the nominees were on the stage.

a/c. Each nominee thanked {every other nominee/one of the other nominees}. The nominees thanked each other personally.
b/d. The nominees thanked each other personally. Each nominee thanked {every other nominee/one of the other nominees}.

15. Everyone in the room was angry.
a/c. Each person annoyed {every other person/one of the other people}. The people annoyed each other accidentally.
b/d. The people annoyed each other accidentally. Each person annoyed {every other person/one of the other people}.

16. All the boys were telling riddles.
a/c. Each boy tricked {every other boy/one of the other boys}. The boys tricked each other easily.
b/d. The boys tricked each other easily. Each boy tricked {every other boy/one of the other boys}.

17. The five models were unhappy.
a/c. Each model criticized {every other model/one of the other models}. The models criticized each other viciously.
b/d. The models criticized each other viciously. Each model criticized {every other model/one of the other models}.

18.All the children hid, unsuccessfully.
a/c. Each child spotted {every other child/one of the other children}. The children spotted each other quickly.
b/d. The children spotted each other quickly. Each child spotted {every other child/one of the other children}.

19. Six cars were involved in the accident.
a/c. Each driver cursed at {every other driver/one of the other drivers}. The drivers cursed at each other angrily.
b/d. The drivers cursed at each other angrily. Each driver cursed at {every other driver/one of the other drivers}.

20. The art class did portraits today.
a/c. Each student drew {every other student/one of the other students}. The students drew each other in crayon.
b/d. The students drew each other in crayon. Each student drew {every other student/one of the other students}.

Experiment 2: Chain/non-chain eye movement study
1.   a/b. At noon,⏐ the children ⏐followed ⏐{each other/the teacher} through the door ⏐ and into the classroom.
c/d. As soon as the teacher left the room,⏐ the children ⏐ teased ⏐ {each other/the visitor} meanly ⏐ and made a lot of noise.
2.   a/b. When the bell rang,⏐ the biologists ⏐ followed ⏐ {each other/the speaker} into the auditorium ⏐ for the lecture.
c/d. When the manuscript was printed out, ⏐ the editors ⏐ teased ⏐{each other/the intern} about the spelling ⏐ errors.
3.   a/b. To receive their awards,⏐ the players ⏐ lined up behind ⏐{each other/the stage} and waited ⏐very patiently.
c/d. When the problem arose,⏐ the nurses ⏐ helped ⏐{each other/the patient} and showed ⏐great professionalism.

4.   a/b. In the photo of the fairground, | the customers | are lined up behind | {each other/the gates} waiting | to enter.
c/d. Last night, | the lawyers | helped | {each other/the client} in preparation | for the big case.

5.   a/b. As all the owners watched, | the dogs | chased | {each other/the squirrel} out of the park | and across the street.
c/d. Right before the important race, | the cyclists | observed | {each other/the coach} closely | as the crowd roared.

6.   a/b. When the zookeeper opened the door, | the hawks | chased | {each other/the pigeon} up into the sky, | unfortunately.
c/d. When the blueprints arrived, | the engineers | observed |{each other/the builder} while the boss | looked at the plans.

7.   a/b. When Dave mopped the floor, | the chairs | were stacked on top of | {each other/the table} so nothing | was in the way.
c/d. When they were all in the store, | the teenagers | insulted | {each other/the clerk} and somebody | called the manager.

8.   a/b. When Chris got home, | the packages | were stacked on top of | {each other/the counter} neatly | so he was relieved.
c/d. After the final siren sounded, | the fans | insulted | {each other/the referee} obnoxiously | and loudly.

9.   a/b. When we got there, | the boxes | were placed inside | {each other/the crate} so they didn't | take up too much space.
c/d. When they all reached the summit, | the hikers | photographed | {each other/the scenery} with disposable | cameras.

10.   a/b. When Karen moved, | the bowls | were placed inside {each other/the carton} and protected | with crumpled newspaper.
c/d. When the lights came on, | the artists | photographed | {each other/the statue} from across | the room.

11.   a/b. As the mother cat watched, | the kittens | ran after |{each other/the mouse} and tumbled | down the stairs.
c/d. When the boss asked for comments, | the managers | complimented |{each other/the janitor} in an insincere | manner.

12.   a/b. When Kim said "Go", | the girls | ran after | {each other/the horse} as fast | as they could.
c/d. When the faculty meeting started, | the professors | complimented |{each other/the guest} before starting | to work.

13.   a/b. The last time Mike was at the site, | the planks | were lying on top of |{each other/the pipes} in a disorganized | way.
c/d. Today at the meeting, | the neighbors | complained about| {each other/the factory} while the mayor | read the newspaper.

14.   a/b. When we arrived, | the fallen trees | were lying on top of |{each other/the vehicle} as the wind | continued to howl.
c/d. After the boss suggested a compromise, | the workers | complained about | {each other/the factory} just like | always.

Experiment 3: Stative/Eventive questionnaire

1.   a/b. There were three kids in the yard: Stacey, Mark and Leah.

Stacey {liked/hit} Mark. Mark {liked/hit} Leah. And Leah {liked/hit} Stacey.

c/d. There were three girls and three boys in the yard. Missy {liked/hit} Tom. Anne-Marie {liked/hit} Carl. And Caroline {liked/hit} David.

a/b. Description: The kids {liked/hit} each other.

c/d. Description: The girls {liked/hit} the boys.

2. a/b. There were three baseball players at the gym: Bill, Jerry and Dave. Bill {knew about/helped} Jerry. Jerry {knew about/helped} Dave. And Dave {knew about/helped} Bill.

c/d. There were three athletes at the gym: Steve, Will and Eric. And there were three celebrities: Paris, Britney and Madonna. Steve {knew about/helped} Paris. Will {knew about/helped} Britney. And Eric {knew about/helped} Madonna.

a/b. Description: The baseball players {knew about/helped} each other.

c/d. Description: The athletes {knew about/helped} the celebrities.

3. a/b. There were three boys: Jason, Tim and Louis. Jason {believed/recommended} Tim. Tim {believed/recommended} Louis. And Louis {believed/recommended} Jason.

c/d. There were three boys and three girls. Jason {believed/recommended} Sarah. Tim {believed/recommended} Maria. And Louis {believed/recommended} Angela.

a/b. Description: The boys {believed/recommended} each other.

c/d. Description: The boys {believed/recommended} the girls

4. a/b. There were three girls: Emily, Anna and Lizzie. Emily {appreciated/criticized} Anna. Anna {appreciated/criticized} Lizzie. And Lizzie {appreciated/criticized} Emily.

c/d. There were three girls: Amelia, Michelle and Carrie. And there were three teachers: Mr. Waters, Ms. Clayton and Ms. Williams. Amelia {appreciated/criticized} Mr. Waters. Michelle {appreciated/criticized} Ms. Clayton. And Carrie {appreciated/criticized} Ms. Williams.

a/b. Description: The girls criticized each other.

c/d. Description: The girls appreciated the teachers

5. a/b. The magazine had three journalists at the press conference: Brown, Stewart and Mulligan. Brown {hated/quoted} Stewart. Stewart {hated/quoted} Mulligan. And Mulligan {hated/quoted} Brown.

c/d. The newspaper had three journalists at the press conference: Moore, Martin and Thompson. And there were three actors: Tom Cruise, Brad Pitt and Harrison Ford. Moore {hated/quoted} Tom Cruise. Martin {hated/quoted} Brad Pitt. And Thompson {hated/quoted} Harrison Ford.

a/b. Description: The journalists hated each other.

c/d. Description: The journalists quoted the actors.

6. a/b. There were three staff members involved in the project: Stevenson, Waters and Macdonald. {Stevenson respected Waters. Waters respected Macdonald. And Macdonald respected Stevenson./ On Monday, Stevenson contacted Waters. Waters contacted Macdonald. And Macdonald contacted Stevenson. }

c/d. There were three staff members involved in the campaign: Stevens, Wright and Collins. And there were three clients: Mr. Smith, Mr. Jones and Mr. Brown. {Stevens respected Mr. Smith. Wright respected Mr. Jones.

And Collins respected Mr. Brown./ On Monday, Stevens contacted Mr. Smith. Wright contacted Mr. Jones. And Collins contacted Mr. Brown.}
a/b. Description: The staff members {respected/contacted} each other.
c/d. Description: The staff members {respected/contacted} the clients.

7.   a/b. There were three songwriters: Lucy Hart, Georgie Donnelly, and Shannon Rogers. Hart {envied/sued} Donnelly. Donnelly {envied/sued} Rogers. And Rogers {envied/sued} Hart.
c/d. There were three songwriters: Melinda Young, Kevin Harris, and Missy Turner. And there were three singers: Cher, Beyonce and Pavarotti. Young {envied/sued} Cher. Harris {envied/sued} Beyonce. And Turner {envied/sued} Pavarotti.
a/b. Description: The songwriters {envied/sued} each other.
c/d. Description: The songwriters {envied/sued} the singers.

8.   a/b. There were three lawyers: Amy, Steven and Ian. {Amy understood Steven. Steven understood Ian. And Ian understood Amy. / On Thursday, Amy consulted Steven. Steven consulted Ian. And Ian consulted Amy.}
c/d. There were three lawyers: Jesse, Mike and Robert. And there were three judges: Judge Green, Judge Rubin and Judge Stickney. {Jesse understood Judge Green. Mike understood Judge Rubin. And Robert understood Judge Stickney./ On Thursday, Jesse consulted Judge Green. Mike consulted Judge Rubin. And Robert consulted Judge Stickney.}
a/b. Description: The lawyers consulted each other.
c/d. Description: The lawyers understood the judges.

9.   a/b. There were three women in the studio: Megan, Angela and Kathryn. Megan {could hear/recorded} Angela talking. Angela {could hear/recorded} Kathryn talking. And Kathryn {could hear/recorded} Megan talking.
c/d. There were three technicians in the studio: Megan, Adam and Kate. And there were three priests: Father O'Reilly, Father Buckley and Father Masterson. Megan {could hear/recorded} Father O'Reilly talking. Adam {could hear/recorded} Father Buckley talking. And Kate {could hear/recorded} Father Masterson talking.
a/b. Description: The women {could hear/recorded} each other talking.
c/d. Description: The technicians {could hear/recorded} the priests talking.

10.   a/b. The experiment had three participants. Participant #1 {trusted/interviewed} participant #2. Participant #2 {trusted/interviewed} participant #3. And participant #3 {trusted/interviewed} participant #1.
c/d. The experiment had three participants. And there were three lab assistants: Frank, Greg and Danny. Participant #1 {trusted/interviewed} Frank. Participant #2 {trusted/interviewed} Greg. And participant #3 {trusted/interviewed} Danny.
a/b. Description: The participants {trusted/interviewed} each other.
c/d. Description: The participants {trusted/interviewed} the lab assistants.

11.   a/b. There were three criminals on the loose: 'Scarface' Lee, Dan Mackenzie, and Billy Bowen. Scarface {feared/shot} Mackenzie. Mackenzie {feared/shot} Bowen. And Bowen {feared/shot} Scarface.

c/d. There were three criminals on the loose: Bill 'Bones' McGee, Jimmy Knuckles, and Little Max Walker. And there were three police officers on the case: Detective Cohen, Detective d'Erico and Sergeant Rafferty. McGee {feared/shot} Detective Cohen. Jimmy Knuckles {feared/shot} Detective d'Erico. And Walker {feared/shot} Sergeant Rafferty.
a/b. Description: The criminals {feared/shot} each other.
c/d. Description: The criminals {feared/shot} the police officers.

12.   a/b. There were three friends: Sam, Chrissy and Adam. Sam {loved/spotted} Chrissy. Chrissy {loved/spotted} Adam. And Adam {loved/spotted} Sam.
c/d. There were three friends: Justin, Ingrid and Paul. And there were three new people: Meg, Max and Miriam. Justin {loved/spotted} Meg. Ingrid {loved/spotted} Max. And Paul {loved/spotted} Miriam.
a/b. Description: The friends {loved/spotted} each other.
c/d. Description: The friends {loved/spotted} the new people.

13.   a/b. The school had three bullies: Annie, Mike and Louise. Annie {was scared of/betrayed} Mike. Mike {was scared of/betrayed} Louise. And Louise {was scared of/betrayed} Annie.
c/d. The school had three bullies: Chris, Mike and Amy. And there were three hall monitors: Monitor Stanley, Monitor Owen and Monitor Madison. Chris {was scared of/betrayed} Monitor Stanley. Mike {was scared of /betrayed} Monitor Owen. And Amy {was scared of /betrayed} Monitor Madison.
a/b. Description: The bullies {were scared of/betrayed} each other.
c/d. Description: The bullies {were scared of/betrayed} the hall monitors.

14.   a/b. There were three actors in the play: Luke, Michelle and Heather. Luke {couldn't stand/slapped} Michelle. Michelle {couldn't stand/slapped} Heather. And Heather {couldn't stand/slapped} Luke.
c/d. There were three actors in the play: Patrick, Tony and Sylvie. And there were 3 directors: the script director, the art director and the costume director. Patrick {couldn't stand/slapped} the script director. Tony {couldn't stand/slapped} the art director. And Sylvie {couldn't stand/slapped} the costume director.
a/b. Description: The actors {couldn't stand/slapped} each other.
c/d. Description: The actors {couldn't stand/slapped} the directors.

Experiment 4: Single event preference questionnaire

Items 1-12: The 'bump' class
1.   a/b. At 12.05 pm, the SUV bumped into the sedan, and the sedan bumped into the SUV.
c/d. The SUV bumped into the sedan on Monday, and the sedan bumped into the SUV on Thursday.
Description: {Those cars bumped into each other./Those cars each bumped into the other.}
2.   a/b. Two players got in a fight in the first quarter, and both of them ended up with broken bones.

c/d. The goalie broke the forward's nose a few years ago, and in the finals last year, the forward gave the goalie a concussion.
Description: {Those players injured each other./Those players each injured the other.}

3.   a/b. At the fair, Lisa and Paula went on the bumper-cars. Just after they started, Lisa crashed into Paula, and Paula crashed into Lisa.
c/d. At the fair, Lisa and Paula went on the bumper-cars. Just after they started, Lisa crashed into Paula. Then, just before the end, Paula crashed into Lisa.
Description: {Those girls crashed into each other. / Those girls each crashed into the other.}

4.   a/b. At the meeting, Max and Walter got into a loud argument in front of everybody. They were yelling.
c/d. At the meeting, Max yelled at Walter, and then afterwards Walter yelled at Max.
Description: {Those men yelled at each other. / Those men each yelled at the other.}

5.   a/b. At noon on Monday, the cruise ship smashed into the ferry, and the ferry smashed into the cruise ship.
c/d. When they were leaving the dock, the cruise ship smashed into a ferry. Then, when they reached the open sea, the ferry smashed into the cruise ship.
Description: {Those boats smashed into each other. / Those boats each smashed into the other.}

6.   a/b. The two boys had a pretend boxing match. The tall boy punched the short boy on the arm, and the short boy punched the tall one on the shoulder.
c/d. The tall boy punched the short boy on the arm. And then a while later, the short boy punched the tall one.
Description: {Those boys punched each other. / Those boys each punched the other.}

7.   a/b. There was an accident at the cycle track this morning: the red bike hit the blue bike, and the blue bike hit the red bike.
c/d. There were some accidents at the cycle track this week. The red bike hit the blue bike on Tuesday. On Saturday, the blue bike hit the red bike.
Description: {Those bikes hit each other. / Those bikes each hit the other.}

8.   a/b. The two criminals went outside to settle their argument. Scarface smashed a garbage can over Slim's head, and Slim bashed Scarface's head into a wall.
c/d. The two criminals have fought twice. First, Scarface smashed a garbage can over Slim's head. A week later, Slim bashed Scarface's head into a wall.
Description: {Those criminals beat each other up. / Those criminals each beat the other up.}

9.   a/b. Two kids damaged their go-karts during the race. They were speeding out of control, and they collided.
c/d. Two kids damaged their go-karts recently. Max was speeding out of control, and he hit Mike. The next day, Mike's brakes malfunctioned, and he smashed full-speed into Max.

Those kids ploughed into each other. / Those kids each ploughed into the other.
10. a/b. Liz and Kelly were walking around in socks on the new carpet. Then they touched, and got a jolt of static electricity.
c/d. Liz and Kelly were walking around in socks on the new carpet. Liz rubbed her feet really fast on the floor, and then touched Kelly, giving her a jolt of static electricity. Kelly got her back later: she did the same thing to Liz.
Description: {Those girls jolted each other with static electricity./Those girls each jolted the other with static electricity.}
11. a/b. At midnight, the two vandals took the riding mowers from the shed. The guy on the green mower rammed into the guy on the red mower, and at the same time the guy on the red mower rammed into the guy on the green one.
c/d. At midnight, the two vandals took the riding mowers from the shed. The guy on the green mower rammed into the guy on the red mower. And then the guy on the red mower rammed into the guy on the green one.
Description: {Those vandals rammed into each other. / Those vandals each rammed into the other.}
12. a/b. When Cameron and Jake went down the water-slide together, Cameron slammed into Jake and Jake slammed into Cameron.
c/d. Cameron went down the water-slide and at the bottom he slammed into Jake. Then Jake went down the slide, and slammed into Cameron.
Description: {Those boys slammed into each other./Those boys each slammed into the other.}

Items 13-24: The 'bite' class
13. a/b. Richardson sued Summers, and Summers sued Richardson. They are both songwriters. It was a dispute about which of them wrote the hit song.
c/d. Richardson sued Summers about 10 years ago, and then recently Summers sued Richardson over another matter. They are both songwriters.
Description: {Those songwriters sued each other./Those songwriters each sued the other.}
14. a/b. At kindergarten today, Melissa and David were pretending to be dogs. She bit him, and he bit her.
c/d. Melissa bit David at kindergarten last week, and it seems he learned the bad habit from her: he bit her this morning.
Description: {Those children bit each other./Those children each bit the other.}
15. a/b. Amy wanted to drive to Montreal, but she hates driving alone. And Sarah needed to get to Montreal too, but she had no car and no money. So Amy gave her a ride.
c/d. Sarah got Amy a ticket to a concert, and a few weeks later, Amy loaned Sarah her Biology notes.
Description: {Those girls did each other a favor./Those girls each did the other a favor.}
16. a/b. Earlier, my friends Francis and Carly had to carry the heavy

suitcases to the car. Francis helped Carly, and Carly helped Francis.
c/d. My friend Francis helped my friend Carly carry some heavy suitcases to the car. And then Carly helped Francis prepare dinner.
Description: {My friends helped each other./My friends each helped the other.}

17.   a/b. The biologist observed the two chimps sitting together, grooming. The big chimp groomed the little one, and the little one groomed the big one.
c/d. The biologist observed the big chimp grooming the little one. The previous day, the little one had groomed the big one.
Description: {Those chimps groomed each other. /Those chimps each groomed the other.}

18.   a/b. Two little girls ended up with skinned knees. They were playing jump rope, and somehow Eloise tripped Janie and Janie tripped Eloise.
c/d. Two little girls ended up with skinned knees. Eloise tripped Janie this morning. Janie got her revenge: she tripped Eloise at lunch.
Description: {Those little girls tripped each other. / Those little girls each tripped the other.}

19.   a/b. At sunrise this morning the bird-watcher noticed that the male robin fed the female, and the female fed the male.
c/d. This morning the bird-watcher noticed that the male robin fed the female robin some worms. And this evening he noticed that the female fed the male some bugs.
Description: {Those robins fed each other./Those robins each fed the other.}

20.   a/b. The mission was over: the agency spy spotted the foreign spy, and the foreign spy spotted the agency spy.
c/d. At the crowded train station, the agency spy spotted the foreign spy. And at the art museum, the foreign spy spotted the agency spy.
Description: {Those spies spotted each other./Those spies each spotted the other.}

21.   a/b. In the lead-up to the recent election, the governor endorsed the senator, and the senator endorsed the governor.
c/d. Several years ago, the governor endorsed the senator. And in the lead-up to the recent election, the senator endorsed the governor.
Description: {Those politicians endorsed each other./Those politicians each endorsed the other.}

22.   a/b. Immediately after they left the courtroom, the prosecutor criticized the defense attorney, and the defense attorney criticized the prosecutor.
c/d. Five years ago, the prosecutor criticized the defense attorney. Then, after they clashed in a recent court case, the defense attorney criticized the prosecutor.
Description: {Those lawyers criticized each other. / Those lawyers each criticized the other.}

23.   a/b. In June, Leo recommended Jenny for the employee-of-the-month award, and Jenny recommended Leo.
c/d. In June, Leo recommended Jenny for the employee-of-the-month award, and in July, Jenny recommended Leo.

Description: {Those employees recommended each other./Those employees each recommended the other.}
24. a/b. Even though Dr. Woods and Dr. Robinson were sick last week, they didn't stay home. Instead, they went to work at the hospital as usual. Dr. Woods treated Dr. Robinson, and Dr. Robinson treated Dr. Woods. c/d. A couple of years ago, Dr. Woods treated Dr. Robinson for malaria. And last week, Dr. Woods was sick with appendicitis, and Dr. Robinson treated her.
Description: {Those doctors treated each other./Those doctors each treated the other.}

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