FACULTY
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Czech binominal *each* and collective set predicates

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Intro

- data: binominal *each* vs. distributive *each*
- diagnosis of the distributive reading: lack of the cumulative reading

(1) Two boys bought three books.

(2) a. *Each* of the two boys bought three books. **determiner**
b. Two boys bought [three beers *each*]. **binominal**

- (2-a): determiner *each*, *two boys* restriction, VP nuclear scope
- (2-b): binominal *each*, *two boys* key, *three books* share
- syntactic structure: Safir and Stowell (1988)

Outline

1. Slavic (Czech) binominal *each*
   - properties
   - agreement, two types of collectives
2. PCDRT
3. Summary

- joint work with Radek Šimík

Slides: https://bit.ly/2ShGYF0

Basic properties of Czech binominal *each* I

Expected properties of Czech binominal *each*

seminal discussion (English binominal *each*): Safir and Stowell (1988), recently Dotlačil (2012), Zimmermann (2002), a.o.

- Both **pre-** and **post-**position wrt **share NP** (*jednu čepici*) possible:

(3) Chlapci si koupili **každý** jednu čepici.
boys.nom.pl refl bought.pl each.nom.sg one cap.acc
'The boys bought each one cap.'

(4) Chlapci si koupili jednu čepici **každý**.
boys.nom.pl refl bought.pl one cap.acc each.nom.sg
'The boys bought one cap each.'

Basic properties II

- **Bare** (non-determined) **share NP not allowed**; cf. VP-related *each* (5-c):

(5) ??Chlapci si koupili **každý** čepici.
boys.nom.pl refl bought.pl each.nom.sg cap.acc
Intended: 'The boys bought each one cap.'

(6) ??Chlapci si koupili čepici **každý**.
boys.nom.pl refl bought.pl cap.acc each.nom.sg
Intended: 'The boys bought one cap each.'

(7) Chlapci si **každý** koupili čepici.
boys.nom.pl refl each.nom.sg bought.pl cap.acc
'The boys each bought a cap.'

Clause-mate restriction

(8) *Chlapci říkali, že Marie koupila každý jednu čepici.
boys.pl said that Marie bought each.sg.m one cap.acc
Intended: ‘Each of the boys said that Mary bought one cap.’

- **Key** can be **any argument**, not just subject.

(9) Marie přinesla chlapcům každému jednu čepici.
Marie brought boys.dat.pl each.dat.sg one cap.acc
‘Marie bought each of the boys one cap.’

(10) Marie přinesla ty čepice každou jednomu chlapci.
Marie brought the caps.acc.pl each.acc.sg one boy.dat
‘Marie brought each of caps to one boy.’

- Share can be non-accusative

(11) Těm chlapcům se líbila každému jedna dívka.
the boys.dat.pl refl liked each.dat.sg one girl.nom
'The boys liked one girl each.'

Underlying structure of Czech binominal *each* I

Language specific properties: agreement with the key

Idea: Czech binominal *each* contains a covert singular definite description referring back to / bound by a plural antecedent.

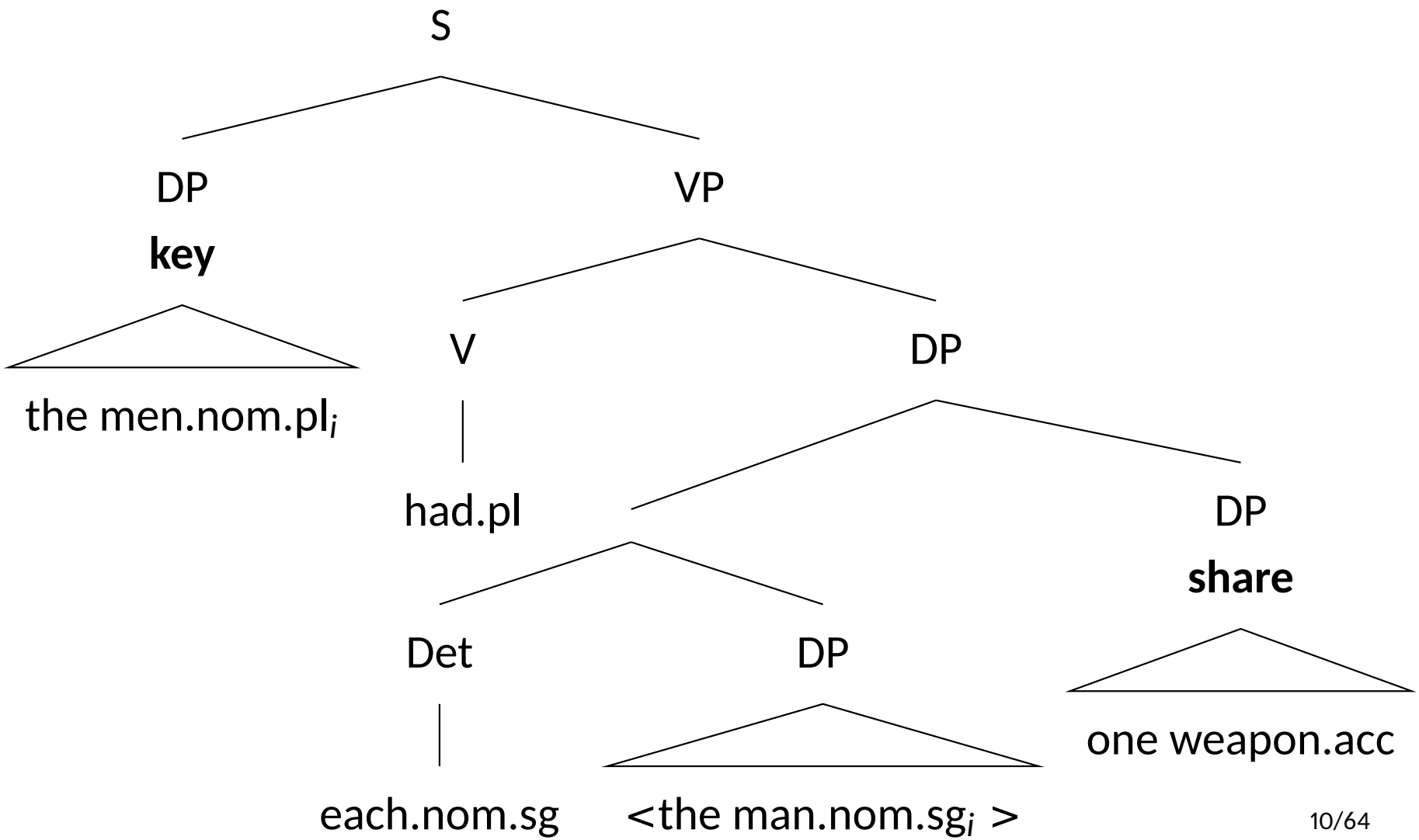
- Example with discourse anaphora:

(12) Přišli nějací muži$_i$. Každý / Jeden (ten muž$_i$) měl
came some men.pl each one the man.sg had.sg
zbraň.
weapon
'Some men came. (Each) one of them (lit. each/one the man) had a weapon.'

- Hypothesized structure of binominal *each*, where <*ten muž*> is obligatorily deleted under (partial) identity with its antecedent; cf. Sauerland (1998), Fox (2003), Johnson (2012), a.o., for a similar treatment of traces

(13) Ti muži$_i$ měli každý <ten muž$_i$> jednu zbraň.
the men.pl had.pl each the man.sg
'The men had one weapon each.'

Proposed constituent structure



Argument: Movement

- Binominal *each* vs. floating *all*: Binominal *each* forms a constituent together with the share.

(14) [Každý /*Všichni 3 medaile] jsme vyhráli jen
each.sg.masc all.pl.masc 3 medals be.1pl won.pl only
my.
we
(Intended:) 'We were the only ones to win three medals each.'

Semantic properties

- distributivity over atoms in key's denotation
- → prevents (usually) cumulative and collective interpretation
- pseudoCzech

(15) two professors examined three students.

a. cumulative: 2 professors … 3 students
b. distributive: 2 professors … 6 students
c. collective: 2 professors (cooperating) … 3 students

(16) two professors examined [each three students].

a. #cumulative: 2 professors … 3 students
b. distributive: 2 professors … 6 students
c. #collective: 2 professors (cooperating) … 3 students

Collectives

- predicates like *gather*, *be a good team*, *be a group (of NP)*
- usually enforce collective reading

(17) The group of two authors wrote three books.

a. *distributive: 2-6

b. *cumulative: 2-3

c. ✓ collective: 2(together)-3

- usually collectives and distributivity markers clash:

(18) *The group of two authors wrote three books each.

Dowty (1987), Brisson (2003), Winter (2002), Dočekal (2012)

Two types of collectives

- two types of collective predicates (Dowty (1987), Winter (2002), Brisson (2003), . . .):
  1. *gather*, *meet*, *sing together*, . . . **set predicates**
  2. *be a good team*, *outnumber NP*, . . . **atom predicates**
  - the criterion (compatibility with *all* – Dowty, sg/pl Winter):

(19) a. all the boys gathered

b. *all the boys are a good team

- collective Czech numerals like *dvojice* ‘twosome’ (parallel data in other Slavic langauges: Polish, Russian, . . .) enforce the **collective reading**

(20) a. **Dva** sportovci vyhráli 2 medaile, ✓první zlato a
two athletes won.pl 2 medals first gold &
stříbro, druhý stříbro a bronz.
silver second silver & bronze
‘Two athletes won 2 medals, the first one G & S, the second one S & B.’

b. **Dvojice** sportovců vyhrála 2 medaile, #první zlato a stříbro, druhý stříbro. . . twosome athletes.gen won.sg.fem 2 medals

- collective set predicates allow limited distributivity (Dotlačil (2012))
- collective Czech numerals can distribute over reciprocals like set collectives

(21) [Bill and Peter, together],/#[the team of students] carried the piano across each other's lawns.

(22) **Dvojice** /#**Skupina** podezřelých zradila jeden druhého.
twosome group suspects.gen betrayed one other.
(Intended:) 'The people within the twosome / group of suspects betrayed one another.'

- provisional assumption: collective numerals are set collectives

The contrast

binominal *each* + set collectives

(23) **Dvojici** detektivů byly předány [každému
twosome.dat detectives.gen were given [each.dat
tři ceny].
three.nom prizes.nom]
'Three prizes each were given to twosome detectives.'

a. only distr.: 2 detectives . . . 6 prizes (3 each)

- binominal *each* can distribute 'into' set collectives

determiner *each* + set collectives

(24) [Každé **dvojici** detektivů] byly předány
[each.dat twosome.dat detectives.gen] were given
tři ceny.
three.nom prizes.nom
'Three prizes were given to each twosome of detectives.'

a. only distr. over twosome: (each) 2 detectives … 3 prizes

- determiner *each* can distribute only over groups, not 'into'

binominal *each* + atom collective predicate

(25)???**Týmu** detektivů byly předány každému **tři**
team.dat detectives.gen were given each.dat three
ceny.
prizes
‘???Three prizes each were given to the team of detectives.’

- binominal *each* clashes with atom collectives

determiner *each* + atom collective predicates

(26) [Každému **týmu** detektivů] byly předány
each.dat team.dat detectives.gen were given
tři ceny.
three.nom prizes.nom
'Three prizes were given to each team of detectives.'

a. only distr. over teams (each 2 prizes)

- determiner *each* can distribute only over group atoms

Agreement confound

- subject vs. non-subject assymetries

(27) a. Dva detektivové dostali [každý 3 ceny].
two.nom detectives.nom received [each.nom 3 prizes.acc]
'Two detectives received [each three prizes].'

b. Deset detektivů dostalo [*každý/*každého 3 ceny].
ten.nom detectives.gen received.sg [*each.nom/*each.gen 3 prizes.acc]

- provisional generalization

(28) Czech (Slavic?) binominal *each* cannot take as its antecedent genitive complement of a numeral.

(29) Generál dal deseti detektivům [dvě ceny každému].
general.nom gave.sg three.dat detectives.dat [two.acc prizes.acc each.dat]
'The general gave ten detectives [three prizes each].'

- similarly for collective numerals:

(30) Dvojice detektivů chytla
twosome.nom detectives.gen caught.sg
[*každý/*každého tři zloděje.]
[*each.nom/*each.gen three.acc thieves.acc]
‘Twosome of detectives caught [trhee thieves each].’

binominal + set collectives perfectly fine in dativ

(31) Dvojici detektivů byly předány [každému
twosome.dat detectives.gen were given [each.dat
tři ceny].
three.nom prizes.nom]
‘Three prizes each were given to twosome detectives.’

a. only distr.: 2 detectives . . . 6 prizes (3 each)

PCDRT

Dotlačil (2012), Dotlačil (2012), Brasoveanu (2008)

(32) Prediction: expected difference between binominal and determiner *each*. Both supply distributivity but binominal distributes locally over the share (it is anaphoric to key but don't scope over it). Determiner *each* scopes over the whole nuclear scope. Predicted innertia of binominal *each* w.r.t. colectivity (and cumulativity) outside of its share.

- main point: illustrate the prediction (Czech data)
- byproduct: semantic and syntactic description of Slavic binominal *each*
- and interaction of determiner/binominal *each* with collectives

Cumulative readings in PCDRT

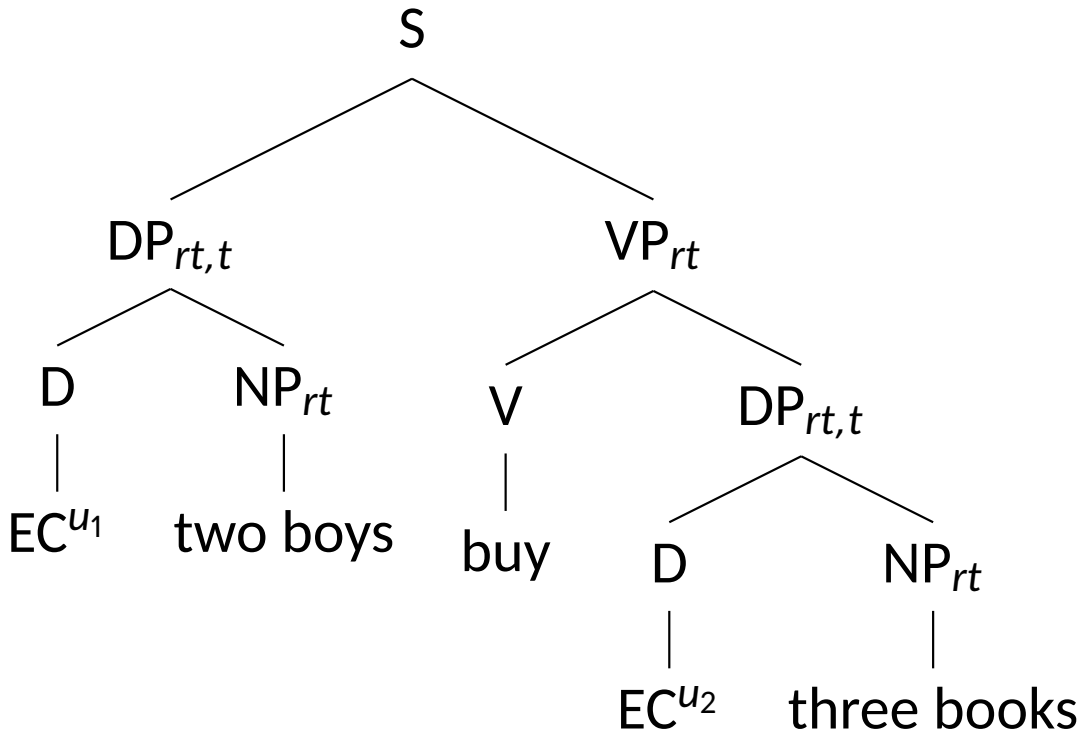
(33) Two boys bought three books.

- essentials: PCDRT works with sets of assignments

Info state J	u_1	u_2
j_1	boy_1	$book_1$
j_2	boy_1	$book_2$
j_3	boy_2	$book_3$

- columns: values of discourse referents, rows: assignments to drefs
- cumulative reading, fully compositional

- E(existential) C(losure): shifts predicates into arguments



(34) $[u_1, u_2 | \#(u_1) = 2 \wedge \text{boys}\{u_1\} \wedge \#(u_2) = 3 \wedge \text{books}\{u_2\} \wedge \text{buy}\{u_1, u_2\}]$

Determiner and binominal *each* in PCDRT

(35) a. $[\![\text{det-každý}^{u_n}]\!] = \lambda P_{rt} \lambda Q_{rt}.\delta_{u_n}(P(u_n)) \wedge Q(u_n)$

b. $[\![\text{binom-každý}^{u_m}]\!] = \lambda v_r \lambda P_{rt} \lambda Q_{rt}.[\, u_m \mid] \wedge \delta_v(P(u_m)) \wedge Q(u_m)$

- distributivity operator δ in both
- but binominal *each* introduces discourse referents
- binominal: anaphoric to the key but scopes locally over the share
- determiner: distributes over the nuclear scope

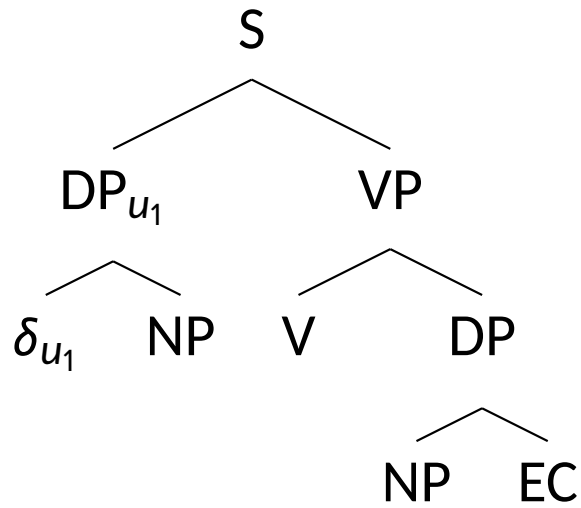
Types in PCDRT: r … drefs, t … truth value

Determiner *each*

(36) Each of the two boys bought three books.

Info state J	u_1	u_2
j_1	boy_1	$book_1$
j_2	boy_1	$book_2$
j_3	boy_1	$book_3$
j_4	boy_2	$book_4$
j_5	boy_2	$book_5$
j_6	boy_2	$book_6$

Determiner *each*



- existential closure of the subject (predicative semantics: $\langle r, t \rangle$)
- distributes over the nuclear scope
  $\delta_{u1}([\,u_2\,] \wedge [\,|\#(u_2) = 3 \wedge \text{books}\{u_2\}\,] \wedge [\,|\text{buy}\{u_1, u_2\}\,])$

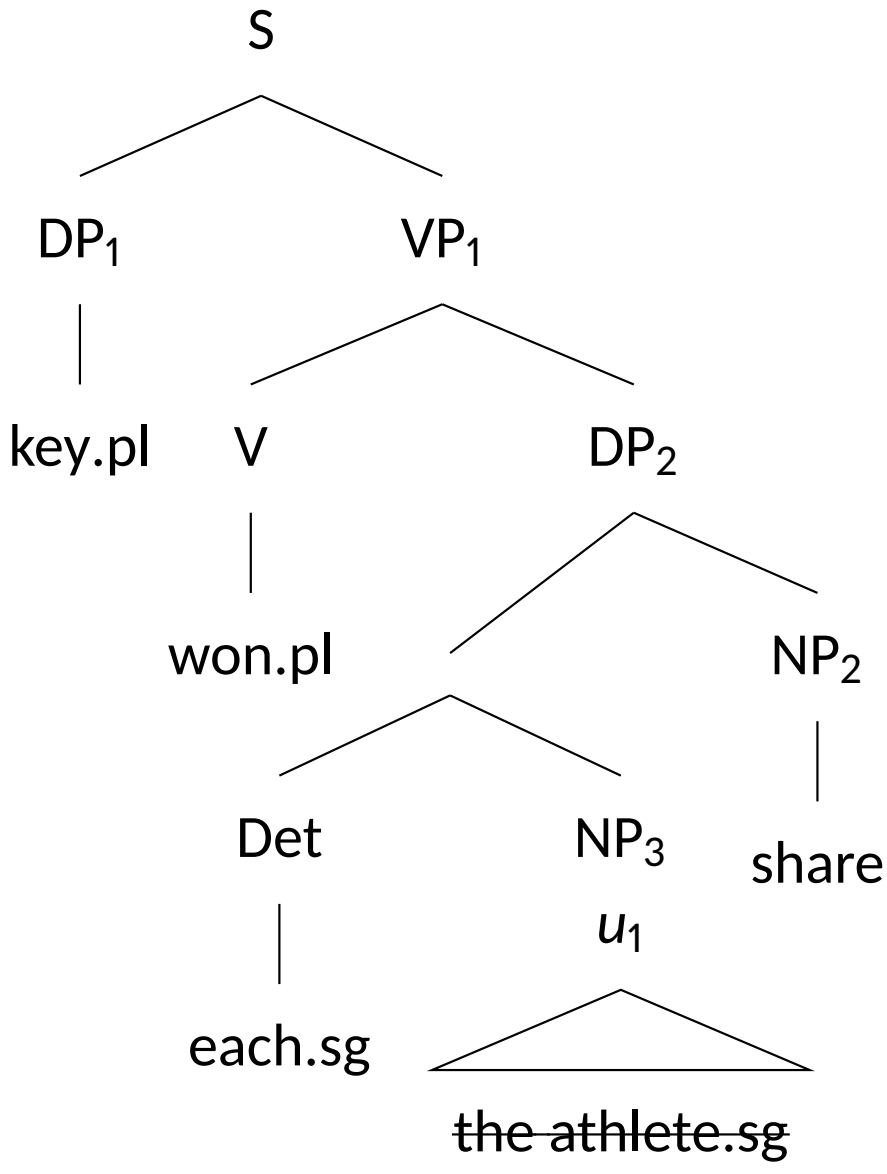
(37) $[\,u_1|\#(u_1) = 2 \wedge \text{boys}\{u_1\} \wedge \delta_{u1}([\,u_2\,] \wedge [\,|\#(u_2) = 3 \wedge \text{books}\{u_2\}\,] \wedge [\,|\text{buy}\{u_1, u_2\}\,])]$

Binominal *each*

(38) **Dva** sportovci vyhráli **každý** 3 medaile.
two athletes won.pl.masc each.sg.masc 3 medals
✓**distributive**

the same info state as for (54)

Info state J	u_1	u_2
j_1	athlete_1	medal_1
j_2	athlete_1	medal_2
j_3	athlete_1	medal_3
j_4	athlete_2	medal_4
j_5	athlete_2	medal_5
j_6	athlete_2	medal_6


S
DP1
VP1
key.pl
V
DP2
won.pl
NP2
Det
NP3
share
u1
each.sg
the athlete.sg

(39) $[u_1|\#(u_1) = 2 \wedge \text{athletes}\{u_1\} \wedge [u_2|\delta_{u_1}([\,\#(u_2) = 3 \wedge \text{prizes}\{u_2\}\,])]\,] \wedge \text{win}\{u_1, u_2\}\,]$

- distributivity percolates through the semantic computation
- the same info state but:

1. determiner *each*: distributes over the nuclear scope + closes the predicative meaning of the subject ($\langle r, t\rangle$)
2. binominal *each*: scopes only over share ($\delta_{u_1}([\,\#(u_2) = 3 \wedge \text{prizes}\{u_2\}\,])$) and is anaphoric to the key (u_1)

- predicted difference: local (binominal) vs. global (determiner) distributivity

Main data puzzle

- binominal vs. determiner *each* vs. set and atom collectives
- pseudoCzech:

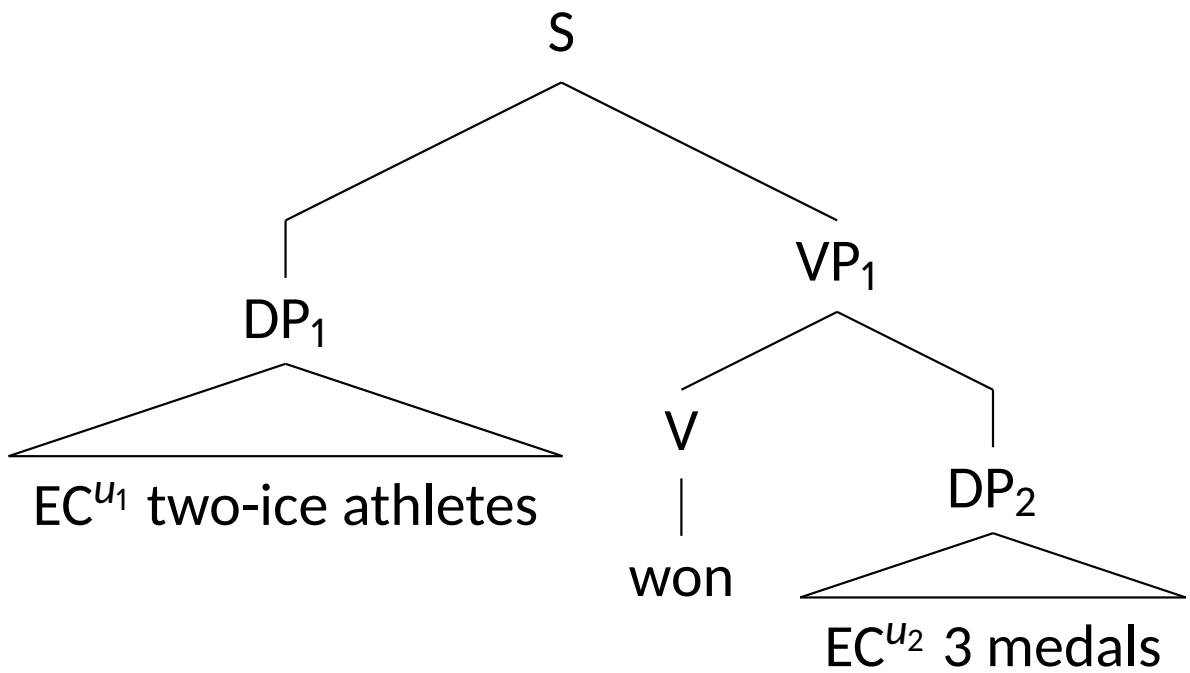
(40) a. binominal *each* + set collective
[Three prizes each] were given twosome detectives.

b. *binominal *each* + atom collective
#[Three prizes each] were given team detectives.

c. determiner *each* + set/atom collective
Three prizes were given [each twosome/team detectives] only distribution over groups

The set collective formalization

(41) **Dvojice** sportovců vyhrála 3 medaile.
twosome athletes.gen won.sg.fem 3 medals. ***distributive**



(42) a. $[\![\text{S}]\!] = [u_1, u_2 | \#(u_1) = 2 \wedge \text{athletes}\{u_1\} \wedge \#(u_2) = 3 \wedge \text{medals}\{u_2\} \wedge \text{win}\{\bigcup u_1, u_2\}]$

b. $[\![\text{DP}_1]\!] = \lambda Q_{rt}.[u_1 | \#(u_1) = 2 \wedge \text{athletes}\{u_1\}] \wedge Q(\bigcup u_1)$

c. $[\![\text{VP}_1]\!] = \lambda v_r [u_2 | \#(u_2) = 2 \wedge \text{medals}\{u_2\} \wedge \text{win}\{v, u_2\}]$

d. $[\![\text{DP}_2]\!] = \lambda Q_{rt}.[u_2 | \#(u_2) = 3 \wedge \text{medals}\{u_2\}] \wedge Q(u_2)$

- our addition to PCDRT: treatment of numeral collectives as imposing the collectivity on its argument (gets propagated into the verb external argument slot)
- technically (42-b)

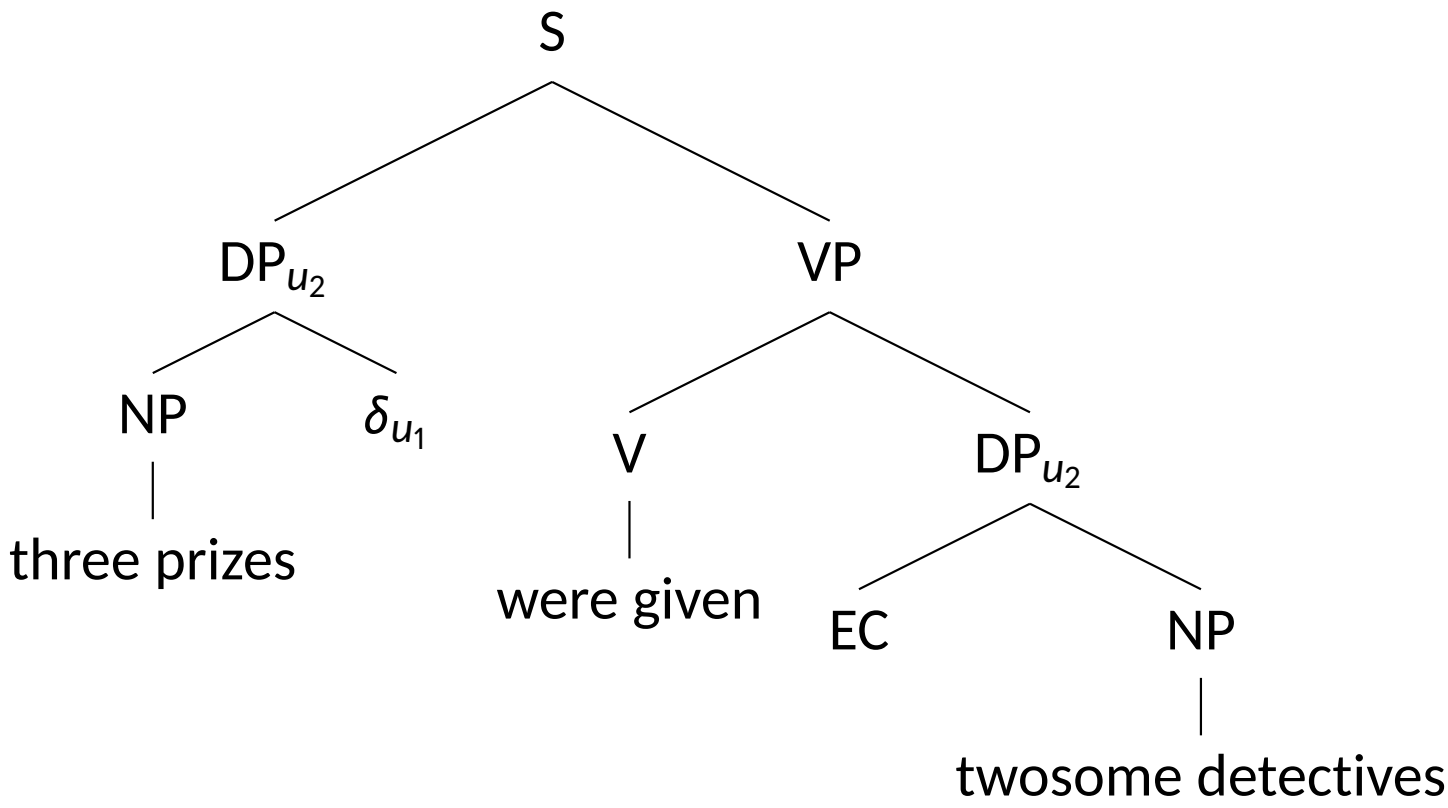
(43) $[u_1, u_2 | \#(u_1) = 2 \wedge \text{athletes}\{u_1\} \wedge \#(u_2) = 3 \wedge \text{medals}\{u_2\} \wedge \text{win}\{\bigcup u_1, u_2\}]$

- one verifying info state:
- collective on the subject
- all the athletes won together the three medals (technically $\text{win}\{\bigcup u_1, u_2\}$)

Info state J	u_1	u_2
j_1	athlete_1	medal_1
j_2	athlete_2	medal_2
j_3	athlete_1	medal_3

Binominal *each* + set collective

(44) [Three prizes each] were given twosome detectives.



(45) [Three prizes each] were given twosome detectives.

Info state J	u_1	u_2
j_1	detective_1	prize_1
j_2	detective_1	prize_2
j_3	detective_1	prize_3
j_4	detective_2	prize_4
j_5	detective_2	prize_5
j_6	detective_2	prize_6

- collective set numeral checks $\bigcup$ (cardinality) of u_1 + imposes collectivity on the predicate
  - binominal *each* distributivity is local: scopes over the share (u_2)

PCDRT formalization

(46) [Three prizes each] were given twosome detectives.

a. $[u_1 | \#(u_1) = 2 \wedge \mathit{detectives}\{u_1\} \wedge [u_2] | \delta_{u_1}([\#(u_2) = 3 \wedge \mathit{prizes}\{u_2\}]) \wedge \mathit{given}\{\bigcup u_1, u_2\}]$

- the detectives were given collectively (local collectivity: key plus predicate) prizes
- each of them received two prizes (local distributivity over the share)

Binominal *each* plus atom collective

(47) #[Three prizes each] were given team detectives.

Info state J	u_1	u_2
j_1	$\text{detective}_1 + \text{detective}_2$	prize_1
j_2	$\text{detective}_1 + \text{detective}_2$	prize_2
j_3	$\text{detective}_1 + \text{detective}_2$	prize_3

- atom collectivity is horizontal, set collectivity is vertical
- probably bad for the same reason as:

(48) Petr drank *[two beers each].

Determiner *each* + set/atom collective

(49) Three prizes were given [each twosome/team detectives]

Info state J	u_1	u_2
j_1	$\text{detective}_1 + \text{detective}_2$	prize_1
j_2	$\text{detective}_1 + \text{detective}_2$	prize_2
j_3	$\text{detective}_1 + \text{detective}_2$	prize_3
j_4	$\text{detective}_3 + \text{detective}_4$	prize_4
j_5	$\text{detective}_3 + \text{detective}_4$	prize_5
j_6	$\text{detective}_3 + \text{detective}_4$	prize_6

- with the determiner *each* the distributivity scopes over collectives and cannot decompose them

Summary

- both determiner and binominal *each* contribute distributivity
- determiner *each* scopes globally (nuclear scope) and interferes with a collectivity (and cumulativity) of other arguments
- binominal *each* distributes locally over the share and allows set collectivity (and cumulativity) outside of its share

Thanks!

Appendix

Main data puzzle

- pseudoCzech:
- binominal *each* and collective numerals

(50) a. Each from twosome athletes won three medals.
coll+distr ok

b. *Twosome from athletes won each three medals.
col+bin-each

(51) Two from athletes won three medals each. num+bin ok

Repeating the pattern

- pseudoCzech:
- binominal *each* and collective numerals

(52) a. Each from twosome athletes won three medals.
coll+distr ok

b. *Twosome from athletes won each three medals.
col+bin-each

(53) Two from athletes won three medals each. num+bin ok

The determiner distributive sentence

(54) **Každý z dvojice** sportovců vyhrál 3 medaile.
each of twosome.gen athletes.gen won.sg.masc 3 medals
✓**distributive**

- verifying info state:

Info state J	u_1	u_2
j_1	athlete_1	medal_1
j_2	athlete_1	medal_2
j_3	athlete_1	medal_3
j_4	athlete_2	medal_4
j_5	athlete_2	medal_5
j_6	athlete_2	medal_6

- needed ingredients:

(55) a. $[\![\text{det-každý}^{u_n}]\!] = \lambda P_{rt} \lambda Q_{rt}.\delta_{u_n}(P(u_n)) \wedge Q(u_n)$

b. z 'from/of' predicates of groups $\rightarrow$ predicates of their parts – $\lambda P_{rt} \lambda v_r.[\,|v \subseteq P]$

c. predicative meaning of CN: $\lambda w_r[\,|\#(w) = 2 \wedge \text{athletes}\{\bigcup w\}]$

d. whole subject: $\lambda Q_{rt}.[v|\delta_v([\,|\lambda v_r.[v \subseteq \lambda w_r[\,|\#(w) = 2 \wedge \text{athletes}\{\bigcup w\}]]]) \wedge Q(v)$

- determiner *each* quantifies over parts (partitioning z 'from') of the group denotation
- predicative meaning results in:

(56) $[v, u_2|\text{athlete}\{v\} \wedge \delta_v([\,|\lambda v_r.[v \subseteq \lambda w_r[\,|\#(w) = 2 \wedge \text{athletes}\{\bigcup w\}]]]) \wedge \#(u_2) = 3 \wedge \text{medals}\{u_2\} \wedge \text{win}\{v, u_2\}])]$

Clash of CN with binominal *each*

(57) *__Z dvojice__ sportovců vyhrál __každý__ 3
twosome athletes.gen won.sg.masc each.sg.masc 3
medaile.
medals

- star for the binominal *each*
- can be floated *each* but not the binominal *each*
- the problem is that the percolated distributivity cannot be applied to the subject's argument meaning
- plus argument subject imposes collectivity ⟷ clash:

(58) a. $[\![\text{DP}_1 \text{ of } (57)]\!] = \lambda Q_{rt}.[u_1 | \#(u_1) = 2 \wedge \text{athletes}\{u_1\}] \wedge Q(\bigcup u_1)$

b. $[\![\text{VP}_1 \text{ of } (57)]\!] = \lambda y_r[u_2 | \delta_{u_2}([\#(u_2) =$

- *Each* can “float” in both cases, even in a position that apparently points to a binominal *each*. Note two differences though: NP (being obligatorily plural) triggers plural verb agreement vs. PP antecedent does not trigger agreement → agreement with the postverbal sg *každý*.

(59) [$_{NP}$ Ti chlapci] vyhráli {každý} jednu cenu {každý}.
the boys.nom.pl won.pl each.nom one prize.acc each.nom
‘The boys won one prize each.’

(60) [$_{PP}$ Z těch chlapců] vyhrál {každý} jednu cenu {každý}.
from the boys.gen.pl won.sg each.nom one prize.acc each.nom
‘Each of the boys won one prize.’

Derived collective numerals

- Czech: group nouns/numerals derived from cardinal numerals with the suffix *-ice*: *tr-oj-ice námořníků*
- properties:

1. both singular and plural: *s troj-icí*$_{INST.SG}$ *námořníků*, *s troj-ice-mi*$_{INST.PL}$ *námořníků*
2. incompatible with the singular universal quantifier *všechno* ‘all’: **všechna troj-ice námořníků* (not mass)
3. obligatorily non-cumulative: *troj-ice + troj-ice = 2 troj-ice*
4. obligatorily non-divisive: parts of *troj-ice* are not *troj-ice*

5. can be counted with cardinal numerals: *dvě troj-ice námořníků*
6. usualy enforce the collective interpretation:

Two arguments that PP antecedents cannot antecede binominal *each*, despite the initial appearance:

- Agreement with the *each*-phrase rather than with the antecedent (see above).
- No constituent:

(61) *[Každý jednu cenu] vyhrál(i) jenom [$_{PP}$ z těch
each.nom one prize.acc won.sg(pl) only from the
chlapců].
boys.gen.pl
Intended: Only the boys were such that each of them won one prize.'

- NP ellipsis of the *each*-restrictor not obligatory:

(62) [$_{PP}$ Z těch chlapců] vyhrál [$_{NP}$ každý chlapec]
from the boys.gen.pl won.sg each boy.nom.sg
jednu cenu.
one prize.acc
'From the (group of) boys, each boy won one prize.'

- Possibility to combine binominal *each* with distributive *po*:

(63) Ty slepice snesly po třech vajíčkách.
the hens.nom.pl layed po three eggs.loc
'The hens layed three eggs each.'

(64) Ty slepice snesly každá tři vajíčka.
the hens.nom.pl layed each.nom three eggs.acc
'The hens layed three eggs each.'

(65) Ty slepice snesly každá po třech vajíčkách.
the hens.nom.pl layed each.nom.sg po three eggs.loc
'The hens layed three eggs each.'

Comparison with prepositional restrictors

- The following two have identical truth-conditions in Czech → the singular nominative NP *ten chlapec* can have the same use as a prepositional PP containing a (partitive?) plural genitive *těch chlapců*.

(66) Každý [$_{NP}$ ten chlapec] vyhrál jednu cenu.
each.nom the boy.nom.sg won.sg one prize.acc
'Each of the boys won one prize.'

(67) Každý [$_{PP}$ z těch chlapců] vyhrál jednu cenu.
each.nom from the boys.gen.pl won.sg one prize.acc
'Each of the boys won one prize.'

každý v vs. *každý z*

- the distinction seems to be between non-distinguishing *každý z* vs. plurality non-accepting *každý v*
- partially based on ČNK:
- case distinction: LOC vs. GEN

(68) Každý z

a. pronouns: nich, nás, …
b. plural count: manželů, partnerů, účastníků
c. -ice: trojice
d. numerals (indefinite?): pěti, …
e. collective nouns: týmu, rodiny

(69) Každý v

a. collective nouns: týmu, říši, rodině, nemocnici
b. entity denoting: Praze, ČR,
c. *plural count: # každý v účastnících, #každý v manželích, …
d. *pronouns: # [každý v nich], …
e. *numerals: # [každý v pěti], …
f. -ice: každý ve dvojici (dostane do ruky …)

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