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Semantics of distributivity in Czech Sign Language

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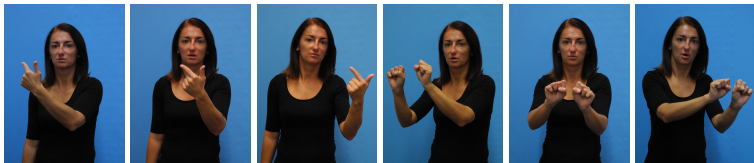
Outline of this talk

1. Introduction: distributivity markers
2. Two strategies: binominal 'each' vs. dependent indefinites
3. Interpretation of sign repetition on R-loci in CSL
4. PCDRT solution

Introduction: distributivity markers

Introduction: distributivity markers

- distributivity markers
 - (1) a. The girls saw two dogs **each**.
 - b. Die Mädchen haben **jeweils** zwei Hunde gesehen.
'The girls saw two dogs each.'
- binominal *each* (standard terminology): *the girls* **sorting key**, *two dogs* **distributed share**
- spoken languages: lot of attention (Balusu 2006, Dotlačil 2012, Champollion 2012, Safir and Stowell 1988 among many others)



- SL data: Kimmelman 2015,2017; Quer 2012; Kuhn 2017
semantics of dependent indefinites

(2) DAUGHTER MY THEY-THREE DOG TWO_i TWO_j TWO_k BATH_i
BATH_j BATH_k
'My three daughters bathed two dogs each.'

- sign repetition on Reference loci (R-loci): positions in space that realize discourse referents/logical variables (Schlenker et al. 2013)

- main claim: CSL sign repetition (R-loci) is distributive operator (similar to binominal *each*)
- our goal: semantic account for (multiple) distributivity marking in Czech sign language

**Two strategies: binominal 'each' vs.
dependent indefinites**

- two closely related phenomena:

1. binominal *each*
2. dependent indefinites: (3) from Kuhn (2017)

(3) EACH-EACH-a PROFESSOR NOMINATE ONE-redup-a
STUDENT .

'Each professor nominated one student .' [ASL, Kuhn 2017]

- **common:** atomicity on sorting key, distributed share of required cardinality
- **distinction:** compatibility with distributive universal quantifier (ungrammatical vs. preferred)

(4) #Each boy had one apple each.



Figure 2: Dependent indefinites in CSL: THEY-arc, TWO-arc

- CSL: repetition on R-loci and dependent indefinites: different marking – DI – Figure 2, (5)
- (5) GIRL THEY-arc-a DOG TWO-arc-a BATH-arc-a [▶ link](#)
'The girls bathed two dogs each.'

Distributive universal quantifier vs. R-loci repetition

- preferential strategy in CSL: distributive *each* with dependent indefinites – (6)
- reduplication of numeral with EACH in CSL dispreferred – (7)
- evidence against treating the reduplication on R-loci as dependent indefinites (DI)

(6) GIRL EACH-arc-a DOG TWO-arc-a BATH-arc-a [▶ link](#)
'The girls bathed two dogs each.'

(7) #/?? DAUGHTER MY 3_{ijk} EACH-arc_{ijk} DOG TWO_iTWO_jTWO_k
BATH
'Each of my daughters bathed two dogs each.'

Interpretation of sign repetition on R-loci in CSL

Terminology: individual vs. occasional distribution

- adverbial German *jeweils* vs. English *each*

- (8) Die Mädchen haben jeweils **zwei Hunde** gesehen.
- a. **# cumulative**
 - b. individual distributivity (**each girl** ... two dogs)
 - c. occasional distributivity (**each time** ... two dogs)
- (9) The girls saw two dogs **each**.
- a. **# cumulative**
 - b. individual distributivity
 - c. #occasional distributivity

CSL: Gathering data

- data survey with two Deaf signers
- truth judgements task
- variation of R-loci reduplication structures
- comments on the video-situation pairing (grammaticality and appropriateness)
- Situations: 3 daughters, 2 or 6 dogs, bathing events



Figure 3: individual distributive



Figure 4: occasional distributive

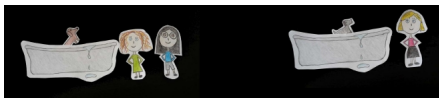


Figure 5: cumulative

Examples from CSL I: cumulative

cumulative reading video: [▶ link](#)

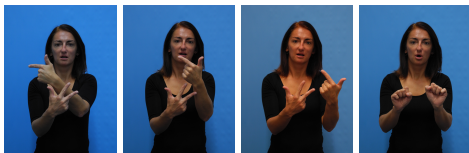
(10) DAUGHTER MY PL DOG PL BATH BATH

'My daughters bathed the dogs.'

- a. #individual
- b. #occasional
- c. **cumulative**

- weak truth conditions, non-scopal reading
- the most salient interpretation of a sentence with plurality denoting subject and object is cumulative

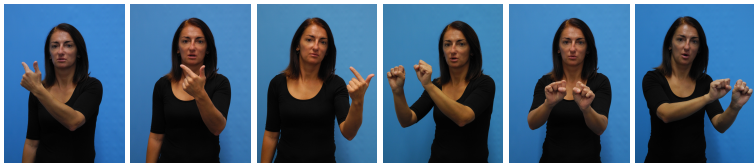
Examples from CSL II: distributive: [link](#)



(11) DAUGHTER 3_{ijk} THEY MY DOG $TWO_i TWO_j TWO_k$ BATH
'My three daughters bathed two dogs each.'

- readings:
 1. individual
 2. # occasional
 3. # cumulative

Examples from CSL: occasional distributivity: [▶ link](#)



- (12) DAUGHTER MY THEY-THREE DOG TWO_i TWO_j TWO_k BATH_i
BATH_j BATH_k
'My three daughters bathed two dogs each / each time.'
- individual
 - occasional
 - #cumulative

PCDRT solution

Cumulative reading

cumulative reading video: [▶ link](#)

(13) DAUGHTER MY PL DOG PL BATH BATH

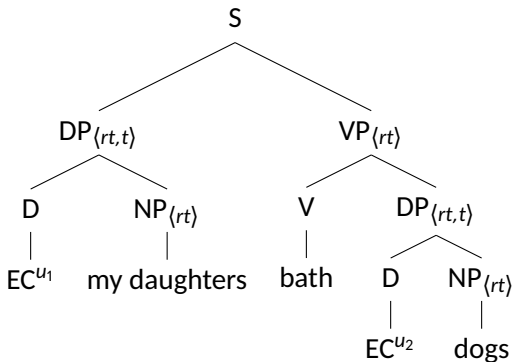
- a. #individual
- b. #occasional
- c. **cumulative**

- weak truth conditions, non-scopal reading
- the most salient interpretation of a sentence with plurality denoting subject and object is cumulative
- sets of assignments: team logic, PCDRT, ...

- very elegant PCDRT solution essentially following Dotlačil (2012)
‘fastidious’ PCDRT: rows assignments to discourse referents, columns: values of discourse referents in all assignments
- adding events as primitive type following Minor (2017): ϵ
- adding group-shifting (\uparrow) after Landman \leftrightarrow 1-1 mapping of events and θ -roles

(14) cumulative:

J	ϵ_1	u_1	u_2
j_1	e_1	$\uparrow(\text{daughter 1 \& 2})$	dog 1
j_2	e_2	daughter 3	dog 2



(15) $[|u_1|]; [|u_1| > 1][|daughters\{u_1\}]; [u_2|][|u_2| > 1][|dogs\{u_2\}]; [|bath\{u_1, u_2\}]$

- pluralization is due to repetition of verb and pluralization of NPs

PCDRT: ingredients

- following Brasoveanu 2008, Dotlačil 2012:

- (16) a. $\llbracket \text{daughters} \rrbracket = \lambda v_r. [| \text{daughter}(s) \{v\}] \quad \langle r, t \rangle$
b. $\llbracket \text{bath} \rrbracket = \lambda Q_{rt,t} \lambda v_r. Q([\lambda v'. [| \text{bath} \{v, v'\}]]) \quad \langle r, t \rangle$
c. $\llbracket \text{three} \rrbracket = \lambda P_{rt} \lambda v_r. [| |v| = 3]; P(v)$
d. $\llbracket \text{dogs} \rrbracket = \lambda v_r. [| \text{dog}(s)(s) \{v\}] \quad \langle r, t \rangle$
e. $\llbracket EC^{u_n} \rrbracket = \lambda P_{rt} \lambda Q_{rt}. [u_n |]; P(u_n); Q(u_n)$
 $\langle r, t \rangle \rightarrow \langle \langle r, t \rangle, t \rangle$

- weak truth conditions: cumulative or collective
- plurality of daughters (u_1) and plurality of dogs (u_2)
- predicate *bath* applied to the $\{u_1, u_2\}$

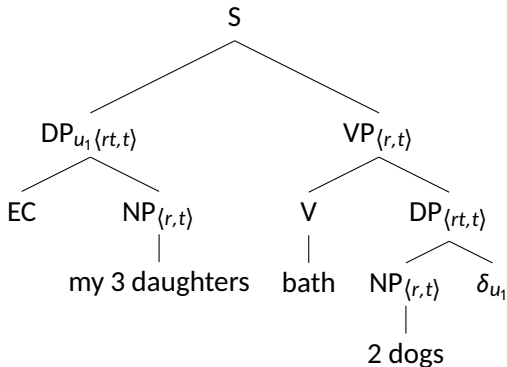
Individual distributive reading

(17) DAUGHTER 3_{ijk} THEY MY DOG TWO_i TWO_j TWO_k BATH
'My three daughters bathed two dogs each.'

- readings:
 1. individual
 2. # occasional
 3. # cumulative
- distributive operator: carried by TWO TWO TWO (reduplicated on DAUGHTERs R-loci), anaphoric to the sorting key
- Schlenker et al. (2013): R-loci positions that can realize discourse referents (logical variables)

- (18) DAUGHTER 3_{ijk} THEY MY DOG TWO_iTWO_jTWO_k BATH
 'My three daughters bathed two dogs each.'

(19)



- reduplication happens in the object position, fastidious via binding into dref u_1

- semantic interpretation: binominal *each* as a quantifier over atoms in the sorting key denotation
- formalization (Dotlačil 2012): atomicity $|\bigcup u_n I| = 1$ plus right cardinality for the distributed share, *each* is essentially the distributive operator plus two arguments, one **anaphoric** and distributed over, second: the distributed share
- adding (20-b) enforces (21):

- (20) a. Distributivity operator: $\delta_{u_n}(D) := \lambda I_{st} \lambda J_{st} \cdot u_n I = u_n J \wedge \forall d \in u_n I (|\bigcup u_n I| = 1 \wedge D(I | u_n = d)(J | u_n = d))$
- b. $\llbracket \text{each}_{u_n}^{u_m} \rrbracket = \lambda P_{rt} \lambda Q_{rt} \cdot [u_m I]; \delta_{u_n}(P(u_m)); Q(u_m)$

(21)

J	ϵ_1	u_1	u_2
j_1	e_1	daughter 1	$\uparrow(\text{dog 1 \& 2})$
j_2	e_2	daughter 2	$\uparrow(\text{dog 3 \& 4})$
j_3	e_3	daughter 3	$\uparrow(\text{dog 5 \& 6})$

Interpretation:

(22) $[u_1]$; $[|u_1| = 3][|\text{daughters}\{u_1\}]$; $[u_2]$; $\sigma_{u_1}([|u_2| = 2][|\text{dogs}\{u_2\}])$; $[|\text{bath}\{u_1, u_2\}]$

- cumulative reading out: share is of the wrong cardinality
- reduplication/bn *each* introduces (like EC) one dref (u_m): share
- reduplication anaphoric to u_n : key
- reduplication is determiner: $\langle r, t \rangle \rightarrow \langle \langle r, t \rangle, t \rangle$

Occasional distributivity

(23) DAUGHTER MY THEY-THREE DOG TWO_i TWO_j TWO_k BATH_i
BATH_j BATH_k

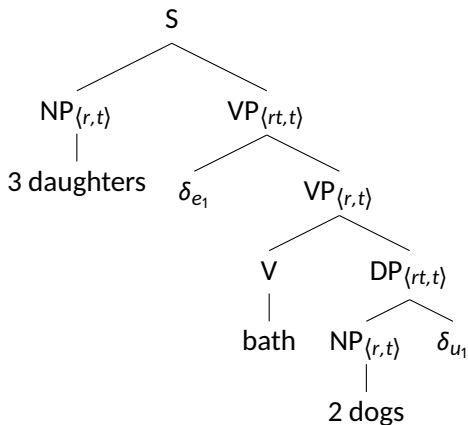
'My three daughters bathed two dogs.'

- a. individual
- b. occasional
- c. #cumulative

Occasional distributive reading

- 2 reduplications:
 1. TWO on DAUGHTERs R-loci
 2. BATH on DAUGHTERs R-loci
- following Schlenker et al (2013): Agents modifying pronouns with incorporated numerals introduce split key antecedents

(24)



(25)

J	ϵ_1	u_1	u_2
j_1	e_1	$\uparrow(\text{daughter 1 \& 2 \& 3})$	$\uparrow(\text{dog 1 \& 2})$
j_2	e_2	$\uparrow(\text{daughter 1 \& 2 \& 3})$	$\uparrow(\text{dog 3 \& 4})$
j_3	e_3	$\uparrow(\text{daughter 1 \& 2 \& 3})$	$\uparrow(\text{dog 5 \& 6})$

$$(26) \quad [u_1]; [|u_1| = 3][|\text{daughters}\{u_1\}|]; [u_2]; \sigma_{u_1}([|u_2| = 2][|\text{dogs}\{u_2\}|]); [\epsilon_1]; \sigma_{\epsilon_1}([|\epsilon_1| > 1][|\text{bath}\{\epsilon_1, u_1, u_2\}|])$$

Ambiguity: both reduplications require atomicity both in ϵ and u :

1. atomicity via groups \rightarrow occasional reading
2. atomicity via individuals \rightarrow individual reading

Reduplication of object: atomicity only in u

- two σ operators: both anaphoric – one (σ_{u_1}) to subject, another (σ_{e_1}) to the events
- individual reading: entailed (less complex – no group-shifting) by the occasional interpretation – preferred by signers

(27)

J	e_1	u_1	u_2
j_1	e_1	daughter 1	\uparrow (dog 1 & 2)
j_2	e_2	daughter 2	\uparrow (dog 3 & 4)
j_3	e_3	daughter 3	\uparrow (dog 5 & 6)

Summary

- CSL distributive reduplication (reduplication of R-loci) is a realization of the distributive fastidious operator σ
- two reduplications \leftrightarrow ambiguity (TWO TWO TWO BATH BATH BATH)
- alternative proposal: Kimmelman (Russian SL) solves by proposing a syntactic concord analysis (following Zeijlstra's Negative Concord theory; abstract D, marking agrees with D, multiple marking possible but not necessary)
- unclear predictions (e.g. for nominal/numeral reduplication vs. verbal reduplication) – probably cannot explain occasional reading without stipulations

- **our proposal:**

- every distributive reduplication marking in CSL is a σ operator
- σ operator is **selective/fastidious** to the sorting key (u_1/ϵ_1 ... individual/occasional distribution reading); R-loci are anaphoric (Schlenker)

- **our analysis:**

- accounts for the multiple distributivity marking in SL
- uses previous theoretical work on distributivity in spoken languages and referentiality in sign languages

Thanks!

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