Reciprocal Verbs as Collective Predicate Concepts*

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1. Introduction

Reciprocal verbs like *date* and *hug* have a unary-intransitive guise and a binary-transitive guise. This article reports an experimental study of the semantic relation between these two forms. To introduce the problem, let us first consider the contrast between (1) and (2):

(1) a. Mark dated Violet.
b. Mark and Violet dated.

(2) a. The drunk hugged the lamppost.
b. ??The drunk and the lamppost hugged.

Sentence (1a) entails the unary guise sentence (1b), whereas (2a) does not entail (2b). This contrast suggests that, unlike previous assumptions, not all reciprocal verbs behave in a similar manner. Works that attempt to explain the semantic relation between the unary and the binary guise with reciprocal predicates date as far back as early transformational grammar. (Gleitman 1965) proposed a deletion rule, which removes a reciprocal pronoun *each other* from a stipulated deep structure for sentences like (1b) and (2b). In another transformational account, (Lakoff & Peters 1966) concentrated on *with* constructions, assuming one deep structure for both the unary usage of verbs like *meet* and for binary usages like *meet with*. (Dowty 1991) used so-called "proto-roles" to analyze reciprocity, basing his account on the number of volitional agents a verb has (e.g. two for *hug* in the unary guise, one for *hug* in the binary guise. (Carlson 1998) analyzed reciprocal verbs in terms of thematic roles, in an account that was further developed by (Dimitriadis 2008) and (Siloni 2012). All these proposals have one premise in common: with all reciprocal verbs, the intransitive

*We thank Robyn Berghoff, Luca Bischetti, Carien Westenbroek and Joost Zwarts. The illustrations in (3) are by Ruth Noy Shapira. For their dedicated work on the materials for Experiment 2, we are thankful to Olaf Bramlage, Hilbert Dijkstra, Anna Peeters and Lianne Zandstra.The work of the second and third authors was partially supported by a VICI grant 277-80-002 of the Netherlands Organisation for Scientific Research (NWO).

entry is assumed to entail symmetric participation of the entities mentioned. Thus, it has been assumed that sentences like *Violet and Mark hugged* describe events where both Mark hugged Violet and Violet hugged Mark. Similar entailments have been assumed to hold for all reciprocal verbs.

The current proposal challenges this assumption. Following the recent analysis in (Winter 2016), we accept that in many cases there is a logical connection between the two forms, as illustrated by (1). However, in other cases, as in (2), we argue that the connection between the unary and binary guise of reciprocal predicates is not logical, but preferential. We propose that reciprocal predicates like *hug* do not logically entail two subevents with directional acts. As our results show, speakers clearly prefer reciprocal predicates in situations where the binary relation holds bi-directionally, but they also tolerate such predicates in situations where the relation only holds in one direction. For instance, a sentence like *Mark and Violet hugged* may be accepted in situations where only one of the participants hugged the other. To analyze this behavior, we propose that categorizing events using reciprocal predicates relies on a graded notion of typicality. An event is considered *prototypically reciprocal* for a verb like *hug* based on two properties: 1) the participants make a symmetric contribution to the event, and 2) the group of participants is displaying *collective intentionality*: a shared intention, shared belief or shared emotion (Searle 1990 a.o.). The closer an event is to the reciprocal prototype, the more speakers are inclined to accept a unary reciprocal sentence describing that event. Less prototypical events like uni-directional hugs less often lead to acceptance of unary reciprocal sentences, although acceptability may increase when the agents show collective intentionality. To examine this proposal, we experimentally tested the following hypotheses:

1. Symmetric participation is not a prerequisite of the acceptability of reciprocal intransitive sentences.

2. Collective intentionality has a positive effect on the acceptability of such sentences.

We conducted two experiments that aimed to test these hypotheses by collecting speakers' truth-value judgements on various situations where symmetric participation is missing. In both experiments, each item consisted of a visual stimulus and a Dutch sentence. Experiment 1 (section 2) used illustrations as visual stimuli, whereas Experiment 2 (section 3) used video-clips. All target items contained reciprocal sentences of the form *A and B hug*. One type of target items had visual stimuli that depicted situations with two characters, of which one is visibly performing the relevant action (e.g. hugging the other) and the other character is passive. These visual stimuli are designed to test the behavior of reciprocal verbs in situations lacking symmetric participation where the passive character looks collaborative. A second type of target items tested the role of collective intentionality. Like the primary target items, secondary target items contained reciprocal sentences of the form *A and B hug* and visual stimuli with active and passive characters. However, the passive character in the secondary target items looked uncooperative. Based on our hypotheses, it is expected that : (i) acceptance rates of reciprocal sentences in situations without symmetric participation between two characters are above chance level; (ii) whether the passive character looks collaborative has a significant positive effect on these acceptance rates.

2. Experiment 1 - Testing Acceptance of Reciprocity Using Graphical Illustrations

2.1 Method

2.1.1 Participants

48 participants (37 female, age $M = 23$) took part in the experiment. They all received monetary compensation for their participation. All participants were native speakers of Dutch and indicated not to have been diagnosed with dyslexia.

2.1.2 Materials

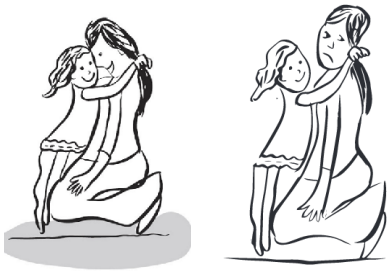
A total of 24 Dutch sentences were tested on their acceptability in a given situation. The experiment contained eight target items, eight secondary target items and eight control items, as well as 32 filler items. All items consisted of a drawing and a Dutch sentence. The sentences in target items, secondary target items and control items contained reciprocal verbs that have both a binary guise (e.g. "A hugs B") and a unary-collective guise (e.g. "A and B hug"). Eight such verbs were selected: *knuffelen* "hug", *botsen (tegen)* "collide (with)", *appen* "send whatsapp messages", *praten (tegen)* "talk (to)", *spreken (tegen)* "speak (to)", *kletsen (tegen)* "chat (to)", *roddelen (tegen)* "gossip (to)", *vechten (tegen)* "fight (against)".

Target items Target items each included a sentence containing one of the eight selected verbs in the unary guise (e.g. "The girl and the woman hug"), resulting in a total of eight items. Drawings in target items each depicted one active individual (who performs the reported action on the other individual) and one passive individual, whose attitude is visibly "cooperative", i.e. he or she looks attentive, happy, or otherwise accepting of the ongoing action. The target drawing for *knuffelen* is presented in figure (3a) below.

Control items The control items tested whether the situations depicted in the target stimuli involve non-symmetric participation with respect to the revelant verb. Accordingly, the control items used the same visual stimuli and the same verbs from the target items. However, the sentence in each control item had the verb in the binary guise, where the non-active individual in the illustration serves as the subject (e.g. "The woman hugs the girl"). This resulted in a total of eight control items.

Secondary target items Similar to the target items, secondary target items each included a sentence containing one of the eight selected verbs in the unary guise (e.g. "The girl and the woman hug"), resulting in a total of eight items. However, drawings in secondary target items differed from target items. As in the target items, these drawings depict one active individual and one passive individual. The difference between target and secondary target drawings lies in the attitude of the passive individual. For the drawings in secondary target items, the passive individual looks uncooperative or uninvolved in the action. Figure (3b) below shows the secondary target drawing for *knuffelen* ("hug").

(3) *Target (left) and Secondary Target (right) drawing for knuffelen ("hug")*



(**a**) (**b**)

In addition to target items, control items and secondary target items, we also included 32 filler items. The filler items contained drawings or photographs of actions (different than those of the target verbs) with two individuals, of which one was passive and another was active. For instance, one of the filler items showed two individuals, one of which drinking coffee and the other one passive. This filler item was combined with the test sentence "The two women are drinking coffee".

The order of items was pseudo-randomized with the following restrictions:

- All secondary target items were presented as the very last items of the experiment.
- There were at least 15 items between a target item and a control item that contained the same verb.

Two versions of the experiment were created, the only difference between them being the order of the items. In each version, half of the verbs first appeared in a target item, while the other half appeared in the control item. The verbs whose target item appeared first in version 1 had their control item appearing first in version 2, and vice versa. This was done in order to prevent interference and confusion from seeing the target items as well.

2.1.3 Procedure

The experiment was presented on a PC in a lab environment. Participants were instructed to indicate whether they judged the sentence true or false in the accompanying drawing, by pressing a green (=true) or red (=false) button. They were instructed not to think too long about their judgement and use their intuition. After 28 trials, halfway through the experiment, participants had the possibility to take a short break.

2.2 Results

The results of Experiment 1 are summarized in table (4) below. As these results show, a substantial percentage of the participants accepted unary reciprocal sentences for situations in which there was no symmetric participation.

(4) *Results Experiment 1*

Verb	*% true* responses on target items	*% true* responses on control items	% participants who answered *true* on the target item and *false* on the control item	*% true* responses on secondary target items
knuffelen (“hug”)	79%	31%	48%	19%
botsen (“collide”)	98%	2%	85 %	44%
appen (“send whatsapp messages”)	94%	8%	85 %	44%
praten (“talk”)	46%	4%	42%	13%
spreken (“speak”)	69%	13%	56%	33%
kletsen (“chat”)	98%	17%	81%	27%
roddelen (“gossip”)	90%	6%	83 %	46%
vechten (“vechten”)	73%	15%	58 %	23%
MEAN	81%	12%	69%	34%

The percentages in the second column of table (4) are the rates of “true” judgements on the target item sentences, which tested unary reciprocal sentences in asymmetric situations. As expected, these rates were high above zero. They varied from 46% for *praten* (“talk”) to 98% for *kletsen* (“chat”) and *botsen* (“collide”). The third column contains acceptance rates of “true” judgements on the control item sentences, which tested binary sentences in the same situations. According to our intuitive judgement, these items should all have been judged as false. The results show acceptance rates ranging from 2% for *botsen* (“collide”) to 31% for *knuffelen* (“hug”), with a low average of 12%. The fourth column of the results contains the percentage of participants who judged the target item sentence as “true” and the control item sentence as “false”. This is the percentage of participants who acknowledged that one of the arguments is passive but nevertheless judged the intransitive reciprocal sentence true. For these participants symmetric participation in the drawing was not a necessary condition for accepting the reciprocal sentence. The acceptance rates for the secondary target item sentences are in column 5. With all sentences, these rates were substantially lower than the acceptance rates of the respective target item sentences, with the difference ranging from 33% (with *botsen* “collide” and *praten* “talk”) to 71% (with *kletsen* “chat”). To verify that there is a relationship between drawing (target or secondary target drawing) and acceptance rate of the sentence, we performed a chi square test for independence for each verb individually. The threshold significance level is 0.05. Results of the chi square test indicate very strong evidence of a relationship between type of drawing and acceptance rate for all verbs ($p < 0.005$).

2.3 Discussion

Experiment 1 tested the hypothesis that speakers accept sentences with reciprocal verbs in situations in which there is no symmetric participation. One conclusion from the results is that a substantial percentage of participants identifies a passive agent in the drawing, but nevertheless accepts the reciprocal sentence. The acceptance rates vary per target item, but they were substantial for all the verbs we tested (M = 69%). There are two possible explanations for this finding. One possible explanation is that reciprocity does not require symmetric participation, as we hypothesized. Another possible explanation is that participants thought that the passive individual in the drawing was going to act later, or acted before the depicted moment. According to this explanation, although the great majority of participants judged the act in the drawing as asymmetric, when judging the target item sentence with the reciprocal verb, participants might have inferred symmetric participation in some time that was not depicted. To distinguish between the two possible explanations we conducted a follow-up experiment using video clips, as described below. Another conclusion that we can draw from the results concerns the substantial difference between acceptance rates of sentences for target items and secondary target items. The only difference between these items is in the attitude of the passive individual towards the situation (as demonstrated by her facial expression, attention, etc.). The conclusion is that a positive attitude of the passive individual positively influences the acceptability of reciprocal sentences in situations without symmetric participation. This can be considered as evidence for the role of "collective intentionality" in judgements about reciprocal sentences, or as evidence for inferred acts of the passive person in some non-depicted time.

3. Experiment 2 - Testing Acceptance of Reciprocity Using Video Clips

3.1 Method

To tease apart the two possible explanations of the results of Experiment 1, we conducted a follow-up experiment that resembled the first experiment but included short video clips as visual stimuli. These video clips showed events with a clear beginning and a clear end, hence they allowed us to test reciprocal sentences referring to a completed event in the past. Since we were referring to an event in the past, the test sentences were in the past tense.

3.1.1 Participants

A total of 25 participants (19 female, age M = 22) took part in this pilot experiment. All participants were native speakers of Dutch and indicated not to have been diagnosed with dyslexia. They all received monetary compensation for their participation. None of the participants participated in Experiment 1.

3.1.2 Materials

A total of 20 Dutch sentences were tested on their acceptability in a given situation. In contrast to Experiment 1, situations were now depicted using video clips instead of drawings. Additionally, a new type of item was added: true filler items. In the video clips of the true filler items, both characters were actively engaged in the action. In total, the experiment contained five target items, five control items, five secondary target items, five true fillers and seventeen other fillers. Every item consisted of a video clip of approximately 30 seconds, followed by a sentence. In all video clips, the same two professional actors – a man and a woman – acted out a script that was designed to test our expectations about reciprocal verbs.

For target item sentences, control item sentences, secondary target item sentences and true fillers, we used five reciprocal verbs from Experiment 1: *knuffelen* "hug", *botsen* "collide", *appen* "send whatsapp messages", *praten* "talk" and *vechten* "fight". We used the same verbs as in Experiment 1 because we wanted to test whether a set-up with video clips yields similar results to the set-up with drawings. We did not test all eight verbs from Experiment 1 due to time restrictions and budget limitations.

Target items All target items included a sentence containing one of the five selected verbs in the unary guise (e.g. "Violet and Mark hugged"), resulting in a total of five items. All video clips in target items started with the actors being silent and/or staying at some physical distance from each other. Then, the woman (Violet) acted out the verb while the man (Mark) was passive, but attentive. After the action, the man and woman departed from each other.

Control items All control items included a sentence containing one of the five selected verbs in the binary guise (e.g. "Mark hugged Violet"), also resulting in a total of five items. Video clips were identical to those that were used in target items. The control items aimed to test whether participants judge the "passive character" to be non-active. Intuitively, we expected these items to be judged false.

Secondary target items Similar to the target items, secondary target items included a sentence containing one of the five verbs in the unary guise (e.g. "Violet and Mark hugged"). As in the videos of the target items, the woman performs the relevant act (hugs the man, fights him etc.) and the man does not. However, in the secondary target movie clips the man ignores the act of the woman, while in the target movie clips he is attentive.

True filler items For the five verbs, the true filler items contained reciprocal sentences identical to those of the target items. However, in the video clips within the true filler items, both characters were equally engaged in the action. For instance, in the true filler video clip for *hug*, the woman hugs the man and the man hugs the woman. The aim of adding true filler items was to contrast them with the asymmetric participation in the target items. Intuitively, true filler items would be judged as true. In addition to target items, control items, secondary target items and true filler items, we included 17 filler items. Filler items consisted of video clips depicting other verbs, such as shaking hands or whispering. The aims of adding filler items were the same as in Experiment 1.

The order of items was pseudo-randomized with the following restrictions:

- In order to prevent interference between the target items and the true filler items, all true filler items were presented as the final items of the experiment.
- In order to prevent interference between the target items and the secondary target items, all secondary target items were presented as second to last items, before the true filler items.
- There were at least seven items between a target item and a control item that contained the same verb.

Similar to Experiment 1, we created two versions of the experiment with different order of items.

3.1.3 Procedure

Participants performed the experiment individually in a soundproof booth on a computer. Videos were displayed, after which a sentence was shown on the screen. Participants were instructed to indicate whether they judged the sentence true or false, by pressing a green (=true) or red (=false) button. They were instructed to not think too long about their judgement and use their intuition. After 17 trials, halfway through the experiment, participants had the possibility to take a short break.

3.2 Results

The results of Experiment 2 are summarized in table (5) below. As the results show, although the mean acceptance rates are lower than in Experiment 1, a substantial percentage of participants accepted reciprocal sentences in situations without symmetric participation.

(5) *Results Experiment 2*

Verb	% *true* responses on "true" filler items	% *true* responses on target items	% *true* responses on control items	% participants who answered *true* on the target item and *false* on the control item	% *true* responses on secondary target items
knuffelen ("hug")	100%	64%	28 %	36%	24%
botsen ("collide")	84%	92%	0 %	92%	76%
appen ("send whatsapp messages")	100%	20%	0 %	20%	8%
praten ("talk")	88%	48%	4%	48%	8%
vechten ("fight")	84%	48%	4%	48%	8%
MEAN	91%	54%	7%	49%	25%

The second column of table (5) contains the rates of *true* judgements for the filler item sentences that we considered as intuitively true in the filmed situation. As expected, these sentences showed high acceptance rates. The third column contains the rates of "true" judgements on target item sentences. These show a considerable variation: from 20% (for *appen* "send whatsapp messages") to 92% (*botsen* "collide"). The fourth column contains the rates of "true" judgements on the control items. Expectedly, these rates were very low, with one notable exception: 28% acceptance for control item sentences containing *knuffelen* ("hug"). Column 5 shows the percentages of participants who judged the control item sentences as false and the corresponding target item sentences as true. Column 6 summarizes results for the secondary target item sentences, which show a large variance: between 76% (with *botsen* "collide") to 8% (with *appen* "send whatsapp messages", *praten* "talk" and *vechten* "fight").

To test whether the relationship between type of video clip (target or secondary target) and acceptance rate is significant, a chi square test of independence was performed for each verb individually. The threshold significance level was 0.05. The p-values show that only for *knuffelen* ("hug"), *praten* ("talk") and *vechten* ("fight") the relationship between item and acceptance rate is significant ($p < 0.005$). For *appen* ("send whatsapp messages") and *botsen* ("collide") the p-values were $p = 0.21$ and $p = 0.12$, respectively. This shows no indication for a relationship between type of video clip (target or secondary target) and acceptance rate.

3.3 Discussion

Like Experiment 1, Experiment 2 tested the hypothesis that speakers accept sentences with unary reciprocal verbs in situations without symmetric participation. The percentages of participants that identified a passive agent but nevertheless accepted the reciprocal sentence were substantial for all verbs (M = 49%) but were in general lower than in Experiment 1 (M = 69%). In Experiment 2 the video clips depicted a completed event and the sentences referred to a past event, hence it is unlikely that participants made inferences about unseen interactions between the two characters in the video clips. Since acceptance rates for Experiment 2 were lower than acceptance rates for Experiment 1, we conclude that some of the "true" reactions in Experiment 1 might indeed have ensued from inferences about past and/or future. However, Experiment 2 shows that this cannot be the full explanation of the high acceptance rates of reciprocity without symmetry in Experiment 1. We conclude that there is a substantial number of participants for whom symmetric participation is not a requirement for accepting unary guise reciprocal sentences.

4. General Conclusions

Overall, Experiments 1 and 2 show that for a substantial group of speakers, symmetric participation is not a mandatory requirement with all reciprocal verbs. This goes against assumptions by virtually all previous works on the topic prior to Winter (2016). On the other hand, our results clearly show that situations without symmetric participation are not acceptable for all speakers, and full symmetry is quite uniformly preferred. This preference

calls for an account of the concepts underlying reciprocal verbs. Consistently with theories of lexical concepts (Hampton 2007), we propose that for any reciprocal predicate P there are two typical preferences for categorizing an event e with a group agent G. Thus, e is ***typical*** for P ***proportionally*** to two values:

1. *Participation* = the number of pairs in G satisfying the corresponding binary relation R:

$$|\{\langle x,y\rangle \in G \times G \ : \ x \neq y \text{ and } \exists e' \leq e.R(e',x,y)\}|$$

For instance, the more "transitive collisions/hugs" there are within G in e, the more typical e becomes as collective collision/hug of G. In a sentence like *A and B collide/hug*: an event with two transitive collisions/hugs is more typical than an asymmetric event, but this doesn't categorically require two transitive collisions/hugs.

2. *Collective Intentionality* (CI) = strength of evidence that G's members have in e a shared intention, joint attention, a shared belief, or a collective emotion about the relevant act.

This proposal explains why symmetric participation plus CI is preferred to asymmetric participation plus CI as in figure (3a), which is preferred to asymmetric participation without CI as in figure (3b). More generally, it explains how lexical reciprocity is sensitive to symmetric participation without fully requiring it, while being also sensitive to other factors in the semantics of collectivity like the intentionality of groups.

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