Scope-related cumulativity asymmetries and cumulative composition

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FWF Der Wissenschaftsfonds.

Today's talk

1. Empirical problem: Cumulative readings of *every* DPs, distributive conjunction
2. Novel analysis: cumulation is built into composition rules
3. Independent motivation: Behavior of plural expressions in conjunctions
4. Comparison to existing analyses (time allowing)

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Cumulativity asymmetries: English singular universals

Distributivity wrt. lower plural expressions

(1) *Every girl in this town fed (the) two dogs.*

SCENARIOS: girls Ada and Bea, dogs Carl and Dean

'distributive' scenario: Ada fed Carl and Dean. Bea fed Carl and Dean. TRUE

'cumulative' scenario: Ada fed Carl. Bea fed Dean. FALSE

Cumulativity wrt. higher plural expressions

(2) *(The) two girls fed every dog in this town.*

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Cumulativity asymmetries: German distributive conjunction

CONTEXT: There are two skiing World Cup races this weekend. Ada and Bea are the only Austrian participants. Ada is competing in the downhill and Bea in the slalom.

Cumulativity wrt. higher plural expressions

(3) *Zum Glück haben die zwei Österreicherinnen sowohl die Abfahrt als auch den Slalom gewonnen!*
to-the fortune have the two Austrians PRT the downhill PRT also the slalom won
'Fortunately, the two Austrians won both the downhill and the slalom.'

'cumulative' scenario: Ada won the downhill. Bea won the slalom. TRUE

Distributivity wrt. lower plural expressions

(4) *Zum Glück haben sowohl die Ada als auch die Bea die zwei Rennen gewonnen!*
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1. always have a distributive reading wrt. semantically plural expressions in their scope
2. allow for cumulative readings if they occur in the scope of a semantically plural expression
3. Assumption here: asymmetry tied to scope (following Champollion (2010), further research needed)

ADUs cross-linguistically

- singular universals: English *every* DPs, German *jed-* DPs
- German distributive conjunction: *sowohl A als auch B* 'A as well as B'
- possibly other distributive conjunctions: Hungarian *A is és B is*, Polish *i A i B* (preliminary data)

Next point: Why ADUs represent a problem for a theory of cumulativity.

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Cumulative relations between individuals

(5) *The two girls wanted to buy the two dogs.*

adapted from Beck and Sauerland (2000)

- Cumulative truth conditions:
  Each of the two girls wanted to buy at least one of the two dogs &
  for each of the two dogs, at least one of the two girls wanted to buy it
- $\Rightarrow$ Relation [$\lambda x.\lambda y.y$ wanted to buy x] applies cumulatively to the girls and the dogs
- Cumulative relation may be derived by LF-movement Beck and Sauerland (2000)

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Problem for this simple view of cumulativity: Schein sentences

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Why Schein sentences are a problem (1/2)

Schein sentences: ADUs ‘sandwiched’ between two other plural expressions.

Schein (1993), Kratzer (2000), Champollion (2010)

(6) *Ada and Bea taught every dog two new tricks*. adapted from Schein (1993)

SCENARIO: There are two dogs, Carl and Dean.
Ada taught Carl trick 1 &
Ada taught Carl trick 2 &
Ada taught Dean trick 3 &
Bea taught Dean trick 2 TRUE

1. it is not the case that for every dog each of the girls taught it two tricks
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2. every dog was taught two tricks, tricks can be different
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SCENARIO: A taught C trick 1, A taught C trick 2, A taught D trick 3, B taught D trick 2.

Why a cumulative relation between individuals isn't enough

- Cumulative relation R1, which takes the arguments Ada+Bea and Carl+Dean:

  (7) R1 = $\lambda x_e.\lambda y_e.y$ taught x two new tricks

  No cumulation with two tricks $\leadsto$ each girl taught two tricks to some dog.

  predicted FALSE

- Cumulative relation R2, which takes the arguments Ada+Bea and two tricks:

  (8) R2 = $\lambda x_e.\lambda y_e.y$ taught x to every dog

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Our approach: Predicate pluralities

(9) *Ada and Bea taught every dog two new tricks.* adapted from Schein (1993)

Existing approaches

- Cumulative relations between events and individuals
  Schein (1993), Kratzer (2000), Zweig (2008)
- Cumulative relations between individuals plus more complex LF
  Champollion (2010)

Our basic idea

- Cumulation between individuals and predicate pluralities
- Ada+Bea must be in a cumulative relation with one of the elements of this set:

(10) {**taught C T1 + taught C T2 + taught D T1 + taught D T2**,
taught C T1 + taught C T2 + taught D T2 + taught D T3,
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- We only consider those pluralities of predicates that assign two tricks to each dog.

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- We only consider those pluralities of predicates that assign two tricks to each dog.

Flattening effect (1/2)

(11) Ada owns a dog, Carl. Bea owns another dog, Dean, and a cat, Eric. Now they went on a trip and guess what . . .
The two girls made Gene [[feed the two dogs]$_P$ and [brush Eric]$_Q$] when all he wanted to do was take care of his hamster. Schmitt (2017)

SCENARIO: A made G feed C, B made G feed D, B made G brush E. TRUE

What happens in this scenario

1. Cumulativity between the two girls and P and Q : No girl satisfies both P and Q.
2. Cumulativity between the two girls and the two dogs: No girl made Gene feed both of the dogs
3. We cannot derive a 3-place cumulative relation between the two girls, the two dogs and P and Q, because P and Q contains the two dogs

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- Intuitively, we want binary cumulation between a+b and the following predicate plurality:

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- Traditional approach to cumulative truth-conditions: Binary relations between individuals apply cumulatively. Relations may be syntactically derived.
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  cf. Schmitt (2017) for a related version
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- The part structure of lower pluralities ‘projects’ up to higher pluralities (cf. focus projection / Hamblin sets)

(13) *feed Carl and Dean*

$$\text{feed}(\text{carl})_{\langle et\rangle} + \text{feed}(\text{dean})_{\langle et\rangle}$$

$$\text{feed}_{\langle e\langle et\rangle\rangle} \qquad \text{carl}_e + \text{dean}_e$$

(14) *feed and brush Dean*

$$\text{feed}(\text{dean})_{\langle et\rangle} + \text{brush}(\text{dean})_{\langle et\rangle}$$

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Plural projection (2/2)

- For this rule to be generalizable – one more level of complexity: Plural sets

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Ontology, informally

Pluralities across semantic domains

- All domains contain pluralities (including domains for complex types).
- We define a sum-operation + for any type: Isomorphic to union of sets of atoms.

(16) $D_e = \{$ **Ada, Bea, Ada+Bea** $\}$,
$D_{\langle e,t\rangle} = \{\lambda x.\text{smoke}(x), \lambda x.\text{dance}(x), \lambda x.\text{smoke}(x) + \lambda x.\text{dance}(x) \ldots\}$

Plural sets

- For every type a there is a type a^* of 'plural sets'.
- The domains $D_{\langle a,t\rangle}$ and D_{a^*} are disjoint, but have the same algebraic structure. We write [ ] instead of { } for plural sets.

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Plural definites and indefinites denote plural sets of type e^*

(18) $[\![\textit{the girls}]\!]$ = [**Ada**+**Bea**]

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Conjunction involves 'recursive' sum $\bigoplus$

(20) $[\![\textit{Ada and two pets}]\!]$ = [**Ada**] $\oplus$ [**Carl**+**Dean**, **Carl**+**Eric**, **Dean**+**Eric**]
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A plural set S of propositions is true iff S contains **at least one** element p such that **all** atomic parts of p are true.

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Cover

A cover of (P, x) is a relation between atomic parts of P and atomic parts of x in which each atomic part of P and each atomic part of x occurs at least once.

(21) P = **smoke+dance**, x = **Ada+Bea**

a. {⟨ **smoke**, **Ada** ⟩, ⟨ **dance**, **Bea** ⟩}

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Compositional rule for cumulation: $\mathcal{C}$

- It takes two plural sets $P^*_{\langle a,b\rangle^*}$ and $x^*_{a^*}$ and gives us a plural set of type b^*.
- We take all covers of some plurality from $P^*_{\langle a,b\rangle^*}$ and some plurality from $x^*_{a^*}$.
- For each cover R, we form the sum of values $+\{P(x) \mid (P, x) \in R\}$. (actually we use the 'recursive sum' $\bigoplus$ when functional application returns plural sets)

(22) a. *Two children are smoking and dancing.*

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Deriving the flattening effect for conjunction

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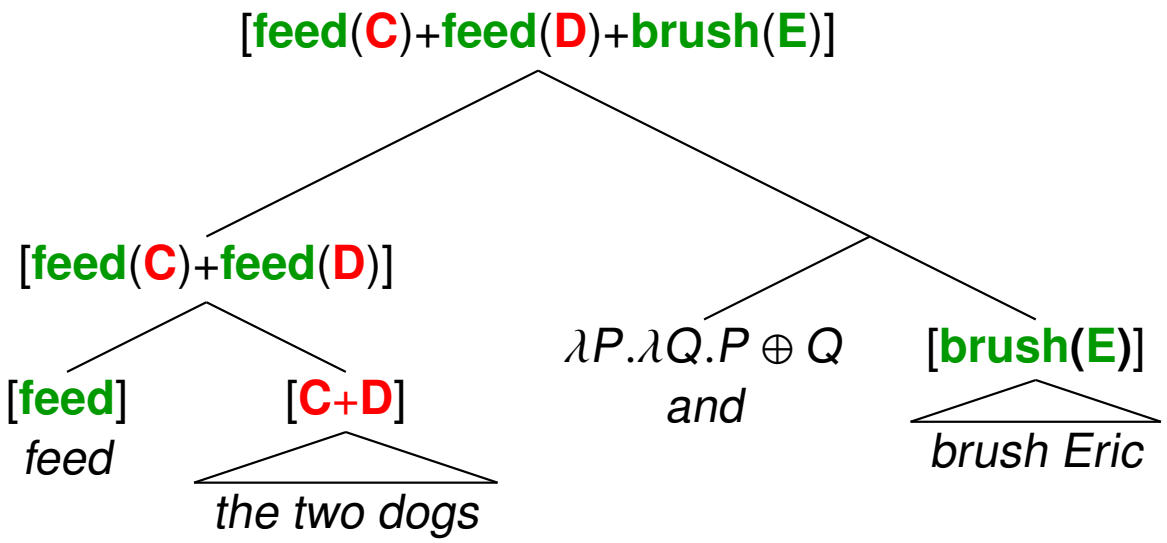

Interim summary: Plural projection

- Semantic plurality ‘projects’ by means of a cross-categorial operation C which also encodes cumulativity.
- This is made possible by assuming pluralities and plural sets of any semantic type.
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Interim summary: Plural projection

- Semantic plurality ‘projects’ by means of a cross-categorial operation C which also encodes cumulativity.
- This is made possible by assuming pluralities and plural sets of any semantic type.
- Syntactically derived cumulative relations and the corresponding LF movement are not needed: In the case of non-lexical cumulation C applies at every intervening node.
- Unlike earlier approaches to cumulativity, the present theory naturally accounts for the flattening effect.

What we will do

- We will give a new meaning for *every* that captures cumulativity asymmetries:

(25) a. *Every girl fed (the) two dogs.*
b. *(The) two girls fed every dog in this town.*

- Rationale based on Schein sentences: We want predicate pluralities that 'cover' every dog and assign two tricks to each dog.

(26) *Ada and Bea taught every dog two new tricks.*

(27) {**taught C T1 + taught C T2 + taught D T1 + taught D T2**,
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every DPs, informally

- Function of type $\langle\langle e, a\rangle^*, a^*\rangle$ – directly manipulates plural sets of predicates.

(28) *every girl fed two pets*
$[\![\textit{every girl}]\!]([\mathbf{feed}(\mathbf{C}) + \mathbf{feed}(\mathbf{D}), \mathbf{feed}(\mathbf{C})+\mathbf{feed}(\mathbf{E}), \mathbf{feed}(\mathbf{D})+\mathbf{feed}(\mathbf{E})])$

- For each atomic individual x in the restrictor, we choose a predicate-plurality P from the scope, apply each $P' \leq_a P$ to x and take the sum (P applies 'distributively' to x)

(29) $\mathbf{feed}(\mathbf{C})(\mathbf{A})+ \mathbf{feed}(\mathbf{D})(\mathbf{A}), \mathbf{feed}(\mathbf{C})(\mathbf{B})+ \mathbf{feed}(\mathbf{E})(\mathbf{B}), \ldots$

- For each such assignment of predicate-pluralities, we take the sum over all individuals and form the plural set of all such sums

(30) $[\![\textit{every girl}]\!]([\mathbf{feed}(\mathbf{C}) + \mathbf{feed}(\mathbf{D}), \mathbf{feed}(\mathbf{C})+\mathbf{feed}(\mathbf{E}), \mathbf{feed}(\mathbf{D})+\mathbf{feed}(\mathbf{E})]) =$
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Deriving cumulativity asymmetries (1/2)

(31) *Every girl in this town fed the two dogs.* only distributive

(32) [**A fed C+A fed D+B fed C+B fed C**]

Prediction

Singular universals always distributive wrt. material in their scope

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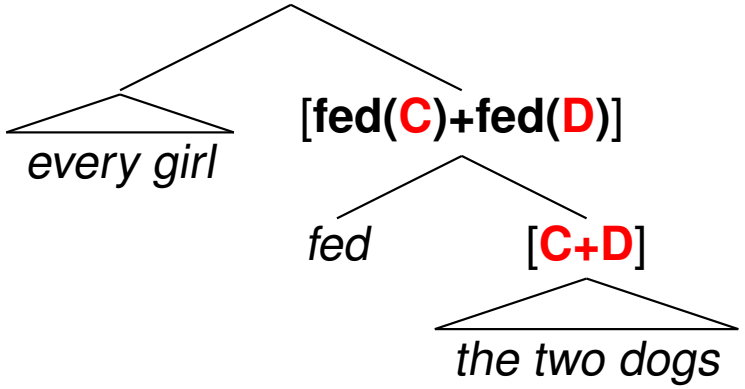

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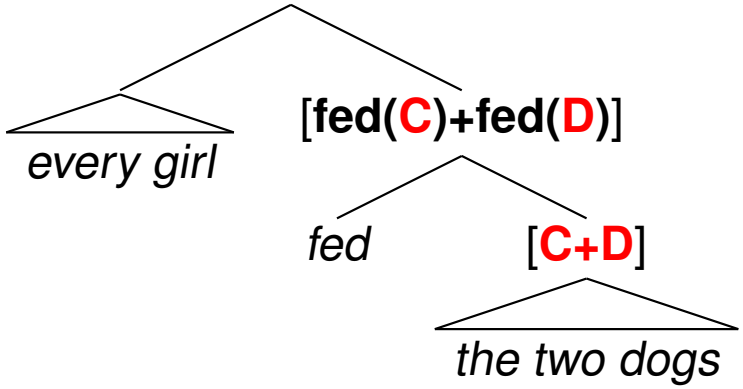

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(33) *The two girls fed every dog in this town.* cumulative possible

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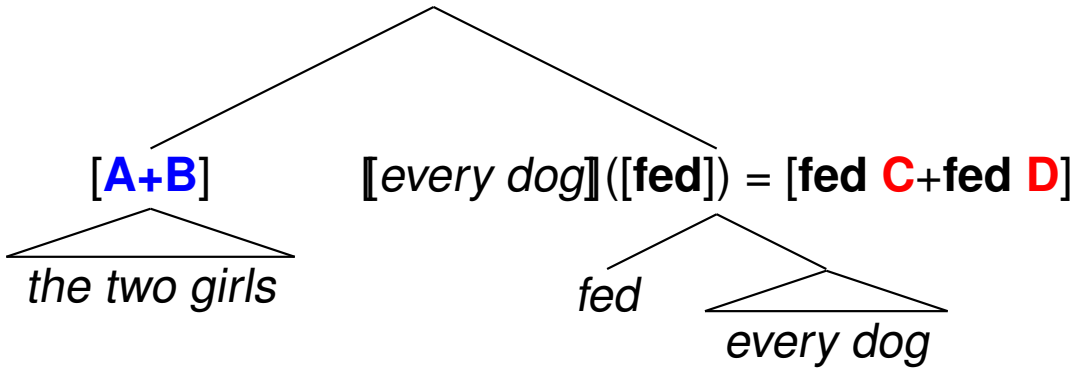

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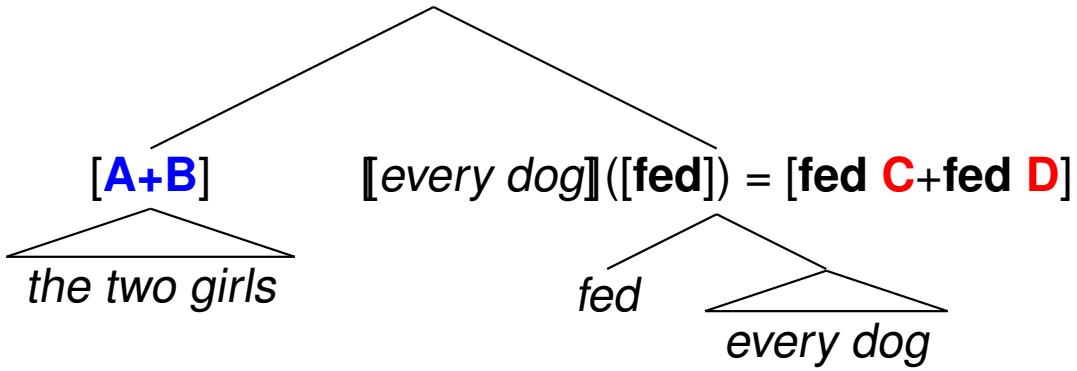

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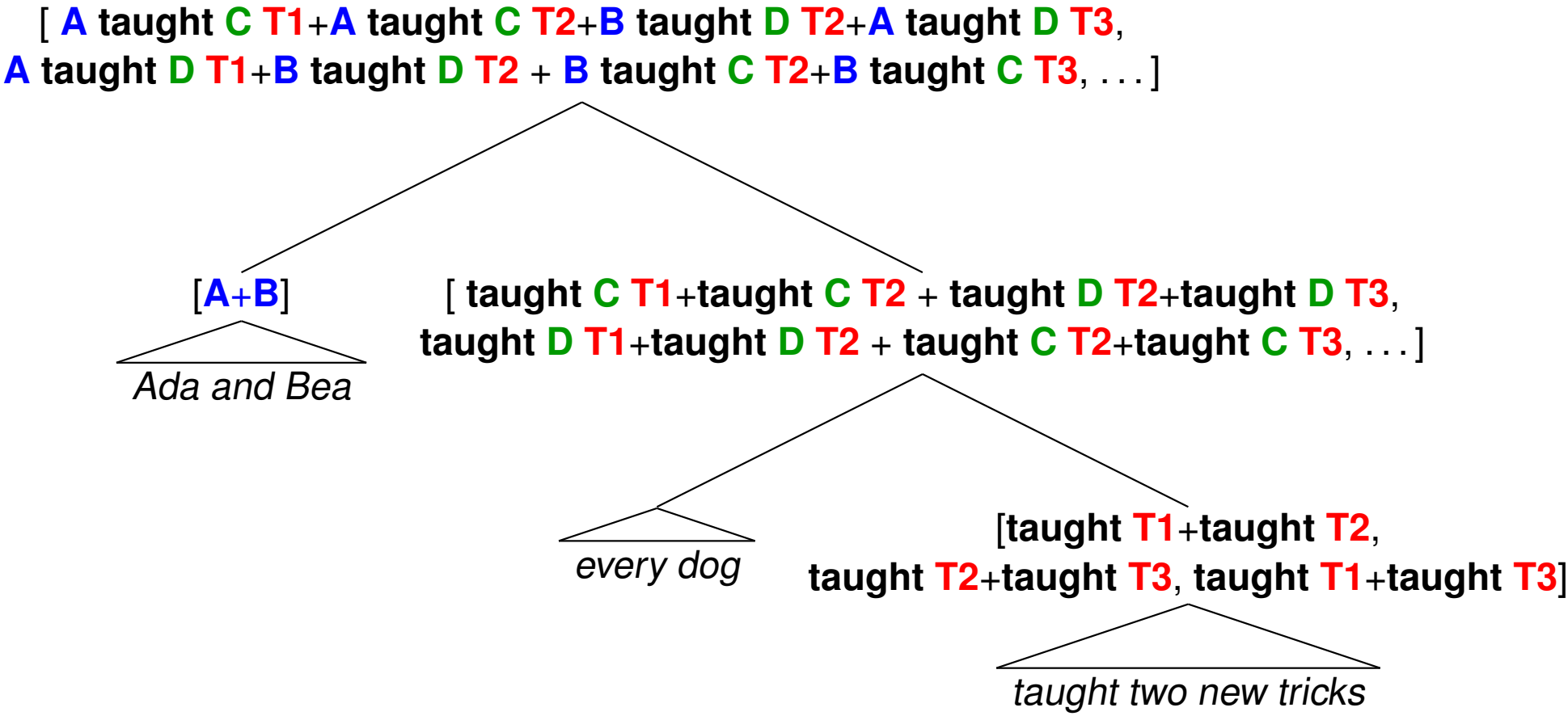

Interim Summary: Plural projection and cumulativity asymmetries

- *every* DPs take plural sets as their argument. They ‘distributively’ apply elements to atoms in the restrictor.
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Event-based analyses

Basic idea — Schein (1993), Kratzer (2000), Zweig (2008)

Cumulation targets relations between events and individuals.

(36) *The two girls taught every dog two new tricks.*

(37) $\exists e[\textbf{teach}(e) \wedge \textsc{agent}(e)(\textbf{A+B}) \wedge \textsc{ben}(e)(+(\textbf{dog})) \wedge \forall y \leq_A +(\textbf{dog})[\exists Z \in [\![\textit{two tricks}]\!].\exists e' \leq e[\textsc{theme}(e')(Z) \wedge \textsc{ben}(e')(y)]]]$ adapted from Zweig (2008)

Differences to our proposal

- We don't require events, so we can maintain that some predicates that allow for cumulativity don't have an event/state argument.
- No special story needed for cumulation across predicates where arguments are neither individuals nor events, such as (some) attitude verbs (38).

(38) *The Georgian ambassador called this morning, the Russian one at noon. They think that Trump should take a walk with Putin and build a hotel in Tbilisi, but neither addressed the Caucasus conflict!*

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(39) $[\![\textit{every dog}]\!] = [\![\textit{the dogs}]\!] = \mathbf{C}{+}\mathbf{D}$

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(43) *Sowohl die Mädchen als auch die Buben haben zwei Hunde gefüttert*
PRT the girls PRT also the boys have two dogs fed
'Both the girls and the boys fed two dogs.' (German)

SCENARIO: The girls fed two dogs between them and the boys fed two dogs between them. TRUE

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- This system derives cumulative truth-conditions step-by-step, along the lines of the hierarchical structure
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- Expansion to collective predicates?
- Expansion to non-upward-monotone DPs (*less than five, exactly five . . .*)
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Thanks to . . .

Magdalena Roszkowski, Dóra Kata Takács and Marcin Wągiel for language consultancy.

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Distribution of ADUs: additional data (1/3)

Why thematic roles aren't the determining factor – two arguments based on German

Argument 1

ADU subjects of embedded infinitives can have cumulative readings even if they are agents.

(44) *Ada und Bea haben jedes Haustier einen Menschen attackieren gesehen.*
Ada and Bea have every pet a human.being attack seen
'Ada and Bea saw every pet attack a person.'

SCENARIO: Three pets, Carl, Dean and Eric. Ada saw Carl and Eric each attack a person. Bea saw Dean attack a person. TRUE

Conclusion

Thematic roles by themselves don't predict when ADUs have cumulative readings.

Distribution of ADUs: additional data (2/3)

Why thematic roles aren't the determining factor – two arguments based on German

Argument 2

For some speakers, ADUs in object position have cumulative readings, but not when scrambled over the subject.

(45) SCENARIO: Between them, five activists managed to call all the voters in the district. Every voter received one or two calls from activists.

(46) a. *Ein Wahnsinn, dass fünf Aktivisten jeden Wähler im Bezirk angerufen haben.*
a madness that five.NOM activists.NOM every.ACC voter.ACC in the district called have
'It's incredible that five activists called every voter in the district.' TRUE

b. *Ein Wahnsinn, dass jeden Wähler im Bezirk fünf Aktivisten angerufen haben.*
a madness that every.ACC voter.ACC in the district five.NOM activists.NOM called have
'It's incredible that every voter in the district got called by five activists.'
FALSE

Distribution of ADUs: additional data (3/3)

Conclusion

- Thematic roles by themselves don't predict when ADUs have cumulative readings.
- Availability of a cumulative reading can depend on scope.

But: Judgments are less clear for double object constructions, even though scrambling influences scope there as well.

Maybe grammatical functions matter in addition to scope. This is definitely the case in Italian (Flor 2017). Question for further research!

Cumulativity asymmetries: Hungarian distributive conjunction

A is és B is usually taken to be distributive — Szabolcsi (2015)

(47) a. SCENARIO: Sára and Marcsi are organizing a party. Sára called 'Express Catering' to organize food. Marcsi called 'Star Catering' to organize beer.

b. *Szerencsére Sára is és Marcsi is időben felhívta a két kiszállító*
fortunately Sára IS and Marcsi IS on-time called the two catering
céget.
company.ACC
'Fortunately, both Sára and Marcsi called the two catering companies ahead of time.' FALSE

(48) a. SCENARIO: Sára and Marcsi are organizing a party. Sára called Bálint, who is supposed to bring the beer. Marcsi called Péter, who is supposed to bring the food.

b. *Szerencsére a két szervező időben felhívta Bálintot is és Pétert is*.
fortunately the two organizers on-time called Bálint.ACC IS and Péter.ACC IS
'Fortunately, the two organizers called both Bálint and Péter ahead of time.' TRUE

examples due to Dóra Kata Takács (pc)

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'Fortunately, both Sára and Marcsi called the two catering companies ahead of time.' FALSE

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Cumulativity asymmetries: Polish distributive conjunction

(49) a. SCENARIO: Sabina and Magda are organizing a party. Sabina called ‘Express restaurant’ to organize food. Magda called ‘Star restaurant’ to organize beer.

b. *Na szczęście i Sabina i Magda dostatecznie wcześnie zadzwoniły do tych*
on the-luck I Sabina I Magda enough early called to these
dwóch restauracji.
two restaurants
‘Fortunately, both Sabina and Magda called the two restaurants early enough.’ ??

(50) a. SCENARIO: Sabina and Magda are organizing a party. Sabina called Adam, who is supposed to bring the beer. Magda called Piotr, who is supposed to bring the food

b. *Na szczęście dwie organizatorki dostatecznie wcześnie poinformowały i*
on the-luck two organizers enough early informed I
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Adam I Piotr
‘Fortunately, the two organizers informed both Adam and Piotr early enough.’
TRUE

examples due to Magdalena Roszkowski and Marcin Wągiel (pc)

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Distributive conjunction (1/2)

- We assume a ‘particle’ structure for distributive conjunction. Szabolcsi (2015)

(51) a. *A is és B is*
A PRT and B PRT
b. LF: [[PRT A] [and [PRT B]]] Szabolcsi (2015)

- Distributive conjunctions are like *every* DPs, but ‘atoms’ are the individual conjuncts.
- Individual conjuncts can be cumulative wrt. lower plurals:

(52) *Sowohl die Mädchen als auch die Buben haben zwei Hunde gefüttert*
PRT the girls PRT also the boys have two dogs fed
‘Both the girls and the boys fed two dogs.’ (German)

SCENARIO: The girls fed two dogs between them and the boys fed two dogs between them.

TRUE

- We therefore build the cumulation operation C built into the particle meaning.

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TRUE

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Distributive conjunction (2/2)

(53) Sowohl Ada als auch Bea haben getrunken und geraucht.
PRT Ada PRT also Bea have drunk and smoked
'Both Ada and Bea were drinking and smoking.' (German)

(54)

$$[\mathcal{C}([\textbf{drink} + \textbf{smoke}], [\textbf{Ada}]) \oplus \mathcal{C}([\textbf{drink} + \textbf{smoke}][\textbf{Bea}])] =$$
$$[[\textbf{drink}(\textbf{Ada}) + \textbf{smoke}(\textbf{Ada}) + \textbf{drink}(\textbf{Bea}) + \textbf{smoke}(\textbf{Bea})]]$$
$$\approx_{shift} [\textbf{drink}(\textbf{Ada}) + \textbf{smoke}(\textbf{Ada}) + \textbf{drink}(\textbf{Bea}) + \textbf{smoke}(\textbf{Bea})]$$