

Two cross-linguistic asymmetries in conjunction: A plural projection account

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(joint work with Nina Haslinger, Eva Rosina, Magdalena Roszkowski, Valentin Panzirsch
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- ① Cross-linguistic evidence for a **cumulative lexical meaning** of conjunctive coordinating morphemes in conjunctions of individual-denoting phrases

Flor et al. 2017a,b

(1) *Ada and Bea*

- ② An analytical problem: How do we derive the meaning of distributive conjunction structures on the basis of this meaning for the conjunction morpheme?
- ③ A proposal based on plural projection (informal) Haslinger and Schmitt 2018, 2019
- ④ Predictions for the cross-linguistic behavior of conjunctions of other semantic categories Haslinger et al. 2019

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Point of departure

- Different hypotheses regarding the meaning of the conjunctive morpheme – COORD – in individual languages (Partee and Rooth 1983, Link 1983, Hoeksema 1983, Krifka 1990, Winter 2001, Szabolcsi and Haddican 2004 a.o.). No consensus.

(2) *Ada* **and**_{COORD} *Bea fed exactly four pets.*

- But: Does COORD have the same meaning cross-linguistically?
- Put differently: Do cross-linguistic data give us evidence for one of the hypotheses?

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But why do we wonder about the meaning of COORD?

- Sentences like (3) have at least two readings.

(3) ***Ada and Bea fed exactly four pets.***

Predicate holds of each conjunct.

distributive

- a. SCENARIO 1: Ada fed 4 pets. Bea fed 4 other pets.
b. SCENARIO 2: Ada fed 1 pet. Bea fed 3 other pets.

(3) true
(3) false

Predicate holds of entire 'group' / 'plurality'.

cumulative

- a. SCENARIO 1: Ada fed 4 pets. Bea fed 4 other pets.
b. SCENARIO 2: Ada fed 1 pet. Bea fed other 3 pets.

(3) false
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Which of the two readings reflects the lexical meaning of COORD und which is the 'derived' reading? (Assuming that COORD is not lexically ambiguous (Dowty 1987).)

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Distributive hypothesis (Partee and Rooth 1983, Winter 2001 a.o.)

- Denotation of COORD recursively derived from \wedge for all types ending in t

$$(4) \quad \llbracket \text{COORD}_t \rrbracket = \lambda p_t. \lambda q_t. p \wedge q,$$

and for every type b ending in t and every type a :

$$\llbracket \text{COORD}_{(a,b)} \rrbracket = \lambda P_{(ab)}. \lambda Q_{(ab)}. \lambda x_a. \llbracket \text{COORD}_b \rrbracket (P(x))(Q(x))$$

- In individual conjunction, we shift the conjuncts via \uparrow to quantifier type, so we end up with a distributive conjunction of quantifiers

$$(5) \quad \llbracket \llbracket \uparrow \text{Ada} \rrbracket \llbracket \text{COORD}_\wedge \llbracket \uparrow \text{Bea} \rrbracket \rrbracket \rrbracket = \lambda P_{(et)}. P(\mathbf{ada}) \wedge P(\mathbf{bea})$$

- Which directly gives us the distributive meaning of our sentence

$$(6) \quad \text{Ada and Bea fed exactly four pets.}$$

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⇒ the distributive reading is **primitive**

- The cumulative reading of the sentences is **derived** by **additional operations** OP_K . They essentially retrieve a plurality of individuals from the quantifier conjunction (see Winter 2001 a.o.)

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Cross-linguistic predictions of the distributive hypothesis (very roughly)

If there is an interpretative asymmetry between morpho-syntactically 'simple' and morpho-syntactically 'complex' strategies for individual conjunction:

'More morpho-syntactic complexity' should correlate with the cumulative reading (as it requires an extra operator).

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Cumulative hypothesis (Link 1983 a.o.)

- Background assumption: The domain D_e contains both atoms and pluralities, i.e. it is closed under a sum-operation \oplus

$$(8) \quad \llbracket \textit{the two girls} \rrbracket = \mathbf{ada} \oplus \mathbf{bea}$$

- COORD in individual conjunction denotes the sum-operation \oplus on individuals

$$(9) \quad \llbracket \text{COORD} \rrbracket_{\langle e, \langle e, e \rangle \rangle} = \lambda x_e. \lambda y_e. x \oplus y$$

$$(10) \quad \llbracket [\textit{Ada} [\text{COORD}_{\oplus} \textit{Bea}]] \rrbracket = \mathbf{ada} \oplus \mathbf{bea}$$

- This directly gives us the cumulative reading of the sentence (assuming that the predicate can hold of pluralities – see below)

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$$(11) \quad \llbracket \textit{Ada} \text{COORD}_{\oplus} \textit{Bea} \rrbracket (\lambda x_e. \mathbf{fed \ exactly \ four \ pets}(x)) = \\ \mathbf{ada} \oplus \mathbf{bea \ fed \ exactly \ four \ pets}$$

⇒ the cumulative reading is **primitive**

- The distributive reading of the sentences is **derived** by **additional operations** OP_D . They essentially apply the predicate to each atomic part of the individual plurality formed by the conjunction (see Link 1987 a.o.)

Cross-linguistic predictions of the cumulative hypothesis (very roughly)

If there is an interpretative asymmetry between morpho-syntactically 'simple' and morpho-syntactically 'complex' strategies for individual conjunction:

'More morpho-syntactic complexity' should correlate with the distributive reading (as it requires an extra operator).

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Is one of the two hypotheses **cross-linguistically** valid?

We cannot answer this question based on the investigation of individual languages. But we saw that both hypotheses make **cross-linguistic predictions**.

What do we do?

- For each language, we identify pairs C1,C2 of 'unmarked' and 'marked' strategies for individual conjunction:
C1 is morpho-syntactically contained in C2 – C2 contains an additional marker μ .
- We consider two kinds of minimal pairs – because the 'additional' operators can occur in different syntactic positions
- Operators on VP: We consider pairs where C2 contains additional marking on the predicate – i.e. external to the coordinate structure.

(12) $[_{C1} [A \text{ COORD } B] [P]]$ vs. $[_{C2} [A \text{ COORD } B] [\mu P]]$

- Operators on DP: We consider pairs where C2 contains additional marking internal to the coordinate structure.

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Methodology

- We are using the **Terraling** database

<http://test.terraling.com/>

- open ended, open source database
- linguists answer yes/no questions on their native languages
- results can be correlated (allows for complex queries)
- Our group, current stage: 79 questions, data for 24 languages from 10 major language families
<http://test.terraling.com/groups/8>
- The first part of our study focusses on **iterative conjunction strategies**, with **individual-denoting conjuncts**, occurring in **subject position**.
- The predicates must contain a **numeral** or a **degree expression** – so that we can distinguish between readings.

(14) *Ada and Bea fed **exactly four** pets.*

- Participants must identify the relevant sentences in their language and then check whether they are true or false in **particular scenarios**.

(15) SCENARIO 1: Ada fed four pets. Bea fed four other pets.

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(17) $[C_1 [A \text{ COORD } B] [P]]$ vs. $[C_2 [A \text{ COORD } B] [\mu P]]$

- Some conjunction patterns require one or more predicate-level markers for a **distributive** interpretation.

(18) C1: [A, B *ni* C] *ḡā-bí-kosná díkóó díśámal*
A B COORD C 2.SM-PST2-receive 13.thousands 13.six
'A, B and C received six thousand francs in total.'

(19) C2: [A, B *ni* C] *ḡā-bí-kosná díkóó díśámal, híkíí mut*
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Basa'a PR, Bassong, Terañing

- No iterative conjunction patterns require predicate-level markers for a **cumulative** interpretation.

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What does generalization 1 tell us?

μ on predicate sometimes needed for distributive reading, never for cumulative reading

- μ is not part of the conjunction structure: Generalization concerns formal correlates of the two readings of the predicate.

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- fed exactly four pets each**
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- suggests that **distributive** interpretation (but not cumulative interpretation) of such predicates cross-linguistically involves additional syntactic operator

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distributive
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- languages differ in whether they must spell out operator overtly (English vs. Basa'a)
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Generalization 2: Marker on the coordinate structure (Flor et al. 2017a,b)

(24) $[[C_1 A \text{ COORD } B] [P]] \quad [[C_2 A \text{ COORD } B \mu] [P]]$

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- If C1 allows for a **distributive** interpretation, so does C2.

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SerBoCroatian J. Gajić, Terraling

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SerBoCroatian J. Gajić, Terraling

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Generalization 2: Marker on the coordinate structure (Flor et al. 2017a,b)

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What does generalization 2 tell us?

μ on the conjunction may remove the cumulative reading, but not the distributive reading

For languages like English where predicates are ambiguous, the two hypotheses make different predictions w.r.t. marking on the conjunction

Cumulative hypothesis: Predictions

- For unmarked structures both readings should be possible.

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b. $A \text{ and}_{\mu} B$ [OP_D *fed exactly four pets*] distributive

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Distributive hypothesis: Predictions

- For unmarked structures both readings can in principle be derived.

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b. *[OP_K [A, B and_i C]]* [*fed exactly four pets*] cumulative

- But in order to obtain the cumulative reading, we have to add an extra-operator to the conjunction. Thus, if a language spells out operators on the conjunction, we would expect that the marker makes the cumulative reading available.

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Conclusion

Based on our sample: The lexical meaning of COORD is **cumulative**

- 1 Cross-linguistic evidence for a cumulative lexical meaning of COORD
- 2 An analytical problem**
- 3 Analysis, part 1: Plural projection (informally)
- 4 Analysis, part 2: Distributive conjunctions and plural projection (informally)
- 5 Some cross-linguistic predictions

- We saw that the lexical meaning of COORD is cumulative
- This means that we have to also derive the meaning of **distributive** patterns on the basis of a cumulative meaning for COORD

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Deriving the meaning of **distributive** patterns compositionally will require us to make a number of assumptions (Haslinger and Schmitt 2019)

- We need a cumulative lexical meaning of COORD also in those cases where it does not conjoin individual-denoting phrases – we need a cumulative meaning for COORD also for 'higher-order' objects (see Link 1984, Krifka 1990, Heycock and Zamparelli 2005 for independent arguments)
- Cross-categorical meaning for COORD involves plurality formation – we need pluralities in 'functional' semantic domains (see Schmitt 2018 for independent arguments)
- Such 'higher-order' pluralities must reflect 'part-structure' of embedded pluralities (see Schmitt 2018, Haslinger and Schmitt 2018, 2019 for independent arguments)

These are exactly the properties of the plural projection mechanism (Schmitt 2018, Haslinger and Schmitt 2018, 2019) – which we will eventually connect the data to.

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But let us first consider how we get to these assumptions.

What we will need for them is an intuitive notion of *cumulativity*, which was already implicit above.

We will say that two plural expressions exhibit cumulativity w.r.t. to one another whenever they exhibit particular weak truth-conditions (Langendoen 1978, Scha 1981 a.o.)

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Background: Syntax of distributive conjunctions

- We now know that distributive conjunctions consist of two (abstract) parts: cumulative COORD_{\oplus} and OP_D on the conjunction
- The morpho-syntactic coding of the 'semantic contribution' of OP_D is more complex: In many languages, distributive conjunctions exhibit conjunction particles on each conjunct (Szabolcsi 2015, Mitrović and Sauerland 2016)

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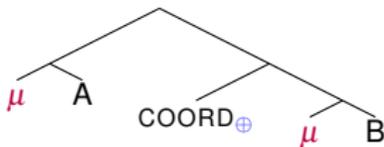
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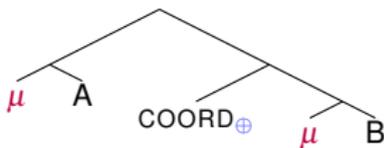
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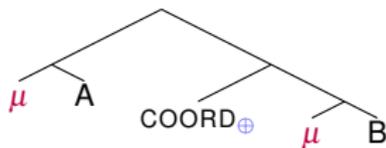
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- The distributive effect must be due to the conjunction particles, μ
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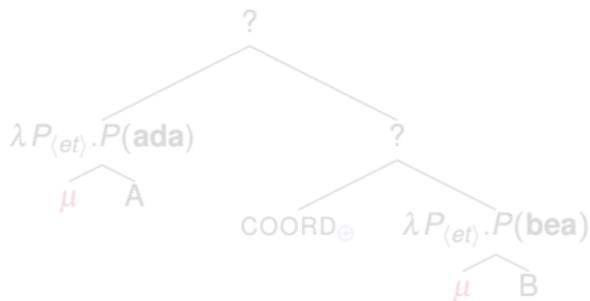
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- This means that the individual conjuncts should take the predicate as their argument

(40) $[[\mu \text{ Ada}] \approx \lambda P_{(e,t)}.P(\mathbf{ada})$

- Accordingly, we will have to conjoin higher-order objects by means of COORD
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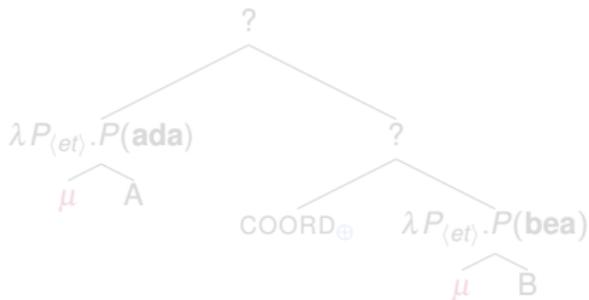
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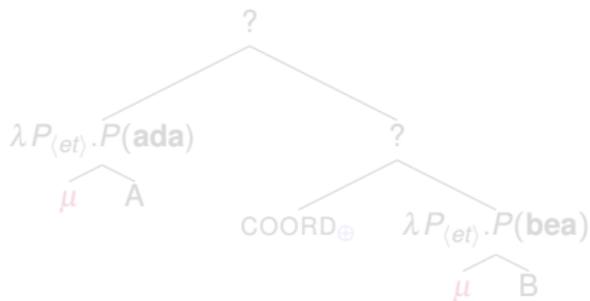
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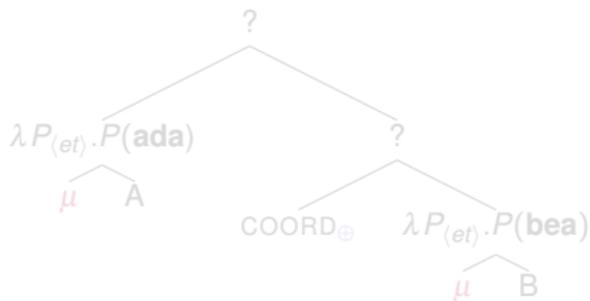
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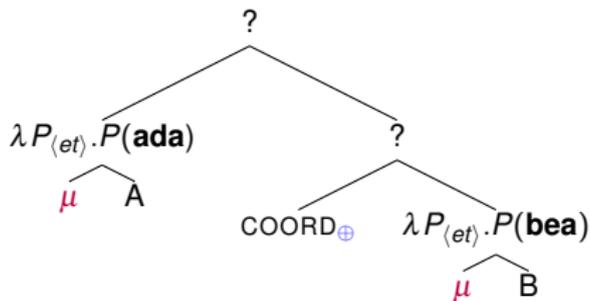
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- But the lexical denotation of COORD is **cumulative** – which so far is only defined for individuals

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We must extend 'cumulative conjunction' to categories other than individuals.

Step 1: Cumulative conjunction of 'higher-order' objects

- The distributive effect must be due to the conjunction particles, μ
- They must achieve that the predicate applies to each conjunct individually.

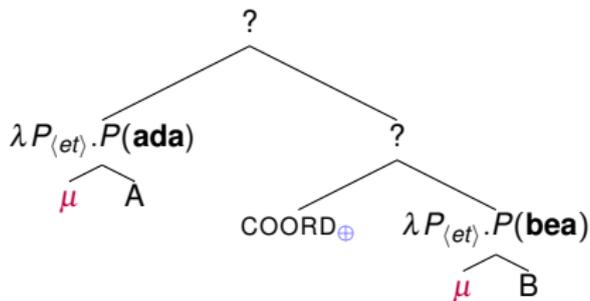
(39) $[[\mu \text{ Ada}] [\text{COORD}_{\oplus} [\mu \text{ Bea}]]] \text{ ate exactly four cookies.}$

- This means that the individual conjuncts should take the predicate as their argument

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- In some languages (e.g. Estonian, German, Hungarian, Polish) distributive conjunctions behave like pluralities in some syntactic positions.
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Plurality-like behavior of distributive conjunctions only w.r.t. syntactically higher plural expressions (like English *every-DP* Champollion 2010, Haslinger and Schmitt 2018, see also Schein 1993, Kratzer 2000, Zweig 2008). We must account for this asymmetry!

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But: It also means that combining distributive conjunctions with their scope must give us 'higher-order' pluralities that reflect the part-structure of scopally dependent pluralities.

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If COORD is lexically cumulative, the analysis of distributive conjunctions shows us that...

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- 2 An analytical problem
- 3 Analysis, part 1: Plural projection (informally)**
- 4 Analysis, part 2: Distributive conjunctions and plural projection (informally)
- 5 Some cross-linguistic predictions

Plural projection (1/2)

- All semantic domains contain pluralities (i.e. we have pluralities of individuals, predicates, propositions)

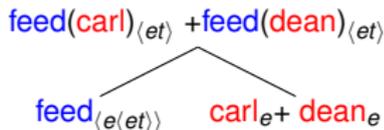
We define a sum-operation $\+$ for any type: Isomorphic to union of sets of atoms.

$$(50) \quad D_e = \{\mathbf{Ada}, \mathbf{Bea}, \mathbf{Ada+Bea} \dots\},$$

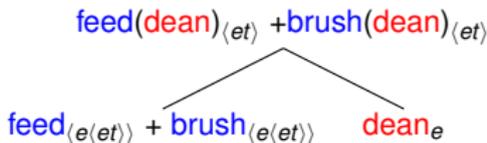
$$D_{\langle e,t \rangle} = \{\lambda x.\text{smoke}(x), \lambda x.\text{dance}(x), \lambda x.\text{smoke}(x) + \lambda x.\text{dance}(x) \dots\}$$

- The part structure of lower pluralities 'projects' up to higher pluralities (cf. focus projection / Hamblin sets)

(51) *feed Carl and Dean*



(52) *feed and brush Dean*



Plural projection (2/2)

- Crucial step: Cumulativity encoded in projection mechanism: Compositional rule
- For this rule to be generalizable – one more level of complexity: Plural sets ($[]$)
For every type a there is a type a^* of ‘plural sets’. ($D_{(a,t)}$ and D_{a^*} are disjoint, but have the same algebraic structure.)

$$(53) \quad D_{e^*} = \{ [], [\mathbf{Ada}], [\mathbf{Bea}], [\mathbf{Ada+Bea}], [\mathbf{Ada, Bea}], [\mathbf{Ada, Ada+Bea}], [\mathbf{Bea, Ada+Bea}], [\mathbf{Ada, Bea, Ada+Bea}] \}$$

- Compositional rule \mathcal{C} :

$$(54) \quad \text{feed and brush Carl and Dean}$$

$$[\text{feed}(\text{carl})+\text{brush}(\text{dean}), \text{feed}(\text{dean})+\text{brush}(\text{carl}), \dots]$$

$$[\text{feed}_{(e(et))} + \text{brush}_{(e(et))}] \quad [\text{carl}_e + \text{dean}_e]$$

- Takes two plural sets $P_{(a,b)^*}$ and x_{a^*} , gives us a plural set of type b^* .
- We take all covers of some plurality from $P_{(a,b)^*}$ and some plurality from x_{a^*} .

$$(55) \quad \{ (\text{feed}, \text{dean}), (\text{brush}, \text{carl}) \}$$

- For each cover R , we form the sum of values $\sum \{ P(x) \mid (P, x) \in R \}$. (actually more complex)

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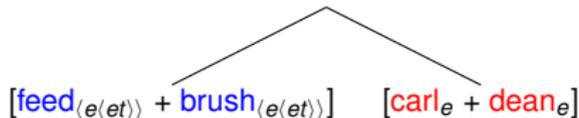
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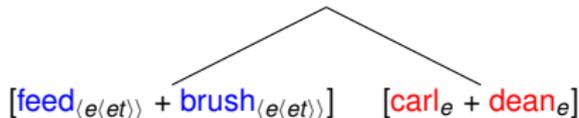
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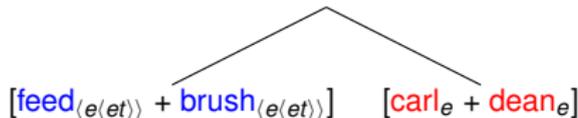
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Plural definites and indefinites denote plural sets of type e^*

$$(56) \quad \llbracket \textit{the girls} \rrbracket = [\textit{Ada+Bea}]$$

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The lexical meaning of COORD cross-categorially involves 'recursive' sum \oplus

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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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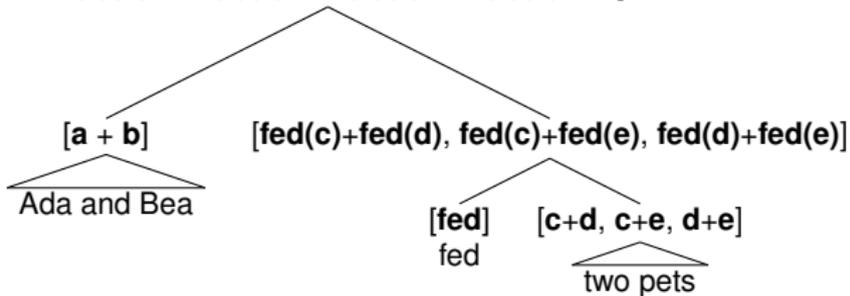
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Sample derivation

**[fed(c)(a)+fed(d)(b), fed(c)(b)+fed(d)(a), fed(c)(a)+fed(e)(b),
fed(c)(b)+fed(e)(a), fed(d)(a)+fed(e)(b), ...]**



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Our next step . . .

Give an informal treatment of distributive conjunctions in this type of system

- 1 Cross-linguistic evidence for a cumulative lexical meaning of COORD
- 2 An analytical problem
- 3 Analysis, part 1: Plural projection (informally)
- 4 Analysis, part 2: Distributive conjunctions and plural projection (informally)
- 5 Some cross-linguistic predictions

We now sketch a compositional treatment of distributive conjunction structures as in (60).

(60) $[[\mu \text{ Ada}] [\text{COORD}_{\oplus} [\mu \text{ Bea }]]] [\text{fed two pets}]$

It has all the properties we motivated above:

- 1 COORD is lexically cumulative, expresses plurality-formation
- 2 COORD expresses plurality-formation across categories
- 3 Distributive conjunctions distribute w.r.t. *lower* plural expressions, but show 'plurality-like' behavior w.r.t. *higher* plural expressions
- 4 'Higher-order' pluralities can 'reflect' part-structure of scopally dependent pluralities

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Basic idea (1/2)

- Conjunction particles map individuals to functions that take plural sets of their scope as their argument (this corresponds to our earlier intuition)

$$(61) \quad \llbracket [\mu \text{ Ada}] \rrbracket = \llbracket [\mu] \rrbracket([\mathbf{ada}]) = \lambda P_{(e,t)^*}^* . \mathcal{C}(P^*, [\mathbf{ada}])$$

- each conjunct is shifted to a plural set

$$(62) \quad \lambda P_{(e,t)^*}^* . \mathcal{C}(P^*, [\mathbf{ada}]) \Rightarrow [\lambda P_{(e,t)^*}^* . \mathcal{C}(P^*, [\mathbf{ada}])]$$

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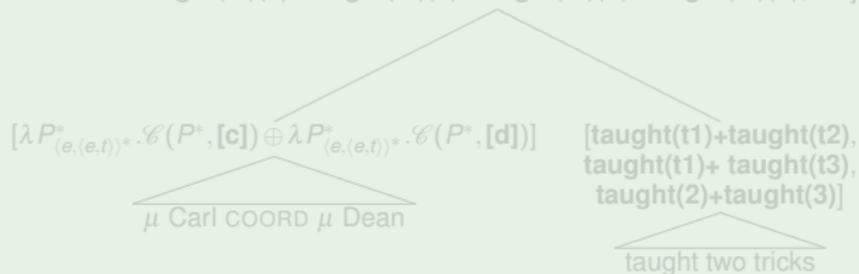
- While distributive conjunctions are distributive w.r.t. their scope (i.e. **lower** plural expressions), the output of combining them with their scope is again a plurality.

(66) *Die Ada und die Bea haben **sowohl dem Carl als auch dem Dean** zwei neue Tricks beigebracht.*

'Ada and Bea taught both Carl and Dean two new tricks'

(67) a. [[[μ Carl] COORD [μ Dean]] [taught two new tricks]]

b. [taught(t1)(c)+taught(t2)(c)+taught(t1)(d)+taught(t2)(d),
taught(t1)(c)+taught(t2)(c)+taught(t2)(d)+taught(t3)(d), ...]



- This means we expect cumulative readings w.r.t. **higher** plural expressions
- And: Combining the distributive conjunction with its scope gives us a set of pluralities that reflect the part-structure of scopally dependent plural expressions.

Basic idea (2/2)

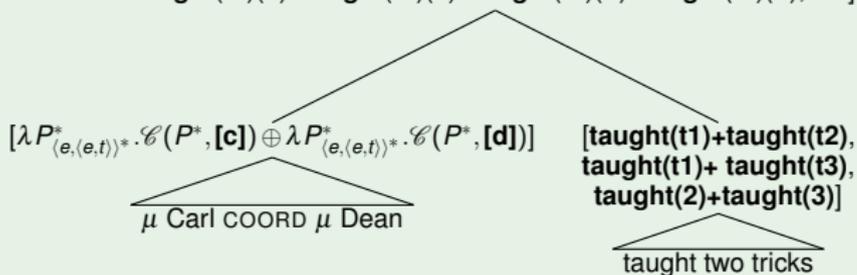
- While distributive conjunctions are distributive w.r.t. their scope (i.e. **lower** plural expressions), the output of combining them with their scope is again a plurality.

(66) *Die Ada und die Bea haben **sowohl dem Carl als auch dem Dean** zwei neue Tricks beigebracht.*

'Ada and Bea taught both Carl and Dean two new tricks'

(67) a. [[[μ Carl] COORD [μ Dean]] [taught two new tricks]]

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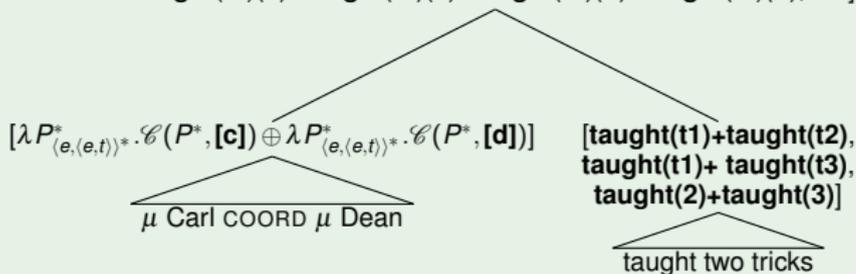
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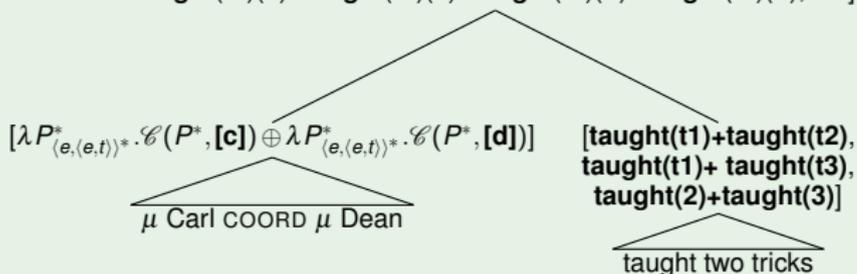
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- 1 Cross-linguistic evidence for a cumulative lexical meaning of COORD
- 2 An analytical problem
- 3 Analysis, part 1: Plural projection (informally)
- 4 Analysis, part 2: Distributive conjunctions and plural projection (informally)
- 5 Some cross-linguistic predictions

Our assumptions so far make a number of cross-linguistic predictions (Haslinger et al. 2019). We consider two of them in the following.

Prediction 1: Cross-categorical cumulative COORD

- Since we assume that COORD is cumulative across categories, we expect that 'simple' conjunction structures exhibit cumulative readings across languages
- We know that we find this reading for VP-conjunctions in English and German (Link 1984, Krifka 1990, Schmitt 2013, 2018)

(68) a. *The three children smoked and danced.*
b. SCENARIO: C1 smoked. C2 danced. C3 danced. **(68-a) true**

- This also seems to be the case in our current Terraling-sample on VP-conjunction (11 languages from 6 language families)

(69) a. *Tih pet gostiju su pili i pevali i*
these.GEN five guests.GEN AUX.3PL drink.part-pl.m | sing.PART-PL.M |
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Prediction 2: Readings of 'marked' VP-conjunction

- If we find the same 'additional' markers μ in individual and VP-conjunction and if we assume that they always make the same semantic contribution, we arrive at a certain prediction concerning structures marked with μ in VP-conjunction.
- We observed that the 'distributive' effect connected to these markers in individual conjunction vanishes w.r.t. **higher** plural expressions.
- If COORD uniformly expresses plurality-formation and if the markers make the same contribution across the board, then VP-conjunctions with additional markers μ should not have a distributive effect w.r.t. a plural subject – because the plural subject is a **higher** plural expression.
- Preliminary results suggest that this prediction could be correct.

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Thanks to...

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Appendix 1: Languages in sample

individual conjunction:

Akan, Basa'a, Baule, Cantonese, Chickasaw, Dagara, Dutch, Estonian, Greek, Hungarian, Igbo, Iraqi Arabic, Italian, Ivorian French, German, Japanese, Korean, Latvian, Nones, Polish, Russian, SerBoCroatian, Sicilian, Tagalog, Turkish, Wuhu Chinese

VP-conjunction:

Baule, Dutch Estonian, Cantonese, Iraqi Arabic, Italian, Japanese, Latvian, SerBoCroatian, Sicilian, Tagalog

Appendix 2: conjunction strategies individuals

Coordination of Proper Names	D-only	ND-only	D/ND	ext. Marker needed for D
A, B ne C (Akan, Twi (Niger-Congo, Kwa))			x	x
A, B ni C (Basaa (Niger-Congo, Bantu))			x	x
A, B tung C (Cantonese, Guangzhou (Sino-Tibetan, Chinese))			x	
A, B ni C (Dagara (Burkina))			x	x
A, B en C A, B en ook C zowel A, B als ook B (Dutch (Indo-European, Germanic))	x x		x	
A, B ja C A, B ning C (Estonian (Uralic, Finno-Ugric))			x x	
A, B und C sowohl A als auch B als auch C (German (Indo-European, Germanic))	x		x	
A, B ce C A, B ala ce C (Greek (Indo-European, Greek))	x [SV]		x	x [SV]
A o B o C (Iraqi Arabic (Afro-Asiatic, Semitic))			x	x
A, B e C (Italian (Indo-European, Italic))			x	
A, B etpuis C (Ivorian French (Indo-European, Italic))			x	
A-to B-to C (Japanese (Japonic))			x	
A-wa B-wa C (Korean (Koreanic))			x	

Appendix 2: conjunction strategies individuals

Coordination of Proper Names	D-only	ND-only	D/ND	ext. Marker needed for D
A, B un C (Latvian (Indo-European, Balto-Slavic))			x	
A, B e C (Nones (Indo-European, Italic))			x	
A, B i C i A i B i C (Polish (Indo-European, Balto-Slavic))	x		x [SV]	
A (i) B i C i A i B i C A, B ali i C (Serbo-Croatian (Indo-European, Balto-Slavic))	x x		x	
A, B e C (Sicilian (Indo-European, Italic))			x	
A, B ve C A dA, B dA ve C dA ¹ (Turkish (Turkic))	x		x	x
A, B ha-you C (Wuhu Chinese (Sino-Tibetan, Chinese))			x	