Hungarian reduplicated numerals – what kind of beast are they?[1]

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The main question of this talk is **how to analyze Hungarian reduplicated numerals (henceforth: RNs) based on their semantic properties**.

But the question that is answered (at least in part) is **how not to analyze** RNs.

1 Quick introduction to RNs

The term REDUPLICATED NUMERAL captures the defining **formal characteristic** of these elements.

- RNs are formed by the **reduplication of a cardinal numeral**.
- RN-expressions are **morphologically marked indefinite NPs** where a common noun is headed by a RN.

(1) *hat facsemete* — Unmarked numeral exp.
six sapling
'six saplings'

(2) ***hat-hat*** *facsemete* — RN-expression
six-six sapling

I will refer to different parts of RN-expressions as in Figure 1.

[1] List of glosses: 3 – third person; ABS – absolutive case; ACC – accusative case; ADZ – adjectivizer suffix; COM – comitative case; COMP – completive aspect; ERG – ergative case; PL – plural; PRT – verbal particle/prefix; PST – past tense; SG – singular; SS – status suffix; SUPE – superessive case.

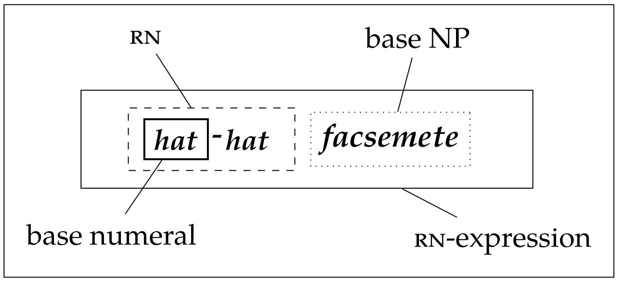


Figure 1: The anatomy of a Hungarian reduplicated numeral expression
BASE NUMERAL: the numeral determiner/prenominal adjective
RN: the base numeral reduplicated
BASE NP: the NP in the complement of the reduplicated numeral
RN-expression: RN+ base NP

2 The core semantic profile of RNS

We can build the core semantic profile of RNS based on a **comparison with unmarked numerals.**

(3) *Az önkéntes-ek el-ültettek három facsemeté-t.*
the volunteer-PL PRT-plant.PST.3PL three sapling-ACC
a. ‘The volunteers planted three saplings in total’ ✓cum.
b. ‘The volunteers planted three saplings each’ ✓$dist_{in}$
c. %‘The volunteers planted three saplings on each occasion’ ✗$dist_{ev}$

(4) *Az önkéntes-ek el-ültettek* ***három-három*** *facsemeté-t.*
the volunteer-PL PRT-plant.PST.3PL **three-three** sapling-ACC
a. %‘The volunteers planted three saplings in total’ ✗cum.
b. ‘The volunteers planted three saplings each’ ✓$dist_{in}$
c. ‘The volunteers planted three saplings on each occasion’ ✓$dist_{ev}$

1. RNS force a distributive interpretation of the sentence they occur in (Farkas 1997, Szabolcsi 2010, Wohlmuth 2019a, a.o.).

- Unmarked numerals are compatible with cumulative (or collective) interpretations (see (3-a)), while RNS are not (see (4-a)).

--- On the concept of distributivity see the box below ---

2. RNS allow the KEY to be from domain other than that of individuals.

- RNS are compatible with distributive interpretations where the KEY is from the domain of events; see (4-c).

  - This interpretation is available **if the relevant plurality of events is salient in the context**.

- Unmarked numerals only allow for distributive interpretations where the KEY is from the domain of individuals; see (3-c).

3. RNS always mark the SHARE.

- RN cannot mark the KEY, even if the NP in their complement has the widest scope on the surface; see (5).

(5) ***Négy-négy*** *néző tapsolt.*
four-four viewer applaud.PST.3SG
a. %'Four members of the audience applauded in total'
b. 'Four members of the audience applauded on each salient occasion'

- Unmarked numerals can be understood cumulatively so their interpretation is not restricted in this way.

What is distributivity?

(6) The volunteers planted three saplings. ≈
a. The volunteers *each* planted three saplings. **dist.**
b. The volunteers planted three saplings *in total*/*together*. **nondist.**

The distributive interpretation of a sentence involves scope-relations between expressions (Link 1991, Roberts 1987, Kamp & Reyle 1993, a.o.).

(7) $\forall > \exists$

According to Choe (1987) distributivity is a quantificational dependency relation between the *sorting key* (henceforth: **KEY**) and the *distributed share* (henceforth: **SHARE**).

- In (6), the KEY is the set denoted by VOLUNTEER, and the SHARE is the set denoted by THREE-SAPLINGS (see Choe 1987, cf. Champollion 2017).
- Distributive interpretation of a sentence involves wide-scope universal quantification over the entities in the KEY and narrow-scope existential quantification over the entities in the SHARE.

Table 1: The core semantic profile of RNS

1.	Obligatory dist. interpretation	✓
2.	KEY from various domains	✓
3.	SHARE-marker	✓

The core semantic profile of RNS is summarized in Table 1.

There are **three phenomena** that share their semantic profile with RNS:

1. dependent indefinites,
2. distance distributive elements, and
3. distributive numerals.

In what follows, I will show that **based on the canonical analyses** of these phenomena, none of these categories involve RNS.

3 RNS as dependent indefinites

RNS are often analyzed as dependent indefinites (henceforth: DEPINDEFS; Farkas (1997), (2002), and (2015), a.o.).

- DEPINDEFS are indefinite NPs that introduce *dependent variables*.

(8) **Definition** Dependent variable
A variable *y* is dependent on a variable *x* iff the values assigned to *y* **co-vary** with those assigned to *x*. (Farkas 1997: (27))

The reasoning in Farkas (1997) *et seq.*:

(S1)
Narrow-scope indefinites introduce dependent variables.
RN-expressions always have narrow-scope.
―――――――――――――――――――――――――
RN-expressions must introduce dependent variables. ∴

Dependent variables are special because they must receive multiple values (co-variation).

- The **main prediction** of the analyzing RNS as DEPINDEFS is that **sentences with RN-expressions are false if the variable introduced by RN-expressions receives a constant value**.

(9) *Az önkéntes-ek ki-festettek* ***egy-egy*** *kórterm-et.*
the volunteer-PL PRT-paint.PST.3PL **one-one** hospital.room-ACC
a. 'The volunteers painted a hospital room each.'
b. 'The volunteers painted a hospital room each time.'

(10) *A* utters (9). Then *B* replies: "Well, that's not true. …
a. #…Each of them painted room 237."
b. #…They painted room 237 each time."
c. …Some of them painted a classroom in the public school."
d. …They painted a classroom in the public school on some occasions."

As (10-a)–(10-b) shows, **the truth of (9) cannot be denied on the basis of the lack of co-variation** (Wohlmuth 2019a).

- Based on (10-c)–(10-d), (9) is FALSE iff it is not the case that **for each element in the KEY there is an element in the SHARE**.
- The co-variation of hospital rooms with volunteers or salient occasions is not part of the truth conditions of (9).
- However, (9) is **distinctly downgraded** if it is uttered in a situation where in fact the same hospital room was painted across volunteers or salient occasions, AND the speaker is aware of that fact or it is relevant in the situation.[2]
- This suggests that **the co-variation condition is a pragmatic requirement** imposed by RN-expressions.
- Since co-variation is a defining property of the variables introduced by DEPINDEFS, and the variables introduced by RN-expressions do not exhibit this property, **RNS should not be analyzed as DEPINDEFS**.

The term *dependent indefinite* should be reserved for elements that do require co-variation, like reduplicated numerals in Kaqchikel (Henderson 2012); see (11).[3]

[2]Similar observations were made for reduplicated numerals in Telugu (Balusu 2006) and distributive numerals in Basque (Cabredo Hofherr & Etxeberria 2017).
[3]Example (399) from Henderson (2012).

(11) *K-onojel* *x-∅-ki-kanö-j* ***ju-jun*** *wuj.* Kaqchikel
ERG.3PL-all COMP-ABS.3SG-ERG.3PL-search-SS **a-a** book
a. 'All of them looked for a different book'
b. %'There is a book and all of them looked for it'[4]

The main difference between DepIndefs and rns is in Table 2.

Table 2: The main difference between DepIndefs and rns

		DepIndef	rns
1.	Obligatory dist. interpretation	✓	✓
2.	key from various domains	✓	✓
3.	share-marker	✓	✓
4.	Co-variation is pragmatic req.	✗	✓

4 rns as distance distributive elements

Distance distributive elements (henceforth: ddes) are share-markers that form one constituent with the expression denoting the share (Zimmermann 2002).

- The term *distance distributivity* is rooted in the hypothesis that the distributive interpretation that arises due to marking the key and the distributive interpretation that arises due marking the share is the **same**; see (14) and (15).

(12) key-marking
a. **Each** of the volunteers planted three saplings.
b. **Each** time the volunteers planted three saplings.

(13) share-marking
a. *Die Freiwillig-en pflanzten* ***jeweils*** *drei Setzling-e.*[5] German
the volunteer-PL plant.PST.3PL **DDE** three sapling-PL
b. *Az önkéntes-ek el-ültettek* ***három-három*** *facsemeté-t.* (= (4))
the volunteer-PL PRT-plant.PST.3PL **three-three** sapling-ACC

(14) The truth conditions of (12-a), (13-a) in C_1 and (13-b) in C_1:
$\forall y[y < \bigoplus {}^*\textsc{volunteer} \wedge \textsc{at}(y) \rightarrow \exists x \exists e[{}^*\textsc{sapling}(x) \wedge |x| = 3 \wedge \textsc{plant}(e, y, x)]]$

[4] Note that rn-expressions cannot be interpreted as wide-scope indefinites either, so sentences with an rn-expression also lack the interpretation like in (11-b). However, truth conditionally they are independent from the identity of the elements in the share.

[5] Many thanks to Theresia Heuser for checking the German data presented in this talk.

(15) The truth conditions of (12-b), (13-a) in C_2 and (13-b) in C_2:
$\forall e[e < e' \wedge \textsc{at}(e) \rightarrow \exists x[{*}\textsc{sapling}(x) \wedge |x| = 3 \wedge \textsc{plant}(e, \bigoplus {*}\textsc{volunteer}, x)]]$

--- Theoretical background in the box below ---

- The KEY-marker *each* is interpreted as a universal quantifier in situ (see (12-a) and (12-b)).
- The SHARE-markers *jeweils* in German and RNS in Hungarian also lead to an interpretation where the KEY is understood as a universal quantifier (see (13-a) and (13-b)).
- SHARE-markers signal distributive interpretation from a distance, hence the term DDE.

Quick recap on the mereological approach to pluralities

The respective domains of individuals D_e and that of events D_v are closed under the sum-formation $\oplus$ (see (16)) and the entities therein are ordered by the mereological part-of relation $\leq$ (see (17)); Link 1983, Bach 1986, Krifka 1989, a.o.).

(16) a. $\forall x, y[x, y \in D_e \rightarrow x \oplus y \in D_e]$
b. $\forall e, e'[e, e' \in D_v \rightarrow e \oplus e' \in D_v]$

(17) $\forall x, y[x \leq y \leftrightarrow x \oplus y = y]$

Singularities have the property of being an atom (see (18)); **pluralities** are sums of singularities.

(18) $\textsc{at}(x) \overset{\text{def}}{=} \neg \exists y[y < x]$

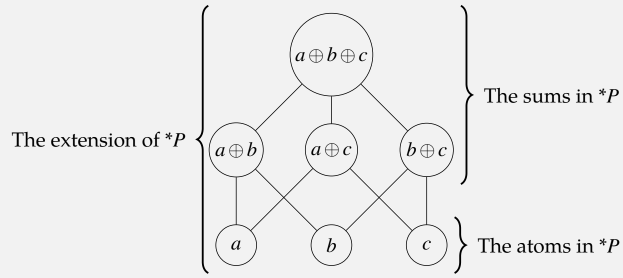
Natural language predicates can be semantically singular or plural.

- **Semantically singular predicates** denote a set of atomic entities.
- **Semantically plural predicates** denote a set of atomic entities and all the possible sums formed by the atomic entities.

Semantic pluralization of predicates is done by the ***-operator** (Link 1983).

(19) $*P$ is the smallest set, such that:
a. $P \subseteq {*}P$
b. $\forall x, y[x, y \in {*}P \rightarrow x \oplus y \in {*}P]$ (Sternefeld 1998 and Nouwen 2016)

Figure 1: The extension of $*P$, where $P = \{a, b, c\}$, represented as a Hasse-diagram



The main question posed by DDEs concerns the **syntax-semantics interface**.

- The semantic effect of DDEs is clear: the assumption is that they require the NP in their complement to be interpreted as a narrow-scope indefinite.
- The universal quantifier that takes scope over this indefinite is provided by a **distributivity operator** associated with the DDE.
- Different compositional mechanisms are proposed in Oh (2001), Zimmermann (2002), Champollion (2016), a.o.
- See an analysis of RNs as DDEs based on the account in Champollion (2016) in Appendix A.

Analyzing RNs as indefinites in the scope of a distributivity operator can capture the core characteristics of these elements (see Table 1).

- However, it cannot capture that **RN-expressions can be the antecedent of a reciprocal pronoun** as in (20) (see Wohlmuth 2019a).

(20) *Az erőpróbá-n egyszerre* ***egy-egy*** *csapat versengett egymás-sal.*[6]
the tournament-SUPE at.a.time **one-one** team compete.PST.3SG each.other-COM
a. %'At the tournament, one team competed with each other at a time'
b. 'At the tournament, two teams competed at a time, one with the other'

The DDE-analysis predicts the interpretation in (20-a) for (20) (nonsensical), but cannot predict its actual interpretation in (20-b).

[6] `https://www.mohacsiujsag.hu/mohacs/hir/helyi-hireink/szombaton-sarkanyhajoverseny-nevezoket-jelentkezoket-varnak`. Last accessed: Aug 21, 2019. In the original example, the verb is in present tense; changing it to past tense should not affect any substantial claims made in relation to the sentence.

- If RNS were DDES, *egy-egy csapat*, lit. 'one-one team' should not be able to provide the antecedent for a reciprocal pronoun because of number mismatch.
  - If *egy-egy csapat* were interpreted as a *egy csapat*, lit. 'one team' in the scope a universal quantifier, the reciprocal pronoun could not pick it out as its antecedent.
- Yet (20) is perfectly grammatical and interpretable.
  - RN-expressions cannot interpreted only as narrow-scope indefinites.
  - **RN-expressions are compatible with plural/scopeless interpretation**.
  - Reduplicated numerals in Telugu can also be the antecedent of a reciprocal pronoun (Rahul Balusu p.c.).
- From all this it follows that **RNS should not be analyzed as DDES**.

The term *distance distributive element* should be reserved for SHARE-markers that are incompatible with plural/scopeless interpretation, like *jeweils* in German; see (21).

(21) #***Jeweils*** *eine Mannschaft trat gegeneinander an.* German
DDE one team compete.PST.3SG against.each.other PRT

The main difference between DDES and RNS is in Table 3.

Table 3: The main difference between DDES and RNS

		DDES	RNS
1.	Obligatory dist. interpretation	✓	✓
2.	KEY from various domains	✓	✓
3.	SHARE-marker	✓	✓
4.	Co-variation is pragmatic req.	✓	✓
5.	Plural/scopeless interpretation	✗	✓

5 RNS as distributive numerals

Distributive numerals (henceforth: DISTNUMS) are **morphosyntactically marked numerals that force a distributive interpretation of the sentence**.

- DISTNUMS are obligatory SHARE-markers.

- **The KEY can be any of the event dimensions** – participants, runtime, location (see Gil 1982, Gil 2013 and Cable 2014, a.o.).

The main difference between DistNums and DDEs (Cable 2014):

- **DistNums always give rise to different kinds of distributive interpretations**.
- There are some DDEs that require the KEY to be from the domain of individuals, like binominal *each* in English (Zimmermann 2002); see (22).[7]

(22) The volunteers planted three saplings **each**.
  a. 'Each volunteer planted three saplings'
  b. %'The volunteers planted three saplings on each (salient) occasions'

Here I assume that **DistNums and DDEs also differ in their ability to serve as antecedents for reciprocal pronouns**, like RNS in (20).

- This is, of course, **not among the traditional criteria for DistNums**.
- However, this assumption is harmless in the sense that it maintains the assumption that all SHARE-markers are either DistNums, or DDEs, or DepIndefs.

This extra criterion is founded in the analysis in Cable (2014).

- In Cable (2014), DistNums are not assumed to be in the scope of a universal quantifier.
- Rather, **DistNums are interpreted as scopeless plural indefinites with extra restrictions**.
- See the analysis of RNS as DistNums based on Cable (2014) in Appendix B.

According to the account in Cable (2014), the meaning contribution of RNS is assumed to be twofold.

1. They signal **the existence of an entity in the denotation of a plural predicate** which is provided by the NP in their complement.

[7] The original definition of DDEs in Zimmermann (2002) excludes floated or binominal *each*. However, (binominal) *each* is often treated as a DDE: the analyses proposed for DDEs are designed to involve/be extendable to (binominal) *each*.

- This entity can serve as **the antecedent of a reciprocal pronoun**.
- A full analysis of reciprocals is in Appendix C.

2. They mark **the cardinality of the part(s)** of that entity participating **in every relevant part of a (plural) event** denoted by the sentence.
   - This is the **distributive-effect** associated with distributive numerals.
   - Again, distributivity is not represented as a quantificational dependency relation à la Choe (1987), but as a relation between parts of individuals and parts of **events**.

The truth conditions for (20) predicted by the analysis based on Cable (2014):

(23) There is a plurality of teams and there is a reciprocal competing event by the teams, and this event can be divided up into subevent such that in each subevent one team participated.

Problem for the analysis in (34): **RNs do not always signal the number of entities associated with events**.

- We predict that (20) is true as long as there is one team participating in each subevent; see an analysis of (20) in (38-b) in Appendix C.
- However, in (20), the RN signals the number of **both the agent and the theme** of the competing subevents.
- Hence the truth conditions for (20) are too weak (Wohlmuth 2019b).

Since the in (20) the distribution is over a set of different thematic roles, **the KEY can be other than event dimensions** (participant, runtime, location).

- Thematic roles are second-order relations between events and individuals (Parsons 1990), so **the KEY does not even have to be a set of of entities** but can be a set of sets.

Table 4: The main difference between DistNums and rns

		DistNum.	rns
1.	Obligatory dist. interpretation	✓	✓
2.	key from various domains	✓	✓
3.	share-marker	✓	✓
4.	Co-variation is pragmatic req.	✓	✓
5.	Plural/scopeless interpretation	✓	✓
6.	key other than event dimensions	✗	✓

6 rns as share-based distributivity elements?

In Wohlmuth (2019a), based on (20) and other examples, I proposed that the defining characteristic of rns is that **they do not specify the key of the distributive relation they establish**.

- I suggested the term share-*based distributivity element* (henceforth: sbde) to be applied to rns and elements alike.
- sbdes can be defined as in (24) (based on Wohlmuth 2019a: (16), pp. 128).

(24) **Definition** share-based distributive element
sbdes establish the distributive interpretation of the sentence they occur in by marking the expression that provides the share. They do not specify the key in the relation, but require it to be provided by the context.

The aim of treating rns as sbdes is to acknowledge that **any contextually salient plurality** can provide the key for the share marked by rns.

- This way we can account for the interpretation of (20) where the key is a set of thematic roles.
- We can also account for the fact that rns can fairly easily give rise to interpretations where the key is
  - a contextually salient set of entities; see (25-b), or
  - a contextually salient set of properties; see (26-b),
  - which are not associated with the event denoted by the sentence as one of its dimensions.

(25) *Amelia* ***egy-egy*** *táská-t vitt.*
Amelia **one-one** bag-ACC carry.PST.3SG
'Amelia carried bags, one per ...
a. ...occasion'
b. ...hand'

(26) *Amelia ki-választott* ***egy-egy*** *táská-t.*
Amelia PRT-choose.PST.3SG **one-one** bag-ACC
'Amelia picked out bags, one per ...
a. ...occasion'
b. ...size/color/brand, etc.'

At this point, I have no formal analysis; but the **desiderata for an analysis of RNS** as SBDES is in Table 5.

Table 5: SBDES and RNS

		SBDES and RNS
1.	Obligatory dist. interpretation	✓
2.	KEY from various domains	✓
3.	SHARE-marker	✓
4.	Co-variation is pragmatic req.	✓
5.	Plural/scopeless interpretation	✓
6.	KEY other than event dimensions	✓

Appendix

A The analysis of RNS as DDES based on Champollion (2016)

In Champollion (2016) DDES are analyzed as overt manifestations of a special kind of distributivity operator Part, defined in (27).

- Champollion's Part-operator is defined for events, and it has a dimension parameter θ and a granularity parameter C.

(27) $[\![\text{Part}_{\theta,C}]\!] = \lambda V \lambda e[e \in {}^{*}\lambda e'[V(e') \wedge C(\theta(e'))]]$ ((85) in Champollion (2016))

The Part-operator takes an event predicate V and returns a predicate that holds of any event e which can be divided into events that are in V and whose θs satisfy the (contextually salient) predicate C.

- θ (which basically provides the KEY in our terms) can be resolved as a thematic relation (Θ) or as runtime (τ).
  - If θ is resolved as a thematic relation then C must be set to AT.
  - If θ is resolved as the runtime then C is set to a contextually salient event or occasion.

RNS as DDES à la Champollion (2016) are overt manifestations of Part in (27).

- The semantics of RNS as DDES is in (28).
- A type-shift is applied to Part because RNS can only appear in NP-determiner position.

(28) $[\![\text{N-N}_{\theta,C}]\!] = \lambda P \lambda \Theta \lambda e[[\![\text{Part}_{\theta,C}]\!](\lambda e'[P(\Theta(e')) \wedge |\Theta(e')| = \text{N}])(e)]$
$= \lambda P \lambda \Theta \lambda e[e \in {}^*\lambda e'[P(\Theta(e')) \wedge |(\Theta(e'))| = \text{N} \wedge C(\theta(e'))]$

A RN takes a predicate P, a thematic role Θ, and returns a predicate that holds of thematic role Θ of any e, such that e can be divided into events e' whose Θ is also in P, and the cardinality of Θ of e' is N (the cardinality expressed by the base numeral of the RN-expression), and the θs of e' satisfy the contextually salient predicate C.

According to (28), we can give the following truth conditions for (13-a) and (13-b).

a) The interpretation in (14) (where the KEY is THE VOLUNTEERS) can be achieved by resolving θ as AG, and C as AT.

(29) $[\![$ (13-a) $]\!]$ in C_1 = $[\![$ (13-b) $]\!]$ in C_1 =
$\exists e[\text{PLANT}(e) \wedge \text{AG}(e) = \bigoplus {}^*\text{VOLUNTEER} \wedge e \in {}^*\lambda e'[{}^*\text{SAPLING}(\text{TH}(e')) \wedge |\text{TH}(e')| = 3 \wedge \text{AT}(\text{AG}(e'))]]$

There is a planting event e whose agent is the volunteers and e can be divided up into events e' whose theme is three saplings, and whose agent is atomic.

b) The interpretation in (15) (where the KEY is some contextually salient events) can be achieved by resolving θ as τ, and C as some contextually salient event – let's say, VISIT.

(30) $[\![$ (13-a) $]\!]$ in C_2 = $[\![$ (13-b) $]\!]$ in C_2 =
$\exists e[\text{PLANT}(e) \wedge \text{AG}(e) = \bigoplus{}^{*}\text{VOLUNTEER} \wedge e \in {}^{*}\lambda e'[\text{SAPLING}(\text{TH}(e')) \wedge |\text{TH}(e')| = 3 \wedge \text{VISIT}(\tau(e'))]]$
There is a planting event e whose agent is the volunteers and e can be divided up into events e' whose theme is three saplings, and whose runtime is a contextually salient visit.

(29) and (30) yield to similar truth conditions as (14) and (15), even though the distributive relation is not represented as à la Choe (1987).

- The KEY is provided by resolving the parameters of the Part-operator manifested by the RN (or DDE) and it is not represented as the restrictor of a universal quantifier.
- The SHARE is represented as properties of each (relevant) subevent of the main event denoted by the sentence.

A clear advantage of the analysis in Champollion (2016): **all distributive markers** (both KEY-markers and SHARE-markers) **can be treated as overt manifestations of the same Part-operator in (27)**.

- The specific semantics of the different markers is determined by their syntactic position and the possible values their parameters can have.

B The analysis of RNS as DISTNUMS based on Cable (2014)

The account in **Cable (2014) relies on three special definitions**: 1. the metalanguage predicate PARTICIPANT; see (31), 2. binary maximality (σ) operator; see (32), 3. the *Partition*-function; see (33).[8]

(31) $\text{PARTICIPANT}(e,x) \overset{\text{def}}{=} x$ bears a thematic relation to $e \leftrightarrow x$ is Agent of e, or x is Theme of e, x is Goal of e... ((52) in Cable 2014)

(32) a. Pair addition: $\langle x', x'' \rangle \oplus \langle y', y'' \rangle \overset{\text{def}}{=} \langle x' \oplus y', x'' \oplus y'' \rangle$

[8] See Wohlmuth (2019a) and Wohlmuth (2019b) for a fine-tuning of the ingredients in Cable (2014) to fit the data with RNS and reciprocals.

b. $\sigma_{\langle x,y\rangle}[Q(x)(y)] \stackrel{\text{def}}{=}$ the pair $\langle\alpha,\beta\rangle$, such that $\langle\alpha,\beta\rangle \in {}^*\{\langle x,y\rangle : Q(x)(y)\}$, and if $\langle\gamma,\delta\rangle \in {}^*\{\langle x,y\rangle : Q(x)(y)\}$ then $\gamma \leq \alpha$ and $\delta \leq \beta$ ((53) in Cable 2014)

The binary σ-operator defined in (32-b) applied to a two-place relation $Q(x)(y)$ yields the maximal pair $\langle\alpha,\beta\rangle$ in the denotation of Q such that for every pair $\langle\gamma,\delta\rangle$ in the denotation of Q, γ is part of α, and δ is part of β.

(33) $Partition(e) = \{e' : e' \leq e\}$, such that

a. $\bigoplus Partition(e) = e$, and

b. $\forall e' \forall e''[e', e'' \in Partition(e) \rightarrow \neg\exists e'''[e''' < e' \wedge e''' < e'']]$ ((71) in Cable 2014)

Partition maps an event e to a set of events e', such that every e' is part of e; moreover, the sum of all elements in the set equals e, and none of the events in the set overlap.

- The *Partition*-function has to be contextually salient and yields a cognitively natural partition over the event it is applied to (Balusu 2006, Cable 2014).

With these three extra ingredients we can give the semantics of RNs as in (34). [9]

(34) $[\![\text{N-N}]\!] = \lambda P \lambda V \lambda e \exists x[P(x) \wedge V(x)(e) \wedge \langle e,x\rangle = \sigma_{\langle e',x'\rangle}[x' \leq x \wedge |x'| = \text{N} \wedge e' \in Partition(e) \wedge \text{PARTICIPANT}(e',x')]]$ (based on (72) in Cable 2014)

N-N takes a predicate P and a predicate V, and returns a predicate over events. This predicate of events holds of an event e if there is an individual x such that P holds of x, and the relation V holds between e and x; and if the pair $\langle e,x\rangle$ is the sum of pairs $\langle e',x'\rangle$ such that x' is part of x and the cardinality of x' is N, and e' is in a salient partition over e and x' is a participant in e'.

- According to (34), **RN-expressions are interpreted as scopeless indefinites**, and the meaning contribution of RNs is as follows:
  - the sentence they occur in is true as long as there is a contextually salient partition over the event e denoted by the sentence such that in each subevent in that partition N number of individuals (denoted by the base NP) participated.
- I assume that P must be a plural predicate.

[9]Here we take the Neo-Davidsonian approach (Parsons 1990), and assume that verbs denote sets of events; events are related to individuals via thematic role functions θ and are are related to time intervals via temporal trace functions (τ) (Krifka 1992). The denotation of verbs (or at least verb roots) is closed under sum formation (see lexical cumulativity in Kratzer 2008), and so is that of thematic roles and temporal traces. Because of that, here I do not make the formal distinction between singular and plural verbs, thematic roles, or temporal traces.

Analyzing RNS as in (34) yields to the following truth conditions in (35-b) for (13-b), repeated here as (35-a).

(35) a. *Az önkéntes-ek el-ültettek* ***három-három*** *facsemeté-t.* = (4)
the volunteer-PL PRT-plant.PST.3PL **three-three** sapling-ACC

b. $\exists e \exists x[\textsc{plant}(e) \wedge {}^*\textsc{sapling}(x) \wedge \textsc{ag}(e) = \bigoplus {}^*\textsc{volunteer} \wedge \textsc{th}(e) = x \wedge \langle e, x\rangle = \sigma_{\langle e', x'\rangle}[x' \leq x \wedge |x'| = 3 \wedge e' \in Partition(e) \wedge \textsc{participant}(e', x')]]$

There is an event *e* and an individual *x* such that *e* is a planting event and *x* is a plurality of saplings, and the agent of *e* is the volunteers and the theme of *e* is *x*, and *x* can be divided up into threes of saplings such that each of the threes participated in a contextually salient subevent of *e*.

C An analysis of reciprocals (based on Wohlmuth 2019a and 2019b)

A potential analysis of the reciprocal pronoun *each other* in direct object position:

(36) $[\![\text{each other}_{\text{D-OBJ}}]\!] = \lambda V \lambda x \lambda e \exists y[V(y)(e) \wedge x = y \wedge \exists e', e'' \leq e[\{e', e''\} \in Rec^x_V]]$

The reciprocal pronoun in direct object position takes a predicate *V* that holds between individuals and events, and an entity *x*, and returns a predicate over events. This predicate holds of an event *e* if there is an individual *y*, such that the relation *V* holds between *e* and *y*, and *y* is equal to *x*, and the event *e* has two subevents, such that the set of those subevents are in Rec^x_V.

- Reciprocity is treated as a restricted version of reflexivity (Murray 2008).
  - The reciprocal pronoun requires that the event *e* denoted by the sentence assigns two thematic roles to the same individual.
  - It also requires *e* to have multiple parts, such that the set of these parts is in Rec^x_V.
- Rec^x_V is a set of sets of events consistent with the reciprocal interpretation of *V* given the entity *x*.
  - Rec^x_V can be defined in different ways; see a potential definition in (37).
  - A crucial property of the events in a set in Rec^x_V is that none of them can assign different thematic roles to the same individual.

(37) $Rec^x_V \overset{\text{def}}{=} \{E : x = \bigoplus\{y : \textsc{participant}(\bigoplus E, y)\} \wedge \forall e \in E[V(e)] \wedge \forall x'[x' \leq x \rightarrow \exists x'' \exists e' \in E \exists \theta[x'' \leq x \wedge x' \leq x'' \wedge \theta(e') = x'']] \wedge \neg \exists e'' \in E[\theta_1(e'') = \theta_2(e'')]$,
and *E* is consistent with the reciprocal interpretation of $V\}$

Given all the assumptions and definitions from above, the truth conditions for (20), repeated as (38-a) below, are in (38-b).[10]

(38) a. *Az erőpróbá-n (egyszerre)* ***egy-egy*** *csapat versengett egymás-sal.*
the tournament-SUPE (at.a.time) **one-one** team compete.PST.3SG each.other-COM

b. $\exists e \exists x \exists y[{}^{*}\textsc{team}(x) \wedge \textsc{compete}(e) \wedge \textsc{ag}(e) = x \wedge \textsc{th}(e) = y \wedge x = y \wedge \exists e', e'' \leq e[\{e', e''\} \in Rec^{x}_{\textsc{compete}}] \wedge \langle e, x\rangle = \sigma_{\langle e''', x'''\rangle}[x''' \leq x \wedge |x'''| = 1 \wedge e''' \in Partition(e) \wedge \textsc{participant}(e''', x''')]]$

According to (38-b), (38-a) is true as long as there is a plurality of teams x and there is a competing event e such that

- x is both the agent and the theme of e,
- and e has parts such that the set of these parts is among the sets of events associated with the verbal predicate *compete* on its reciprocal interpretation holding of x;
- moreover, x can be divided up into single teams such that each of them is assigned a thematic role in some contextually salient subevent of e.

Our analysis treats the meaning contribution of **the reciprocal pronoun and the RN-expression separately**.

- The reciprocal pronoun signals a specific structure associated with the reciprocal event(s) denoted by the sentence.
- The RN signals the number of entities bearing a certain thematic role in each contextually salient subevent of the event denoted by the sentence.

OBVIOUS SHORTCOMINGS (see also Section 6): We rely on **pragmatic reasoning** to account for the fact that RN-expressions signal the number of two different thematic roles of the event when associated with unidirectional subevents.

- For now, I assume that there is a restriction on the set of the unidirectional subevents in Rec^{x}_{V} that the *Partition*-function can access.
  - The set E' must be such that for any given individual that bears a thematic role θ_1 of e' then it must bear a thematic role θ_2 of e'' (such that $e' \neq e''$ and e' and e'' are in E').
- This assumption, however, is not motivated by the analysis itself.

[10] For simplicity, I ignore the word *egyszerre*, lit. 'at a time/at the same time'. This element unambiguously conveys that there were no two simultaneous competing events, and hence implies there were multiple events of reciprocal competing.

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