Lexical Reciprocity and Logical Symmetry

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A binary predicate R is called *symmetric* if R(x,y) is equivalent to R(y,x), for every x and y. Symmetric binary predicates include predicates like *match, marry, cousin of,* and *identical to*. For instance: *A is identical to B* holds if only if *B is identical to A* holds. Symmetric binary predicates have been a perennial challenge since the 1960s, not least because of their puzzling connections with *lexical reciprocity*. Most binary symmetric predicates in English also have a unary guise, related to the binary predicate through reciprocity. For instance, the symmetric statements *A matches B* and *B matches A* are also equivalent to the reciprocal sentence *A&B match.* Yet, many reciprocal predicates – e.g. *kiss, hug, be in love* (*with*) – don't have symmetric correlates. For instance, *A&B hug* is a reciprocal sentence, but the transitive entry *hug* is not symmetric: *A hugs B* is not equivalent to *B hugs A.* Because of such cases, the relations between reciprocity and symmetry have remained puzzling. Focusing on these relations, we uncover a previously unobserved generalization: the *kind* of reciprocity shown by the unary entry correlates with whether the corresponding binary entry is symmetric or not. For instance, the non-symmetry of transitive *hug* correlates with the judgement that *A&B hugged* isn't fully paraphrasable by *A hugged B and B hugged A.* We support the proposed generalization by an extensive study of English and Hebrew predicates. Based on the intuition guiding Dowty's notion of *protoroles*, we propose that predicates are derived from *protopredicates*: set-theoretical specifications of participants in states and events. The proposed analysis explains the intimate relations between reciprocity and symmetry, as well as the emergence of non-symmetry with reciprocal predicates.

Reciprocal predicates and their binary correlates are often inter-definable. E.g. *A&B rhyme* means the same as *A rhymes with B* (*and B rhymes with A*). We refer to reciprocal predicates like *rhyme*, which support inter-definability, as *plain reciprocals* (pR). Focusing on similar predicates, early work proposed transformations that map one entry to the other (Gleitman 1965, Lakoff & Peters 1967). However, it was soon observed (Dong 1971) that these accounts are not general enough: *A&B hug* is distinguished from *A hugged B and B hugged A*. The latter sentence is true if A hugged B in her sleep, and later on, B hugged A in her sleep. By contrast, *A&B hugged* is unacceptable in this scenario. Thus, neither entry of *hug* can be derived from the other entry. Furthermore, in a recent experimental study, Winter et al. (2016) show that *A&B hugged* can be interpreted as true when *A hugged B and B hugged A* is interpreted as false, e.g. in situations as depicted on the right. We call predicates like *hug pseudo-reciprocals* (psR). For more pR and psR predicates, see (1) below. In view of the challenge posed by pseudo-reciprocity, some works don't specify any semantics for the reciprocal alternation (Gleitman et al. 1996), while others suggest general relations between events (Carlson 1998, Dimitriadis 2008, Siloni 2012). This leaves two theoretical gaps: the formal semantics of the plain/pseudo distinction, and its relation with logical symmetry. To address the challenge, we first examined more than 100 pairs of English and Hebrew predicates. In each pair, R is a binary predicate and P is a lexical unary predicate with a collective reading. We found that all these pairs of predicates satisfy the following generalization:

The Reciprocity-Symmetry Generalization (RSG): *The reciprocity between a collective P and a binary R is a* <u>*plain*</u> if and only if *R is logically* <u>*symmetric*</u>*.*

For example: the plain reciprocity between *rhyme* and *rhyme with* correlates with the symmetry of the latter; the pseudo-reciprocity of *hug* correlates with the non-symmetry of the transitive form. Below we give some more examples.

(1) *Plain reciprocal* (plR) *and symmetric*:
talk (with), collaborate (with), meet (with), marry, debate, identical (to), similar (to), twin (of)

Pseudo-reciprocal (psR) *and non-symmetric*:
talk (to), kiss, (fall/be) in love (with), hug, touch, embrace, pet, fuck, fondle, box

Some reciprocal predicates are pR with one of their binary guises and psR with another. E.g. the collective reading of *A&B talked* is equivalent with *A talked with B and B talked with A*. By contrast, there is no logical relation between this collective statement and *A talked to B and B talked to A*: the latter sentence can be true if *A* doesn't listen to *B* and vice versa, but *A&B talked* is unacceptable in such situations.

Conversely, *A&B talked* may be true if *A* is talking while *B* is attentive but quiet (Winter et al. 2016). Thus, reciprocal *talk* is pR in relation to *talk with*, but psR with respect to *talk to*. Another example for such multiple alternations is reciprocal *meet*, and its relations with transitive *meet* (psR) vs. *meet with* (pR). In Hebrew, different verbal templates commonly support different alternations. E.g. reciprocal *hitnaSek* ('kiss') is pR with *hitnaSek im* ('kiss with'), but psR with *niSek* (transitive 'kiss'). This pattern is quite productive (Siloni 2012), and similarly for Greek (Dimitriadis 2008).

Theory. Importantly, the RSG is a *linguistic generalization about possible lexical meanings*. It is not a logical necessity: provably, artificial meanings can violate it. Our account restricts lexical meanings using Dowty's notion of *proto-roles*. According to their protoroles, we distinguish two types of predicate concepts: (i) with *marry* or *match*, participants in events or states are both agentive and patient-like, hence they have the same proto-role. Similarly, with *rhyme* and *similar*, all participants have the same protorole. (ii) with *kiss, hug, be in love* etc., events/states are of two sub-types: "symmetric" eventualities, where participants are both agentive and patient-like, and "asymmetric" events, where some participants are agentive and others are not. Formally, we derive unary and binary entries from *proto-predicates* (PRPs). A PRP is a collection of sets and/or ordered tuples. We assume three types for protopredicates:

B – binary. A binary PRP like ATTACK, for the verb *attack*, describes events using agent-patient pairs $\langle p_1, p_2\rangle$, i.e. it is a standard binary relation.

C – collective. A PRP like MARRY, for intransitive *marry* and transitive *marry*, describes events using *sets*, e.g. doubleton sets $\{p_1, p_2\}$ of marrying people, each of whom is both "agentive" and "patient-like".

BC – binary/collective. These PRPs are mixed B-PRPs and C-PRPs. A BC-PRP like HUG describes events using two kinds of elements: (i) pairs $\langle p_1, p_2\rangle$ of an agent and a patient similar to binary PRPs; (ii) sets of participants in collective hugs.

Below we give a specific model with the PRPs MARRY and TALK:

MARRY: $\{\{m,j\},\{s,b\}\}$	TALK: $\{m,j\},\langle m,j\rangle,\langle j,m\rangle,\{s,b\},\langle s,b\rangle,\langle a,d\rangle,\langle g,h\rangle$
2 *mutual marriage events*: m+j and s+b	2 *mutual talk-with events*: m+j and s+b, where in the first event, both *m* and *j* do the taking; in the second, only *s* talks. *and 2 unidirectional talk-to events*: a>d and g>h

From the PRP of a predicate concept, we derive unary and binary denotations using three strategies:

The unary strategy derives collective denotations using the "plural" part of the PRPs:

$\text{marry}_{col} = \{\ \{m,j\},\ \{s,b\}\ \}$ $\qquad$ $\text{talk}_{col} = \{\ \{m,j\},\ \{s,b\}\ \}$

These denotations are for the verbs in *M&J married/talked, S&B married/talked.*

***Binary strategy* (i)** derives the following binary denotations using the whole PRP:

$\text{marry}_{trans} = \{\langle m,j\rangle,\langle j,m\rangle,\langle s,b\rangle,\langle b,s\rangle\}$ $\qquad$ $\text{talk\_to} = \{\langle m,j\rangle,\langle j,m\rangle,\langle s,b\rangle,\langle a,d\rangle,\langle g,h\rangle\}$

These denotations are for the verbs in the sentences *M married/talked to J, J married/talked to M, S married/talked to B,* etc.

***Binary strategy* (ii)** derives the following denotations only using the "plural" part of the PRPs:

$\text{marry}_{trans} = \{\langle m,j\rangle,\langle j,m\rangle,\langle s,b\rangle,\langle b,s\rangle\}$ = same as in **(i)** $\qquad$ $\text{talk\_with} = \{\langle m,j\rangle,\langle j,m\rangle,\langle s,b\rangle,\langle b,s\rangle\}$

Strategy (ii) only derives symmetric relations, and is often expressed by the comitative (Lakoff & Peters 1967, Siloni 2012). This strategy models cases like *M talked with J*, leaving the semantics of binary *marry* intact. The full paper gives more details about the role of protoroles and protopredicates in the analysis.

Using these three types of protoroles and three derivational strategy, we show a central formal result: a collective-unary predicate *P* and a binary predicate *R* are in plain reciprocity if and only if *R* is symmetric. This accounts for the RSG in a general way.

Acknowledgements: Illustration by Ruth Noy Shapira. This work was partially supported by a VICI grant 277-80-002 of the Netherlands Organisation for Scientific Research (NWO)

References: Carlson 1998: in Rothstein, *Events and grammar*. **Dimitriadis 2008**: in Dolling, *Event structures in linguistic form*. **Dong 1971**: in Zwicky, *Studies out in left field*. **Dowty 1991**: *Language* 67. **Gleitman 1965**: *Language* 41. **Gleitman et al. 1996**: *Cognition* 58. **Lakoff & Peters 1967**: in Reibel, *Modern studies in English.* **Partee 2008**: in Kibrik, *Computational linguistics and intellectual technologies*. **Siloni 2012**: *NLLT* 30. **Schwarz 2006**: *Snippets* 13. **Winter et al. 2016**. Lexical reciprocity as a typicality preference: experimental evidence. *Proc. of Cognitive Structures*, Heinrich Heine University, Düsseldorf.