Understanding Non-Maximal Reciprocity

Imke Kruitwagen, James A. Hampton**, Yoad Winter*, Joost Zwarts**
**Utrecht University **City St. George University of London*

1 Introduction

Reciprocal pronominals (*each other, one another*) and reciprocal verbs (*meet, hug*) support non-maximal interpretations. For example, both 'the men fought each other' and 'the men fought' can effectively describe a brawl in a barroom where only some of the men were fighting others (Dalrymple et al. 1998). This paper reports experimental findings on non-maximal reciprocity, revealing that while both intransitives and pronominals exhibit non-maximality, intransitives demonstrate a higher degree of it, and are more influenced by the perceived intention of the agent in the sentence. This result supports a lexical theory of intransitive reciprocals without covert reciprocal quantifiers. Intransitives are analyzed as lexical predicates applying to a group as a whole. Their pragmatic halos (Lasersohn 1999) stem from slack, typicality-based, relations with their two-place alternates. By contrast, pronominal reciprocals are standardly analyzed using a distributivity operator (Beck 2001), whose halo is tighter due to its quantificational origins (Križ 2016). This distinction is further supported by the different behavior of pronominals and intransitives with group nouns like *team* and *stack*.

2 Two theories of intransitive reciprocals

A key question in the analysis of intransitive verbs like *meet* and *hug* concerns their relations with the corresponding constructions *meet/hug each other*. Pronominal reciprocals like *each other* are often treated using a double distributivity operator '**' with optional covers (Beck 2001), which scopally interacts with existential quantification over events, as illustrated by the two analyses of sentence (1) below, where $\textit{hug}_{tv}$ is the denotation of transitive *hug*:

(1) Ann and Ben hugged each other.

a. $\exists e.[^{**}\lambda x.\lambda y.\textit{hug}_{tv}(e,x,y)](a+b)$ – *event quantifier* > *distributivity*
'there is an event where Ann hugs Ben and Ben hugs Ann'

b. $[^{**}\lambda x.\lambda y.\exists e.\textit{hug}_{tv}(e,x,y)](a+b)$ – *distributivity* > *event quantifier*
'there is an event where Ann hugs Ben and there is an event where Ben hugs Ann'

Decompositional theories of reciprocal intransitives follow Gleitman (1965) and treat intransitive sentences like 'Ann and Ben hugged' using a silent *each other*, analyzed by a narrow scope **-operator as in (1a) (Wehbe 2024). By contrast, *lexical theories* analyze reciprocal intransitives as predicates over groups that are connected to their binary alternates by a lexical rule. Specifically, Kruitwagen et al. (2022) analyze 'A&B hugged' as in (2b) below:

(2) Ann and Ben hugged.

a. **Decompositional analysis**: $\exists e.[^{**}\lambda x.\lambda y.\textit{hug}_{tv}(e,x,y)](a+b)$ (=(1a))

b. **Lexical analysis**: $\exists e.\textit{hug}_{iv}(e,a+b)$, where $\textit{hug}_{iv}(e,a+b)$ is *true*
iff $(1-w)[\textsc{typ}(\textit{hug}_{tv}(a,b)) + \textsc{typ}(\textit{hug}_{tv}(b,a))] + w \cdot \mathrm{I}_{hug}(e,a+b) > \textit{threshold}$

(2b) analyzes the intransitive as true in an event e if e's *reciprocal typicality* exceeds a pragmatic

threshold. The reciprocal typicality of 'A&B hugged' is the sum of typicality values for 'A hugged B' and 'B hugged A' and the *agentive intention* I_{hug} of the couple Ann and Ben in e with respect to the verb *hug* (i.e. affection). The constant w determines the weight of agentive intentionality I_{hug} in the reciprocal typicality of the events, s.t. $0 \leq w < 1$.

As descriptions of a specific event e, the decompositional approach expects sentence (2) to be equivalent to (1), as (1a) and (1b) are equivalent when e is unique. Thus, the sensitivity of both reciprocal forms to intention is only as strong as that of the transitive verb. Furthermore, with two participants as in (1)-(2), non-maximal distributivity is expected to be limited (Križ 2016). For instance, 'A&B smiled' can hardly be true if only one agent smiled. By contrast, the lexical analysis (2b) predicts that intransitives exhibit greater tolerance to exceptions than pronominals, because the fluctuation of threshold values and the effect of intention are independent of the number of participants in an event.

3 Experiment

To compare the predictions of the two theories, we examined eight reciprocal Dutch verbs:

(3) *knuffelen* 'cuddle', *vechten* 'fight', *botsen* 'collide', *appen'* 'send WhatsApp', *praten* 'talk', *delen* 'share', *ruziemaken* 'argue', *fluisteren* 'whisper'

Sentences with these verbs were coupled with video clips describing two participants in non-maximal, asymmetric situations. A woman ('Fleur') performed the typical activity of the verb on a man ('Mark'), while showing the expected intention. For instance, for *knuffelen* ('hug', 'cuddle'), Fleur wraps her arms around Mark and looks at him affectionately. Mark does not show the activity that is typically associated with the verb's agent, e.g. he does not wrap his arms around Fleur. We created two versions of this scene: in one, Mark exhibits the expected attitude, e.g. affection for 'cuddle', while in the other Mark looks disaffected or resistant. We say that the two clips differ with respect to Mark's intention, denoted $+$I or $-$I.

3.1 Method

A total of 302 Dutch speakers (150 female, age M $=$ 25) were recruited through Prolific. Participants were presented with pronominal/intransitive sentences as in (4) below:

(4) *Fleur en Mark hebben* (*elkaar*) *geknuffeld*
Fleur and Mark have (each other) cuddled

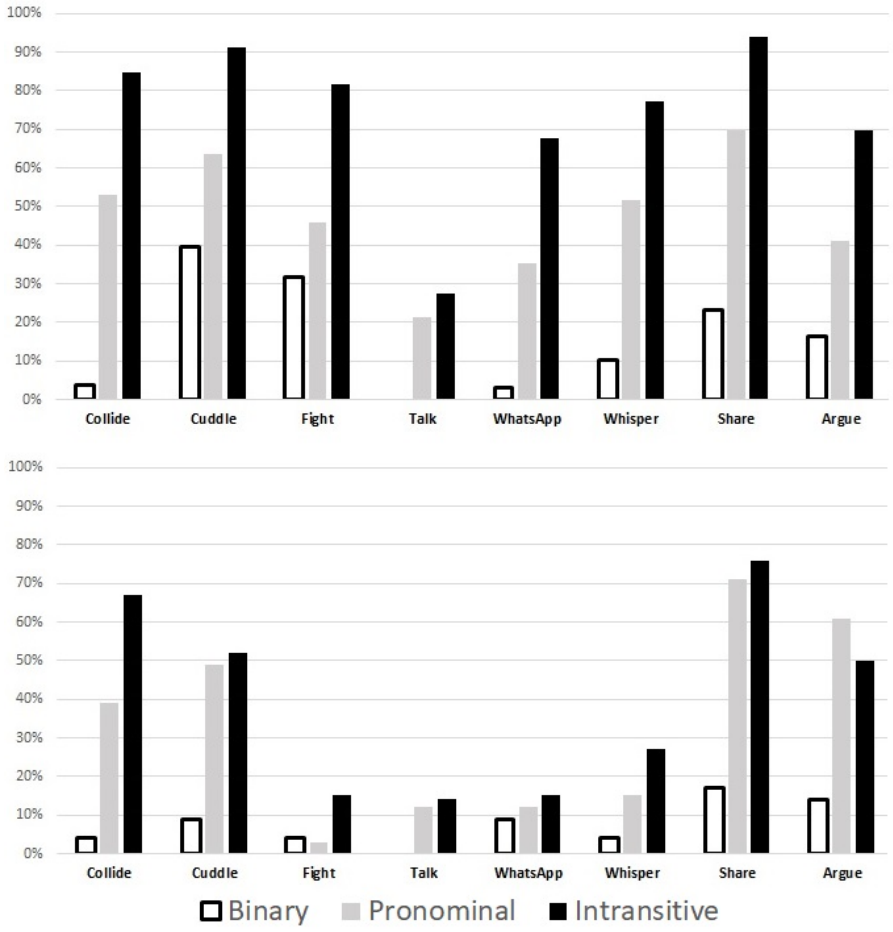
Similarly to (4), Pronominal and Intransitive sentences were constructed using the eight verbs in (3). These 16 sentences were combined with $+$I/$-$I videos, totaling 32 test items. Participants gave truth-value judgements on sentences in relation to the corresponding videos.

To obtain a balance in true/false reactions and prevent automatic answering strategies, we added 7 filler items containing transitive and intransitive sentences with videos where the sentences were clearly true or false. We used a between-subject design with a total of 8 versions. Each version contained 11 items with different verbs: 4 targets (2 with pronominals and 2 with intransitives) and 7 fillers. For each test item, a video was displayed, after which the accompanying sentence was shown and the truth-value judgement was solicited.

For comparison with ground truth judgements about transitive relations in the videos, we also used data from a prior study on binary constructions like the following:

(5) *Mark heeft Fleur geknuffeld*
Mark has Fleur cuddled

In our videos, Mark is visibly passive. Thus, sentences like (5) give an indication of the 'slack' in (4). If reciprocals show no 'slack' at all, we expect no difference in the frequency of true judgements between (5) and (4). If reciprocity allows slack interpretations, as commonly assumed, we expect sentences as in (4) to be accepted more frequently than (5).



← Figure 1: Acceptance rates in +I scenarios

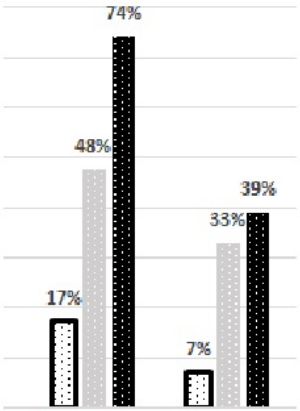


Figure 3: total acceptance rates in the +I (left) and –I (right) scenarios

← Figure 2: Acceptance rates in –I scenarios

3.2 Results

Figures 1-3 show the proportion of true responses in each condition as well as the overall total. A $2\times2\times3$ log-linear analysis found a significant 3-way interaction between Response, Intention, and Sentence ($\chi^2(2) = 11.501$, $p = 0.003$), showing that Intention effects varied by sentence type. Intention and Sentence effects were also significant ($p < 0.001$). Further analysis considered Sentence conditions two at a time.

Intransitives were judged true more often in +I scenarios (74%) than Pronominals (48%, $\chi^2(1) = 40.1$, $p < 0.001$), but not in –I (39% vs. 33%, $\chi^2(1) = 2.511$, $p = 0.113$). A $2\times2\times2$ design comparing Intransitives and Pronominals revealed a significant 3-way interaction ($\chi^2(1) = 11.407$, $p < .001$), confirming that Intention effects varied between these Sentence conditions. Verb-specific analyses supported these results: in +I all but one verb ('talk') significantly favored Intransitives; in –I, only one verb ('collide') showed a difference.

The 3-way interaction was nonsignificant for Intransitive vs. Binary ($\chi^2(1) = 2.899$, $p = 0.084$) and Pronominal vs. Binary ($\chi^2(1) = 1.303$, $p = 0.254$). However, Intention and Sentence effects on Response rate were significant in both cases (Intransitive vs. Binary: $\chi^2(1) = 82.157$, $p < 0.001$; $\chi^2(2) = 314.256$, $p < 0.001$. Pronominal vs. Binary: $\chi^2(1) = 27.922$, $p < 0.001$; $\chi^2(2) = 135.474$, $p < 0.001$).

The "slack" in Intransitive and Pronominal sentences was estimated by their *log*(*odds-ratio*) differences from Binary. The difference between those "slacks" was significant overall ($z = 4.71$, $p < 0.001$) and for $+$I data ($z = 6.08$, $p < 0.001$), but not for $-$I data ($z = 1.20$, $p = 0.114$).

3.3 Discussion

The results clearly distinguish pronominal reciprocals from intransitive reciprocals. While both forms show non-maximality – more 'true' reactions compared to binary sentences with a passive subject – intransitives show significantly more tolerance to exceptions than pronominals. Specifically, intransitives show more slack in $+$I situations than in $-$I situations, while no comparable effect of Intentionality was found with pronominals. This suggests a systematic difference in the mechanisms responsible for reciprocal interpretation with pronominals (*each other*) and intransitive collective verbs (*hug, fight*). Before drawing theoretical conclusions from this difference, the next section presents further evidence demonstrating its significance.

4 Evidence from group nouns

A Pronominal/Intransitive distinction is also observed with group nouns (GNs) like *couple* (of people) or *stack* (of cards). Singular reciprocal intransitives are acceptable with GNs, while pronominals are marginal with animate GNs and downright unacceptable with inanimates:[1]

(6) a. The couple is cuddling.
b. ?The couple is cuddling each other.

(7) a. The stack of cards is neatly aligned.
b. *The stack of cards is neatly aligned with each other.
(*as descriptions of an orderly stack of cards*)

The pronominal analysis of intransitives reciprocals fails to account for contrasts as in (6) and (7). The lexical analysis naturally accounts for these contrasts, since it relies on the rule (2b), which implements De Vries's (2015) predicate-level distributivity for reciprocals, as part of the predicate's lexical meaning. GNs interact with lexical rules like (2b), which are connected to part-whole structure rather than to morphological plurality. By contrast, pronominal reciprocals require plural morphology, or (to a lesser extent) at least semantic plurality as in (6b). These semantic contrasts in the availability of reciprocity are like other familiar processes with distributivity operator.[2] We conclude that distributivity and reciprocity show parallel contrasts, and thus should be derived by similar mechanisms: distributivity and reciprocity of lexical predicates have lexical, typicality-based, origins that are pragmatically more slack than the distributivity and reciprocity introduced by covert operators or overt particles like floating *each/both* and *each other*.

[1]The contrast in animacy with pronominals agrees with the commonly assumed semantic plurality of animate GNs. For further details, see (Pearson 2011, de Vries 2015). E.g., in sentences like *half of the couple/team/stack was painted yellow* (Pearson), 'couple' and 'team' are unacceptable if each person was half-painted, whereas 'stack' is OK if each card was half-painted.

[2]For example: (**i**) De Vries discusses distributivity contrasts such as *the children are hiding somewhere* vs. *the class is hiding somewhere*, where distribution over locations is acceptable in the former but only marginal in the latter. (**ii**) Plural agreement is also required (or preferred) with overt distributors, in contrast to lexical predicates: see e.g. the contrasts in 'the couple has (?both) smiled' and 'the stack of cards was (*each) painted'.

5 General conclusions

Our results show that agents' intentions affect the interpretation of intransitive reciprocals more than that of corresponding pronominal forms – binary constructions where 'each other' is in the verb's object. This suggests that the meaning of intransitive reciprocals cannot be derived solely from the verb's binary form plus pragmatic slack; the intention of the group argument must also be considered. While influences of 'collective intentionality' (Searle 1990) were hypothesized by Winter (2018), our study is, to our knowledge, the first to offer experimental support. Additional evidence that intransitive reciprocals are group predicates comes from their consistent acceptance with group nouns, unlike pronominals, which depend on animacy.

When treating reciprocal intransitives as group predicates, we must still keep track of their semantic relations with their binary alternates. Kruitwagen et al. (2022) maintain such a relation based on typicality preferences, their main empirical argument being the patterns they find between binary and intransitive forms and 'with' forms as in the following examples:

(8) a. Ann fought Ben.
b. Ann fought with Ben.
c. Ann and Ben fought.

The intuitive difference in meaning between (8a)-(8c) can be summarized as follows. Sentence (8a) describes an event where Ann exhibits high agentivity toward Ben. In (8b), Ann's agentivity is still higher than Ben's, but Ben's required agentivity exceeds that of (8a). Finally, (8c) describes the cumulative agentivity of Ann and Ben, without requiring higher agentivity from either of them. Kruitwagen et al. (2022) analyze such contrasts by assigning different weights to different theta-roles and their conceptual attributes (especially activity and intention). Our results about the effects of intention on non-maximal reciprocity with intransitives *vis à vis* pronominals, further support this model.

Agentive hierarchies based on typicality are central to Dowty's (1991) 'proto-role' conception. Our work adds important evidence distinguishing compositional quantification from lexical strategies of reciprocity. Similar hierarchies are critical for the semantics of other verbal alternations. For example, Doron & Rappaport-Hovav (2009) note that the reflexive alternation is not synonymous with reflexive pronominals, similar to our findings on reciprocal alternations. For example, *a priori* we might assume the following sentences are equivalent:

(9) a. John shaved/bathed.
b. John shaved/bathed himself.

However, in contexts where John does not strictly speaking operates on himself (or on one of his 'proxies', cf. Jackendoff 1992), sentence (9a) may be acceptable whereas (9b) may not.[3] Asserting (9a) in such scenarios takes into account the intention of the grammatical subject above and beyond what is necessary for transitive forms to be true.[4]

More broadly, we propose a view of verb alternations, where lexical semantic rules draw on conceptual features like 'activity' and 'intention' of verbal roots to compute event typicality scores, with weights assigned relative to the theta roles of the root's realized verbal form.

[3]Consider for example a scenario where John shaves his face every day, or goes to the barbershop and lets the barber shave him. His wife, who is familiar with his habits, may ask John if he's shaved today. If his barber has shaved him, he must answer affirmatively. However, a positive answer would be unacceptable if she asked if he's shaved *himself*. Similar scenarios can be constructed for *bathe*, in contexts of a young child whose bathing needs to occur with the assistance of an adult.

[4]*Sue shaved/bathed John* can describe a situation where John was shaved or bathed against his will, whereas (9a) can hardly describe such a scenario.

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